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Section 1: AMT Overview

The Alliance for Manufacturing & Technology of the Southern Tier, Inc. (AMT) is a not-for-profit organization that was established in 1988 as a private, non-profit organization to help small and mid-size manufacturers and high-tech startups be more productive, profitable, and globally competitive. As a NIST MEP approved Center, AMT is the official representative of the MEP National Network and NYMEP in the Southern Tier of New York. The MEP National Network is a unique public-private partnership that delivers comprehensive, proven solutions to U.S. manufacturers, fueling growth and advancing U.S. manufacturing.

AMT has been a leader in assisting local manufacturers in overcoming the challenges of today's competitive economy. Our highly skilled team of experts has many years of industry experience combined with extensive consulting, training, and coaching experience. We are Business Advisors who have built a reputation for understanding and meeting manufacturers needs with expert solutions. We are a unique resource for manufacturers seeking to increase sales, streamline operations, achieve certifications, reduce costs, create jobs, and prosper in the following counties:

- Broome
- Chemung
- Chenango
- Delaware
- Schuyler
- Steuben
- Tioga
- Tompkins

Section 2: Manufacturing Landscape

The most common challenge for manufacturers in the United States is workforce attraction and retention, the Southern Tier of New York is no exception. Decades of offshoring, plant closures, layoffs, decline in organized labor, misperceptions, and generational approaches to employment have relegated manufacturing opportunities to an afterthought. As a rule, manufacturing jobs have been perceived as “dirty, dull, and dangerous”, and typically not offered or encouraged as a preferred profession or career.

This is not your dad's factory work... Many of today's manufacturing jobs are utilizing high tech processes and are more like laboratories than the antiquated ideologies of the Henry Ford assembly lines of the previous century. Still, enrollments in vocational programs, direct

hire opportunities, internships, and entrepreneurship leading to careers in manufacturing lag significantly behind other industries that do not require college degrees for entry.

The manufacturing industry netted a loss of 578,000 jobs during the pandemic-challenged year 2020— a figure that represents nearly six years of job gains, and yet, at any given moment in the past six months, nearly 500,000 jobs have remained open in manufacturing. Further, according to the May 2021 study by Deloitte, US manufacturing is expected to have 2.1 million unfilled jobs by 2030. Not surprisingly, manufacturers are reporting that these vacant positions impact critical business metrics, including productivity (51%), growth (47%), customer service (42%) and innovation (43%). To put that in terms of the monetary impact on the U.S. economy, the workforce shortage could jeopardize \$454 billion of economic output by 2028 and more than \$2.5 trillion over the next decade.

Currently, there are approximately 3,000 open manufacturing positions in the Southern Tier. Based on the predictions nationwide, the situation will be much worse in the coming decade.

The most recent Business Workforce Survey Results from the New York State Department of Labor and The Business Council of New York State suggests there is little or no pathway from K-12 or higher education to industry. The following graphic indicates few businesses in the Southern Tier (including manufacturing) have an above average relationship with high schools, technical programs and/or middle schools.

The challenge ahead of manufacturers is multifold, including:

How to get students:

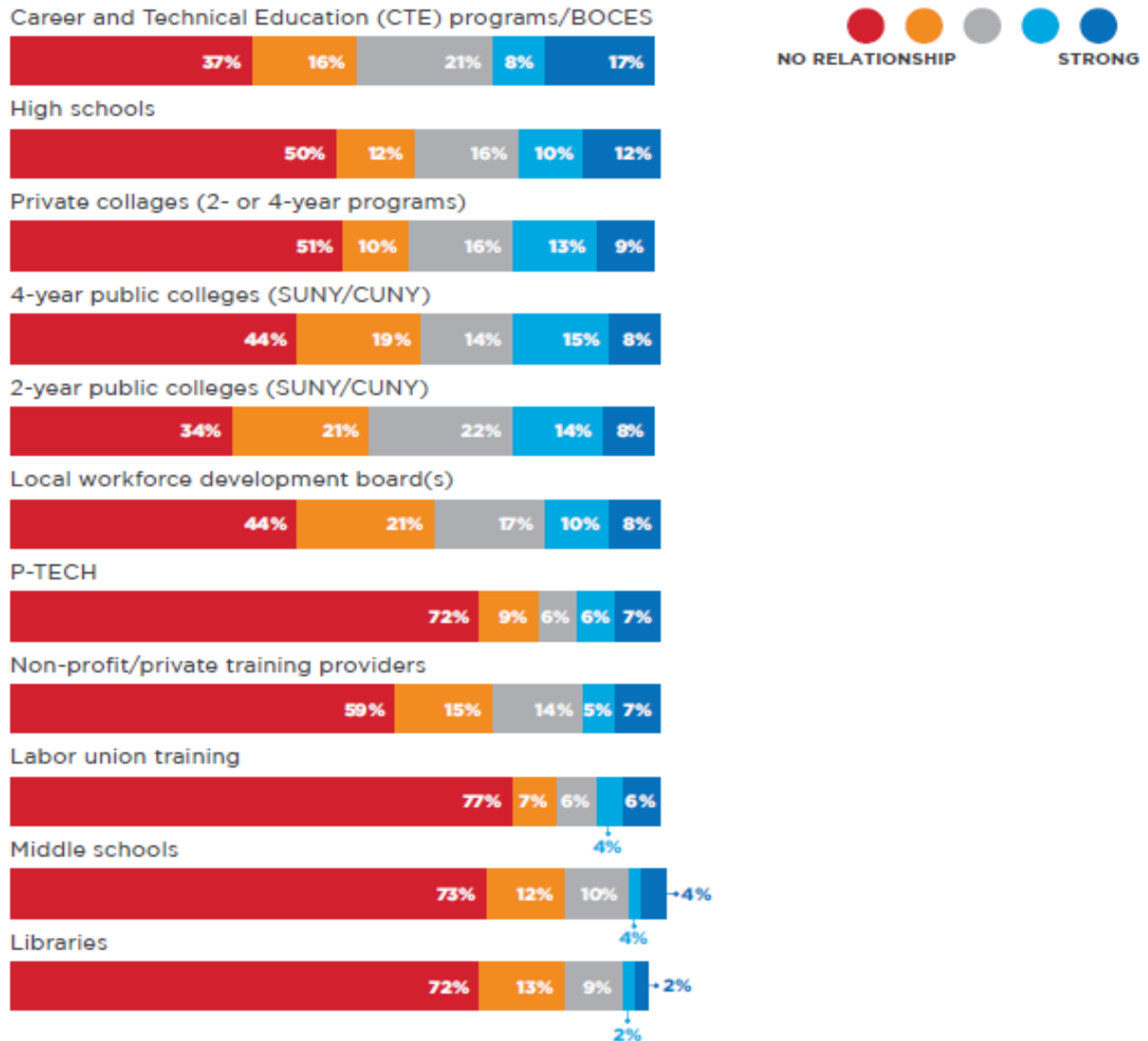
1. Oriented and trained to fill manufacturing open positions.
2. Trained in next generation science and math standards.
3. Introduced to different jobs in manufacturing.
4. To see a viable path to a career in manufacturing.

Trained teachers in current and next generation manufacturing opportunities.

Trained career counselors in Manufacturing opportunities and pathways.

A sustainable standard program to rollout to other school districts.

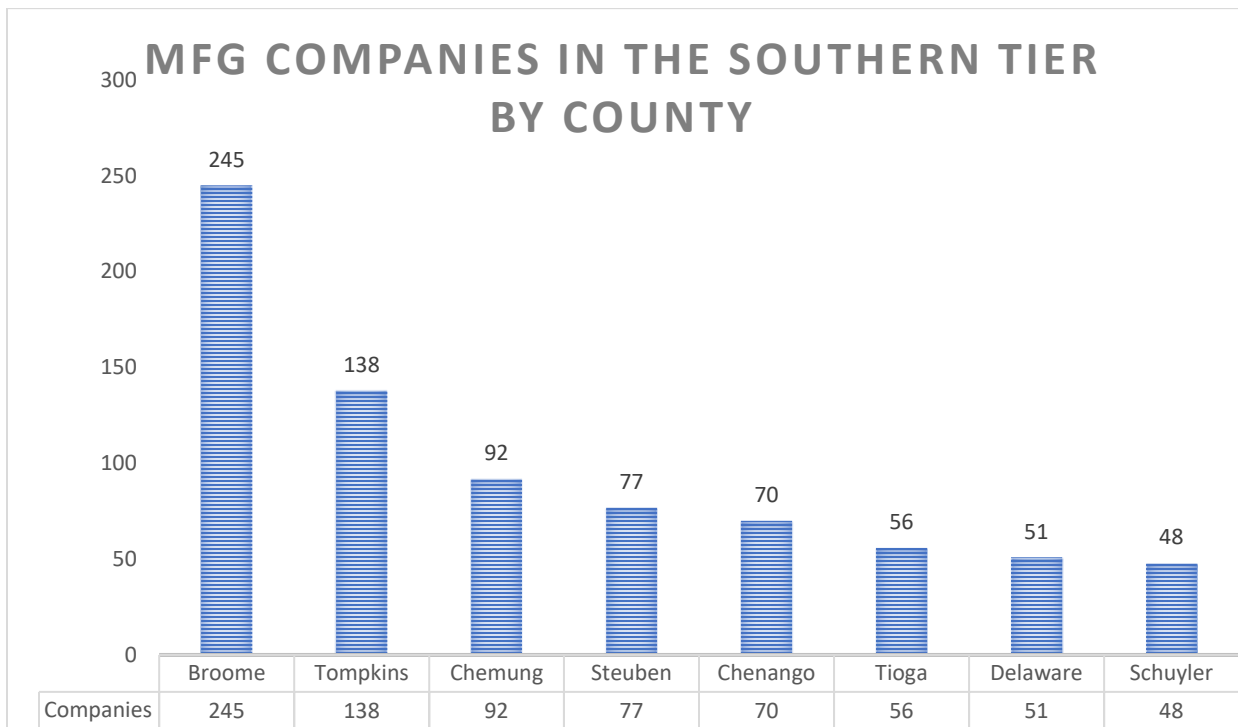
Business Relationships: Southern Tier



New York State Department of Labor and The Business Council of New York State Workforce Survey 2021

Section 3: Top 10 Industries

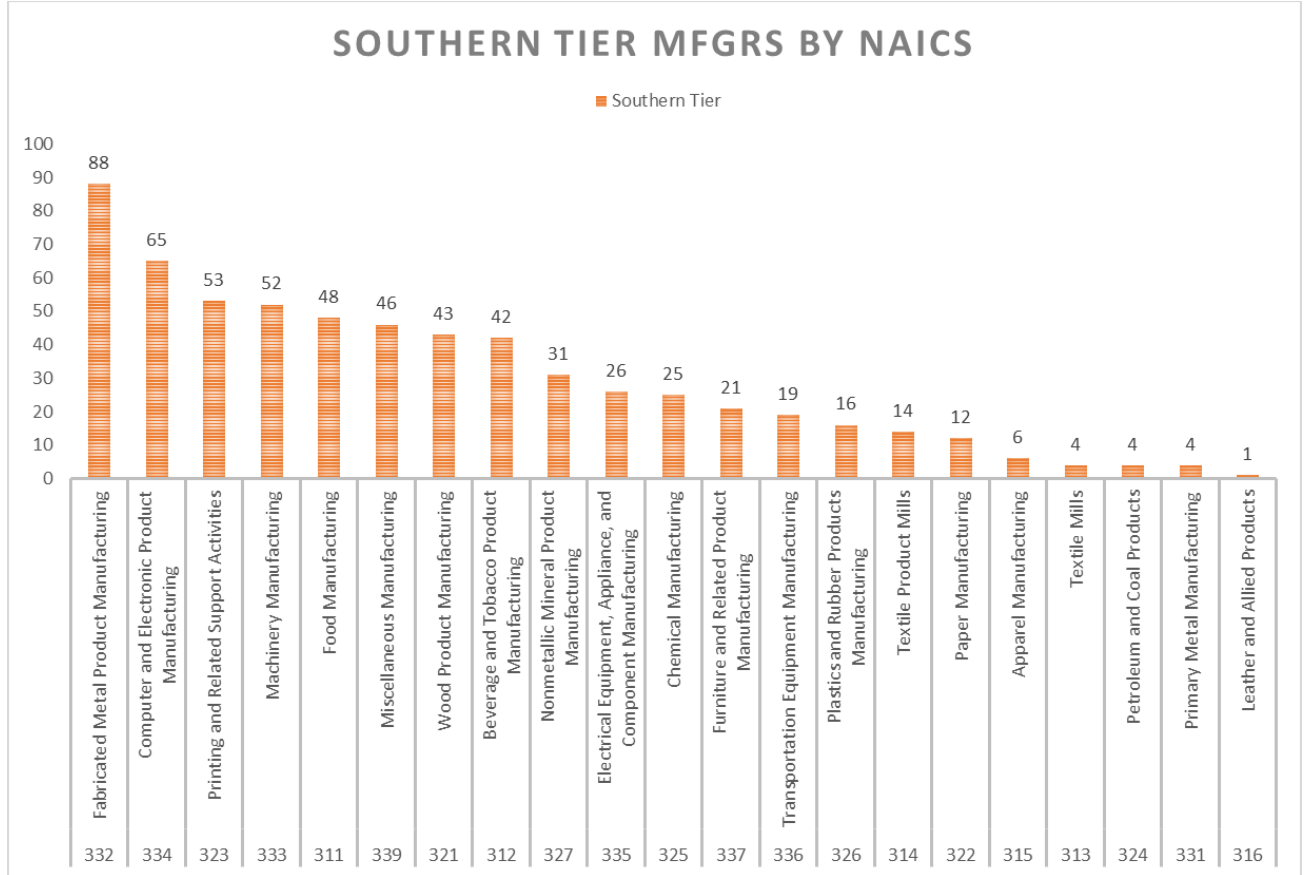
The Southern Tier of New York state has 31,742 manufacturing employees which equals 12% of the total workforce of the region (JobsEQ®, Data as of 2022 Q1). The total number of manufacturers in the Southern Tier is estimated at 777. Broome county is the most populated in the region and boasts 245 manufacturing organizations followed by Tompkins, Chemung, Steuben, Chenango, Tioga, Delaware, and Schuyler counties in quantities of manufacturers.



Original data from Dunn and Bradstreet, updated by AMT/Salesforce.

The North American Industry Classification System (NAICS) is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy. The NAICS code is self-selected by company representatives and can be inaccurate. Companies with missing or inaccurate NAICS codes may be misclassified. The NAICS codes provide a good directional basis.

The following graphic depicts manufacturers in the Southern Tier combined by NAICS code in descending order of quantity in the region.



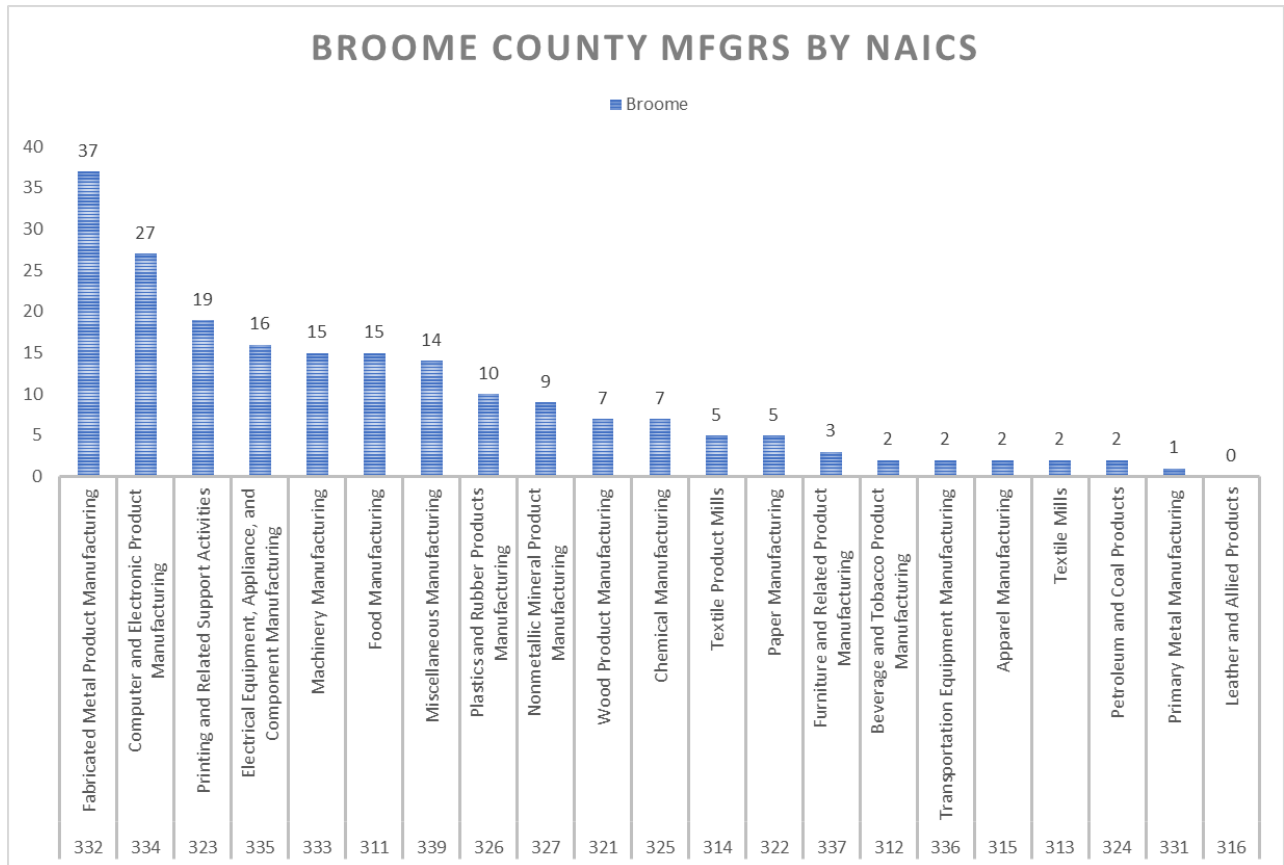
Original data from Dun and Bradstreet, updated by AMT/Salesforce.

The top 10 types of manufacturers by NAICS code in the Southern Tier are as follows. Note: there are 175 manufacturing companies with missing NAICS codes, they are not included.

1. Fabricated Metal Product Manufacturing
2. Computer and Electronic Product Manufacturing
3. Printing and Related Support Activities
4. Machinery Manufacturing
5. Food Manufacturing
6. Miscellaneous Manufacturing (e.g., makers of candles and neon signs)
7. Wood Product Manufacturing
8. Beverage and Tobacco Product Manufacturing
9. Nonmetallic Mineral Product Manufacturing
10. Electrical Equipment, Appliance, and Component Manufacturing

Broome county has 7,280 manufacturing employees which equals 9% of the total workforce of the county (JobsEQ®, Data as of 2022 Q1).

The following graphic depicts manufacturers in Broome County combined by NAICS code in descending order of quantity in the region.



Original data from Dun and Bradstreet, updated by AMT/Salesforce.

The top 10 types of manufacturers by NAICS code in Broome County are as follows. Note: there are 45 manufacturing companies with missing NAICS codes, they are not included.

1. Fabricated Metal Product Manufacturing
2. Computer and Electronic Product Manufacturing
3. Printing and Related Support Activities
4. Electrical Equipment, Appliance, and Component Manufacturing
5. Machinery Manufacturing
6. Food Manufacturing
7. Miscellaneous Manufacturing (e.g., makers of candles and neon signs)
8. Plastics and Rubber Products Manufacturing
9. Nonmetallic Mineral Product Manufacturing
10. Wood Product Manufacturing

The Southern Tier and Broome County top ten manufacturing lists are dissimilar only in the order and two industries (Plastics and Rubber Products – Beverage and Tobacco Products).

Section 4: Top Ten Jobs

The top STEM focused jobs that are determined to be difficult to fill in New York State as reported by Business Workforce Survey (2021) from the New York State Department of Labor and The Business Council of New York State are listed below. Jobs listed do not include engineering positions consisting of software engineers, industrial engineers, electrical engineers, chemical engineers, and mechanical engineers.

NYSDOL & BCNYS Manufacturing/Construction (New York State)

1. Laborer
2. Machine Operator
3. Machinist
4. Skilled Trades
5. Tool Maker
6. Production
7. Mechanic
8. Assembler
9. CNC Operator

The top ten STEM focused jobs in demand in the Southern Tier of New York as reported by Jobs EQ and Burning Glass are listed below. Jobs listed do not include engineering positions consisting of software engineers, industrial engineers, electrical engineers, chemical engineers, and mechanical engineers.

Jobs EQ Top Ten Jobs in Demand (Southern Tier)

1. Team Assemblers
2. Electrical, Electronic, and Electromechanical Equipment Assemblers, Except Coil Winders, Tapers, and Finishers
3. Laborers and Freight, Stock, and Material Movers
4. First-Line Supervisors of Production and Operating Workers
5. Inspectors, Testers, Sorters, Samplers, and Weighers
6. Packaging and Filling Machine Operators and Tenders
7. Machinists
8. Welders, Cutters, Solderers, and Brazers
9. Maintenance and Repair Workers, General
10. Industrial Machinery Mechanics

Burning Glass Top Ten Jobs in Demand (Southern Tier)

1. Production Worker
2. Manufacturing Machine Operator
3. Building and General Maintenance Technician
4. Production Supervisor
5. Laborer / Warehouse Worker
6. Quality Inspector / Technician
7. Manufacturing / Production Technician
8. Electrical and Electronics Technician
9. Forklift / Pallet Jack Operator
10. Industrial / Mechanical Engineering Technician

The top ten STEM focused jobs in demand in Broome County as reported by Jobs EQ are listed below. Jobs listed do not include engineering positions consisting of software engineers, industrial engineers, electrical engineers, chemical engineers, and mechanical engineers.

Jobs EQ Top Ten Jobs in Demand (Broome County)

1. Electrical, Electronic, and Electromechanical Equipment Assemblers, Except Coil Winders, Tapers, and Finishers
2. Team Assemblers
3. Machinists
4. Inspectors, Testers, Sorters, Samplers, and Weighers
5. First-Line Supervisors of Production and Operating Workers
6. Laborers and Freight, Stock, and Material Movers
7. Packaging and Filling Machine Operators and Tenders
8. Maintenance and Repair Workers, General
9. Welders, Cutters, Solderers, and Brazers
10. Electrical and Electronic Engineering Technologists and Technicians

Naming conventions for manufacturing positions can vary because of culture, history, national origin, and HR practices. The three workforce data sources listed above (NYSDOL/BCNYS, Jobs EQ, and Burning Glass) have narrow variations for the descriptive titles of the ranked positions. For this reason, the job titles have been merged to create a uniform format to assign job descriptions to each position.

The job descriptions sourced from Society for Human Resource Management (SHRM) are for the positions of:

1. Assembler
2. Electrical Technician
3. Forklift Operator
4. General Maintenance
5. Industrial Mechanic
6. Laborer-Warehouse Worker
7. Machine Operator
8. Machinist
9. Manufacturing Tech
10. Operations Supervisor
11. Production Worker
12. Inspector/Quality Control Technician
13. Welders, Cutters, Solderers, and Brazers

	Assembler	Electrical Technician	Forklift Operator	General Maintenance	Industrial Mechanic	Laborer - Warehouse Worker	Machine Operator	Machinist	Mfg Tech	Operations Supervisor	Production Worker	Inspector/QC Technician	Welders, Cutters, Solderers, and Brazers
Fabricated Metal Product Manufacturing													
Computer and Electronic Product Manufacturing													
Printing and Related Support Activities													
Machinery Manufacturing													
Food Manufacturing													
Miscellaneous Manufacturing													
Wood Product Manufacturing													
Beverage and Tobacco Product Manufacturing													
Nonmetallic Mineral Product Manufacturing													
Electrical Equipment, and Component Manufacturing													

Top Industries and Jobs Matrix

Section 5: Top Knowledge, Skills, and Abilities

Job descriptions for the above positions have been matched with source data from the Society for Human Resource Management (SHRM) job description database to encompass variability inherent in manufacturing management practices reporting.

A second source included as reference are summaries (Appendix A) for jobs and positions listed on Indeed.com Career Guide database. This service identifies skills, qualifications, education levels, and career advancement paths based on manufacturing job postings on Indeed.com.

The top Knowledge, Skills, and Abilities (KSA's) listed in the following tables are combinations of the most frequently appearing KSA's in Indeed.com job postings and SHRM job descriptions for the defined positions.

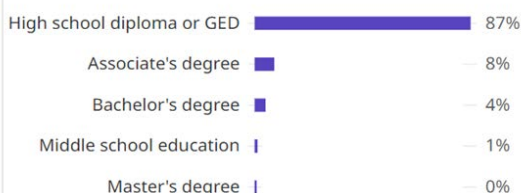
Education levels are also included to represent requirements of job openings on Indeed.com in the United States within the last three years.

Top Operations jobs, education, and preferred skills:

Top Operations jobs

- Production Worker
- Electronic Assembler
- Team Assembler

Education levels for Production Workers



Based on the requirements of Production Worker job openings on Indeed in the United States within the last three years.

Top skills required for Operations:

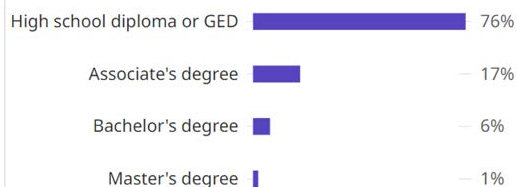
- Assembly
- Basic Math
- Calipers
- Computer Skills (including Microsoft Office proficiency)
- Construction
- Hand Tools
- Blueprint Reading
- Mechanical Skills
- Communication Skills
- Forklift
- Lean
- 5S
- Safety

Top Machining jobs, education, and preferred skills:

Top Machining Jobs:

- Machine Operator
- Machinist

Education levels for Machinists



Based on the requirements of Machinist job openings on Indeed in the United States within the last three years.

Top skills required for Machining:

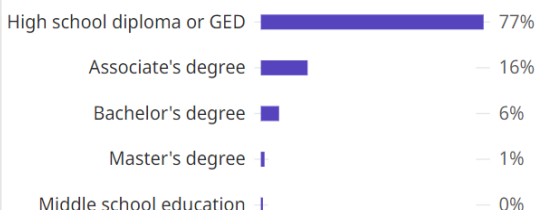
- Analysis Skills
- Basic Math
- Calipers
- Computer Skills (including Microsoft Office proficiency)
- CAM Programming
- Hand Tools
- Blueprint Reading/Engineering Designs
- CNC Programming
- Communication Skills
- Lean
- 5S
- Coordinate Measuring Machine
- Safety

Top Maintenance jobs, education, and preferred skills:

Top Maintenance Jobs:

- General Maintenance
- Industrial Maintenance

Education levels for Maintenance Technicians



Based on the requirements of Maintenance Technician job openings on Indeed in the United States within the last three years.

Top skills required for Maintenance:

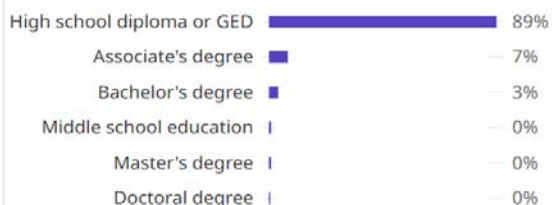
- Automotive Diagnostics
- Basic Math
- Calipers
- Computer Skills (including Microsoft Office proficiency)
- Construction
- Hand Tools
- Electrical
- Fabrication
- Communication Skills
- Lean
- 5S
- Hydraulics
- CMMS Software
- HVAC
- Blueprints
- Safety

Top Shipping & Receiving jobs, education, and preferred skills:

Top Shipping & Receiving Jobs:

- Warehouse Worker
- Forklift Operator

Education levels for Forklift Operators



Based on the requirements of Forklift Operator job openings on Indeed in the United States within the last three years.

Top skills required for Shipping & Receiving:

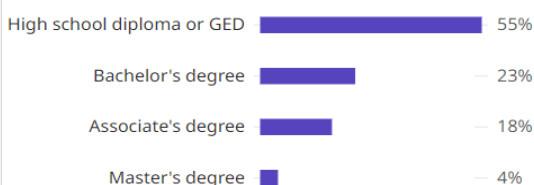
- Communication Skills
- Basic Math
- Customer Service
- Computer Skills (including Microsoft Office proficiency)
- Data Entry
- Forklift
- Cherry Picker
- Clamp Truck
- Vehicle Operators License
- 5S
- Assembly
- Safety

Top Supervisor jobs, education, and preferred skills:

Top Management Jobs:

- Production/Operations Supervisor

Education levels for Production Supervisors



Based on the requirements of Production Supervisor job openings on Indeed in the United States within the last three years.

Top skills required for Production/Operations Supervisor:

- Communication Skills
- Analysis Skills (Problem Solving)
- Customer Service
- Computer Skills (including Microsoft Office proficiency)
- Leadership
- Logistics
- Management (Time & People)
- Vehicle Operators License
- Lean and 5S
- ERP Systems
- Safety

Top Quality Control jobs, education, and preferred skills:

Top Quality Control Jobs:

- Quality Control Inspector

Education levels for Quality Control Inspectors



Based on the requirements of Quality Control Inspector job openings on Indeed

Top skills required for Quality Control Inspector:

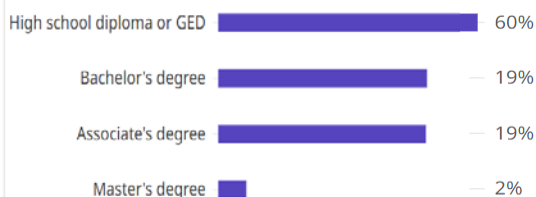
- Communication Skills
- Analysis Skills (Problem Solving)
- CGMP
- Computer Skills (including Microsoft Office proficiency)
- Calipers
- Basic Math
- Coordinate Measuring Machine
- Data Collection
- FDA Regulations
- GD&T (Geometric Dimensioning and Tolerancing)
- 5S/Lean/Safety

Top Technician jobs, education, and preferred skills.

Top Technician Jobs:

- Manufacturing Technician
- Electrical Technician

Education levels for Manufacturing Technicians



Based on the requirements of Manufacturing Technician job openings on Indeed

Top skills required for Technician:

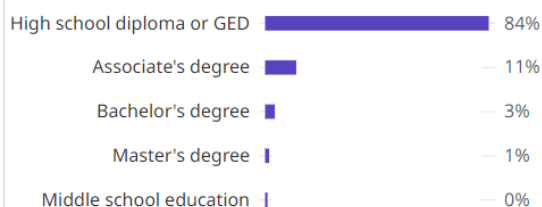
- Communication Skills
- Analysis Skills (Problem Solving)
- CGMP
- Computer Skills (including Microsoft Office proficiency)
- Calipers
- Basic Math
- Coordinate Measuring Machine
- Data Collection
- FDA Regulations
- GD&T (Geometric Dimensioning and Tolerancing)
- 5S/Lean/Safety

Top Welding, Brazing, Soldering jobs, education, and preferred skills.

Top Welding, Brazing, Soldering Jobs:

- Welder
- Solderer

Education levels for Welders



Based on the requirements of Welder job openings on Indeed in the United States within the last three years.

Top skills required for Welder, Brazing, Soldering:

- ASME codes & standards
- Assembly
- Basic math
- Blueprint reading
- Calipers
- Communication skills
- Computer literacy
- Computer skills
- Crane
- English
- Fabrication
- Flux welding
- 5S, Lean and Safety

Skill / Position	Assembler	Electrical Tech	Forklift Operator	General Maintenance	Industrial Maintenance	Laborer/Warehouse Worker	Machine Operator	Machinist	Manufacturing Tech	Operation Supervisor	Production Worker	Quality Control Technician	Welders, Cutters, Brazers, Solders	Quantity
Computer skills/Literacy	x	x	x	x	x	x	x	x	x	x	x	x	x	12
Communication skills	x	x	x	x	x	x	x	x	x	x	x	x	x	12
Lean*	x	x	x	x	x	x	x	x	x	x	x	x	x	12
5S*	x	x	x	x	x	x	x	x	x	x	x	x	x	12
Safety*	x	x	x	x	x	x	x	x	x	x	x	x	x	12
Basic math	x	x	x	x	x	x	x	x	x	x	x	x	x	11
Blueprint reading	x	x		x	x		x	x	x		x	x	x	9
Calipers	x	x		x	x		x	x	x		x	x	x	9
Customer service	x	x	x	x	x	x			x	x				9
Assembly	x	x	x			x	x	x	x		x		x	8
Forklift	x		x			x	x	x		x	x			7
CMMS		x		x	x		x	x	x			x		7
Analysis skills		x					x	x	x	x		x		6
Hand tools	x			x	x		x	x			x			6
Electrical experience		x		x	x				x					4
Mechanical knowledge	x			x	x					x				4
FDA/CGMP/ISO*		x							x			x		3
CNC							x	x						2
Maintenance				x	x									2
Machining							x	x						2
All Positions*														*

Jobs and Skills Matrix

Skills Definitions sourced from Tooling U-SME, United States Food and Drug Administration (FDA), and the State University of New York (SUNY) included in Appendix B.

* Additional skills based on industry knowledge.

Section 6: Potential Future Industries and Job Needs (Southern Tier)

- Industries
 - o Energy Storage / Clean Tech
 - o Hemp/Cannabis
- Technology / i4.0

First Reference:

“Modern manufacturing careers are increasingly high-tech, high-skill, and high-pay. The possibilities in manufacturing will become even more exciting as Manufacturing 4.0 technology continues to revolutionize the industry. Tomorrow’s manufacturing jobs will increasingly rely upon irreplaceable human skills—things like creativity, critical thinking, design, innovation, engineering, and finance—and, by the way, many of these careers don’t require a four-year degree or the debt that can come with it.”

Ref: National Association of Manufacturers

Second Reference:

What Skills will be in High Demand?

The World Economic Forum has published several reports on the future of jobs and top skills that will play significant roles in future technology advancement (Schwab & Samans, 2016; Schwab & Zahidi, 2020). The authors summarized the perspectives of strategy officers and chief human resources managers from leading global companies about the current shifts in required skills, and recruitment across industries. These reports analyze skills needed for the labor market and track the pace of changes. A quick rate of technology adoption signals that in-demand skills across jobs will change over the next five years or longer; therefore, skill gaps will continue to be significant.

Table 1

From: [Reskilling and Upskilling the Future-ready Workforce for Industry 4.0 and Beyond](#)

25/20/15*	in 2025	20/15*	in 2020	in 2015
1	Analytical thinking and innovation	1, 1	Complex problem solving	Complex problem solving
2	Active learning and learning strategies	2, 4	Critical thinking	Coordinating with others
3, 1, 1	Complex problem-solving	3, 10	Creativity	People management
4, 2, 4	Critical thinking and analysis	4, 3	People management	Critical thinking
5, 3, 10	Creativity, originality, and initiative	5, 2	Coordinating with others	Negotiation
6	Leadership and social influence	6	Emotional intelligence	Quality control
7	Technology use, monitoring, and control	7, 8	Judgment and decision making	Service orientation
8	Technology design and programming	8, 7	Service orientation	Judgment and decision making
9	Resilience, stress tolerance, and flexibility	9, 5	Negotiation	Active listening
10	Reasoning, problem-solving	10	Cognitive flexibility	Creativity

Data Source: Gray (2016). The ten skills you need to thrive in the Fourth Industrial Revolution. World Economic Forum, January 19, 2016; and Whiting (2020). These are the top 10 job skills of tomorrow – and how long it takes to learn them. World Economic Forum, October 21, 2020.

* 25/20/15: skills in 2025, skills in 2020, and skills in 2015; 20/15: skills in 2020 and skills in 2015

Table 1 shows the top 10 skills for 2015, 2020, and 2025 (Gray, 2016; Whiting, 2020). The top 10 skills for 2015 are listed under Column 1 on the right-hand side of Table 1, and the top 10 skills for 2020 are listed under Column 2 on the right-hand side. The middle column, column 3, compares the change of rank of the top skills in 2015 and 2020. For example, complex problem solving is ranked number 1 in 2015 and 2020, while critical thinking moved up to number two in 2020 from its rank of number four in 2015. The first column from the left-hand side shows the changes in top skills in 2015, 2020, and 2025. For example, “Analytical thinking and innovation” is listed as the top 1 skill but was not on the list in 2015, or 2020. “Complex problem-solving” is the third most important skill in the 2025 list but was ranked number 1 in 2015 and 2020.

Table 1 Review of reports of top 10 skills on reskilling and upskilling future-ready work force. For those workers who stay in their roles, the share of core skills that will change from 2020 to 2025 is more than 60% (Table 1). Seven out of 10 top skills listed under the column “in 2025” are not listed under 2020 and 2015. While between 2015 and 2020, skill requirements overlap considerably, eight out of ten top skills are the same for the two periods (Table 1).

Looking forward to 2025 and beyond (Table 1), analytical thinking and innovation skills crown the skill-set list that employers believe will grow in prominence in the next five years.

Active learning and learning strategies are a new skill set that trailed behind the top one. Analytical thinking and active learning ranked number 1 and number 2 in 2025, emphasizing cognitive self-management.

Critical thinking and problem-solving skills, which were at the top of the skill list in 2020 and 2015, are now relegated to 3rd and 4th places in 2025's skill list (Table 1). But these two skills, along with creativity, have consistently been viewed as critical skill sets since the first report was published in 2016. With the avalanche of new technologies, new products, and new working processes, employees will become more creative to respond to and benefit from technological changes.

Items six to 10 under 2025 (Table 1) are newly emerging skills focusing on technology-related competencies and skills, cognitive reasoning capability, and leadership, with a sharp uptake from 2020. Five years from now, over two-thirds of skills (67%) considered important in today's job requirements will change. In addition, a third of the essential skill sets in 2025 will consist of technology competencies not yet regarded as crucial to today's job requirements.

What Skills are Less Focused on?

Negotiation and people management were ranked high on the 2015 skill list. However, these skills began to drop on the 2020 list and do not appear on the 2025 list. As companies and managers increasingly use masses of data and make decisions based on data analytics, negotiation and people management retreat their positions in the decision-making process. Society expects artificial intelligence and machine learning to provide decision support information to a company's board of directors by 2026.

Similarly, soft skills in the cognitive scope, such as quality control and active listening, and emotional intelligence, considered core skills on the 2015 skill list, disappeared entirely from the top 10 skill list of 2025. Instead, this year's newly emerging items are skills in self-management such as active learning, resilience, stress tolerance, and flexibility.

Section 7: List of Potential Broome Companies to Engage

NAICS Code	Industry
323	Printing and Related Support Activities
326	Plastics and Rubber Products Manufacturing
327	Nonmetallic Mineral Product Manufacturing
331	Primary Metal Manufacturing
332	Fabricated Metal Product Manufacturing
333	Machinery Manufacturing
334	Computer and Electronic Product Manufacturing
335	Electrical Equipment, Appliance, and Component Manufacturing

- Amphenol Interconnect Products Corp. (334)
- BAE Systems (334)
- Buckingham Manufacturing Co., Inc. (332)
- C.H. Thompson Co., Inc. (332)
- CMP Advanced Mechanical Solutions (334)
- Crowley Fabricating & Machining Co., Inc. (332)
- Curcio Printing (323)
- Datum Alloys, Inc. (327)
- Doron Precision Systems, Inc. (333)
- Eck Plastic Arts, Inc. (326)
- EMS Technologies, Inc. (335)
- Four Square TRE (326)
- George Industries, Inc. (332)
- Harris Assembly Group (334)
- Imperium 3 NY (335)
- Innovation Associates, Inc. (333)
- National Pipe & Plastics, Inc. (326)
- Samscreen, Inc. (331)
- Scorpion Security Products (335)

Section 8: Summary

To remain competitive on a global scale and at home, manufacturers in the Southern Tier of New York must bridge the workforce gap by creating a pathway from K-12 to successful employment. STEM focused coursework can be at the center of training initiatives and create a much-needed launching pad to entry level positions that are currently unfilled.

Partnering with high school programs to reach potential candidates fills the gap for those not on a collegiate path, or at least not at this time.

[Appendix A: Indeed.com Career Guide](#)

Pages 21-39

[Appendix B: Tooling U-SME, Skills Definitions](#)

See Master Skills Definition Chart, Pages 40-81

Assembler

Skills

- Assembly
- Basic math
- Calipers
- Communication skills
- Computer literacy
- Computer skills
- Construction
- Customer service
- Electrical wiring
- English
- Forklift
- Hand tools

How much does an Assembler make in Binghamton, NY?

Average base salary

\$15.43

Non-cash benefit

401(k)

Common qualifications

- Forklift Certification
- Driver's License

Soft Skills

- The ability to work easily with other assemblers and employees as a team
- Critical thinking and problem-solving skills for developing a working procedure for assembling a product
- Concentration and focus for completing your work, even with distractions
- Good color vision for identifying colors of wire, tabs and electronics in order to assemble them properly and efficiently

What does an Electrical Technician do?

An electrical technician repairs electrical systems on various devices and products. They typically collaborate with electrical engineers to view and follow design plans to build or repair a product's electrical system. Electrical technicians may draw their own diagrams to construct and repair products and request approval from electrical engineers once the final project is complete

How much does an Electrical Technician make in Binghamton, NY?

Average base salary

\$31.25

Overtime

\$7,500per year

Non-cash benefit

401(k)

Is there a difference between an electrician and an electrical technician?

While an electrical technician works in an office or factory repairing products' electrical systems, electricians travel to homes and businesses to install electrical or wiring systems. Electricians focus on the electrical systems within larger units, while electrical technicians install or repair smaller products.

What education should an electrical technician pursue?

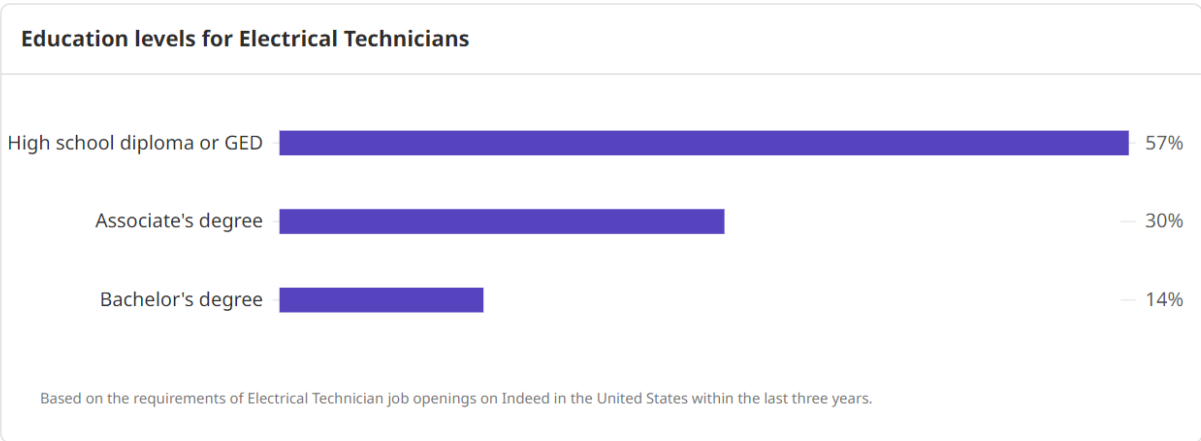
To become an electrical technician, there are a few different options you can pursue, including:

- **Electrical or maintenance certificate:** This takes approximately one year to earn and includes courses such as control circuits, power tool usage and industrial writing.
- **Associate of Applied Science in Electrical and Computer Engineering Technology:** This degree closely relates to electrical systems and circuits. Common courses include digital systems, circuit analysis and electronics.
- **Associate of Applied Science in Electrical technology:** Students who pursue this degree spend two years taking courses like rotational machinery, controls and motors and automation.

What skills help Electrical Technicians find jobs?

Analysis skills
Assembly
AutoCAD
CMMS
Communication skills
Computer literacy
Computer skills
Customer service
Electrical experience
Electrical systems

Electrical wiring
English



What does a Forklift Operator do?

A forklift operator is a manufacturing and transportation professional who uses a forklift to load and unload materials and equipment in a warehouse environment. Working under the supervision of a warehouse manager, the forklift operator is responsible for the physical maneuvering of the equipment, as well as some larger maintenance, safety and organizational functions.

How to become a Forklift Operator

To work as a forklift operator you must be 18 years of age or older, possess a high school diploma or equivalent and be certified as a forklift operator in accordance with the requirements outlined by the Occupational Safety and Health Administration (OSHA). Although OSHA sets the expectations, they do not certify individuals themselves. Employers, training programs or online organizations can certify individuals through coursework, hands-on training hours and successful passing of an exam.

What skills help Forklift Operators find jobs?

- Basic math
- Bilingual
- Cherry picker
- Clamp truck
- Communication skills
- Computer literacy
- Computer skills
- Customer service
- Driving
- English
- Forklift
- Freight

What skills are needed to be a forklift operator?

The most important skills for a forklift operator to have include paying close attention to detail, a discipline to comply with safety and organizational standards, good hand-eye coordination and strong organizational skills. Possessing technical knowledge about the machines being operated and good judgment about risk and corresponding safety precautions are also important.

How much does a Forklift Operator make in Binghamton, NY?

Average base salary

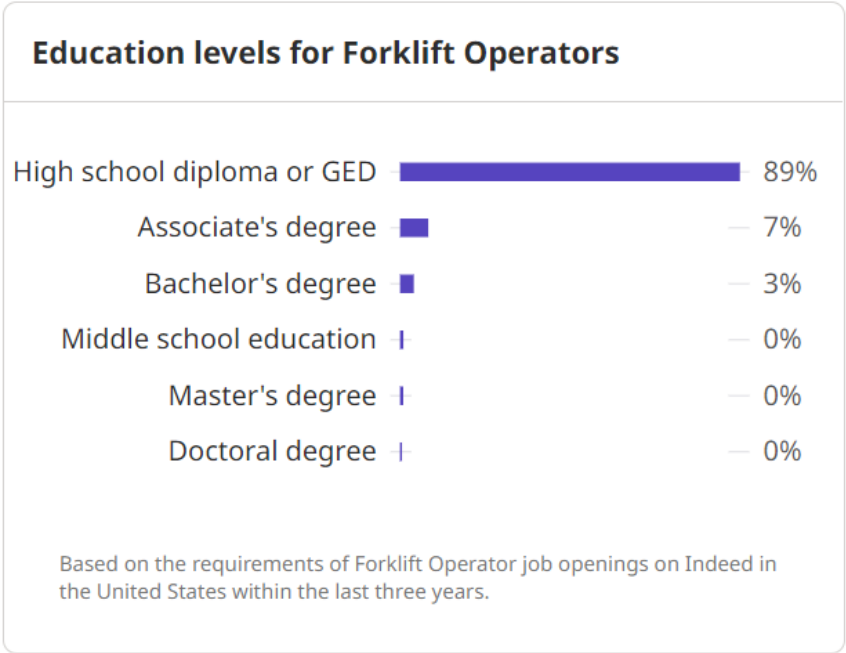
\$17.30

Overtime

\$5,437per year

Non-cash benefit

401(k)



General Maintenance salary in Binghamton, NY

How much does a General Maintenance make in Binghamton, NY?

Average base salary

\$19.89

Non-cash benefit

401(k)

What skills help General Maintenances find jobs?

Commercial driving
Communication skills
Computer literacy
Computer skills
Construction
Customer service
English
HVAC
Hand tools
Hotel experience
Maintenance
Mechanical knowledge

Education levels for General Maintenances



Based on the requirements of General Maintenance job openings on Indeed in the United States within the last three years.

Industrial Mechanic salary in Binghamton, NY

How much does an Industrial Mechanic make in Binghamton, NY?

Average base salary

\$23.90

Non-cash benefit

401(k)

What skills help Industrial Mechanics find jobs?

Automotive diagnostics

CMMS

Calipers

Communication skills

Computer literacy

Computer skills

Electrical experience

English

Fabrication

Hand tools

Hydraulics

Industrial maintenance

Education levels for Industrial Mechanics



Based on the requirements of Industrial Mechanic job openings on Indeed in the United States within the last three years.

Laborer/Warehouse Worker

Responsibilities

A warehouse worker is responsible for organizing, maintaining, and retrieving inventory for shipment that is stored inside a business's warehouse. Their duties are varied but they require good organizational skills, lifting and moving inventory, as well as keeping detailed records of what is done in and around the warehouse.

How much does a Warehouse Worker make in Binghamton, NY?

\$17.45 hr.

Overtime

\$5,250 per year

Non-cash benefit

401(k)

Skills

Assembly
Basic math
Bilingual
Communication skills
Computer literacy
Computer skills
Customer service
Data entry
English
Food service
Forklift
Heavy lifting

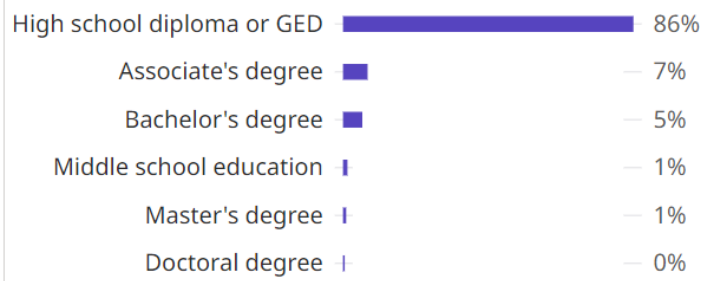
Qualifications

- Forklift Certification
- Driver's License

How can a warehouse worker advance their career?

With experience, a warehouse worker may advance their career by participating in training or moving up to the position of warehouse supervisor, floor supervisor or may even advance to a role in the purchasing department, where they might handle customer accounts and orders.

Education levels for Warehouse Workers



Based on the requirements of Warehouse Worker job openings on Indeed in the United States within the last three years.

Machine Operator

Working as a Machine Operator

- Performing pre-operation inspections to ensure proper functioning of machine
- Inspecting machinery to ensure compliance with safety standards and industry regulations
- Observing the machine's operations and inspecting product output for quality
- Communicating with colleagues about production processes to maximize efficiency
- Performing minor repairs and consulting with technicians for more significant repair needs

How much does a Machine Operator make in Binghamton, NY?

Average base salary

\$15.31

Non-cash benefit

401(k)

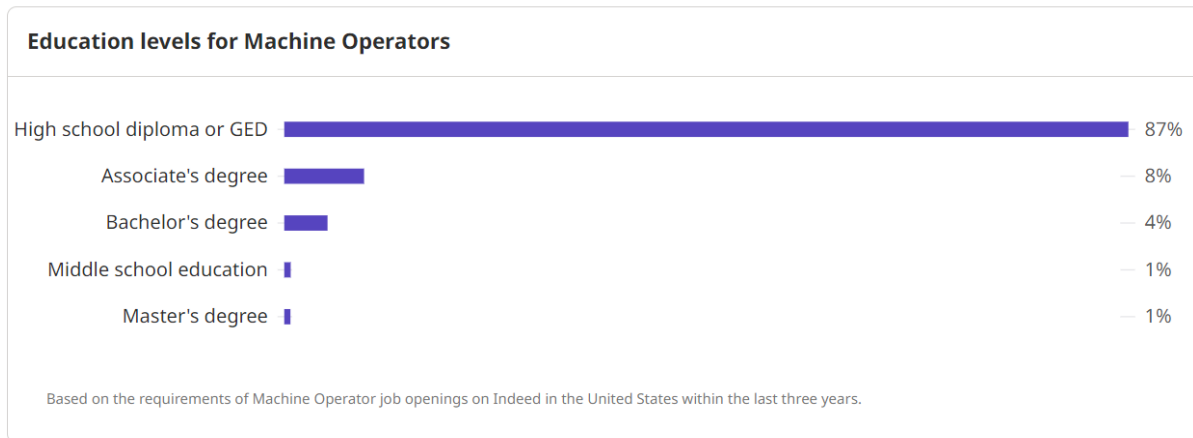
What opportunities for career advancement exist for machine operators? Machine operators can advance to work as a site supervisor or foreman at one site or across several sites. In this capacity, they are responsible for directing and supervising machine operators and other factory employees. They will also establish safety and related compliance guidelines while overseeing all site operations. With additional education, machine operators can pursue employment with computer-controlled equipment or machines that are more mechanically based.

What is the job outlook for machine operators?

Job outlook for machine operators varies depending on their specific occupation. According to the U.S. Bureau of Labor Statistics, the job outlook for metal and plastic machine operators is expected to decline by 8% between 2018 and 2028. The job outlook for material moving machine operators, on the other hand, is expected to grow by 4% between 2018 and 2028.

Skills

Analysis skills
Assembly
Basic math
CNC
Calipers
Communication skills
Computer literacy
Computer skills
English
Forklift
Hand tools
Machining



What skills are essential for a machine operator?

- **Attention to detail:** These professionals must closely monitor a machine's operation and any small malfunctions to ensure it runs properly.
- **Problem-solving** Machine operators often identify issues with machinery or workflow and find effective solutions to maintain productivity and efficiency.
- **Organization:** Machine operators are required to keep records of any maintenance or repair issues, communicate with various stakeholders and ensure machine operations follow a designated schedule

What does a Machinist do?

A machinist is a person who works in trade industries and uses their hands or a machine to create or modify a part made of metal, plastic or wood. Machinists make, modify and repair mechanical instruments and set up and operate a wide variety of tools to produce precision parts. Most machinists work with metal and use machines such as lathes and grinders. In this article, we will discuss what a machinist does and how to become a machinist.

How much does a Machinist make in Binghamton, NY?

Average base salary

\$21.91

Non-cash benefit

401(k)

What skills will I need to be a machinist?

As a machinist, you will need to be able to read electronic or written blueprints or job specifications to produce a part. Once you review the plans, you will need to know how to create a strategy to produce the item in question. Accuracy is crucial, often requiring you to be within hundredths of a millimeter. You must calculate the amount of precision, set up machines, select tools, pick proper metal, and mark pieces. In the past, this took as many as 50 people, but now computers do most of the work. Machinists also write computer programs to control the Computerized Numerical Control, or CNC, machines. They must also be able to modify programs to prevent problems.

How have Computerized Numerical Control (CNC) machines changed the role of machinists?

A machinist must now understand basic physics, be computer literate and understand basic electronics.

How to become a Machinist

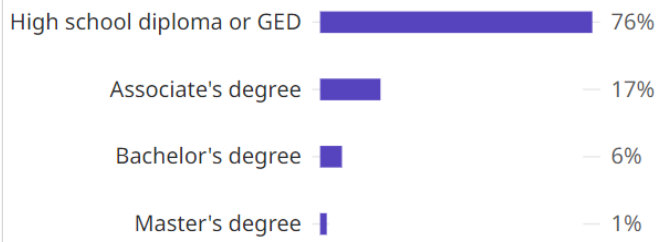
First, you will need to get a background in computers, math or science. In high school, geometry and trigonometry are useful classes. Calculus and physics are also helpful, especially for the more advanced fields such as aviation. Courses in blueprint reading, drafting and metalworking through a high school or vocational program can be helpful as well. Most employers require a four-year apprenticeship with shop and class time or two years of vocational school plus on-the-job training. Some employers pay for training.

What skills help Machinists find jobs?

- Analysis skills
- Basic math
- CAM programming
- CNC
- CNC lathe

CNC milling machine
CNC programming
Calipers
Communication skills
Computer literacy
Computer skills
Coordinate measuring machine

Education levels for Machinists



Based on the requirements of Machinist job openings on Indeed in the United States within the last three years.

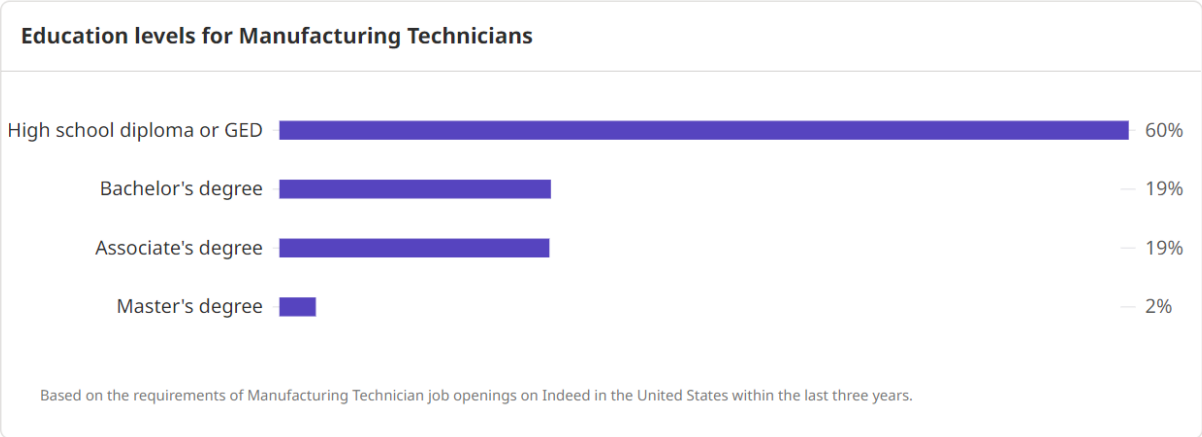
Manufacturing Technician salary in Binghamton, NY

How much does a Manufacturing Technician make in Binghamton, NY?

Average base salary
\$22.33
Overtime
\$6,285per year
Non-cash benefit
401(k)

What skills help Manufacturing Technicians find jobs?

- Analysis skills
- Assembly
- Basic math
- CGMP
- CNC
- Calipers
- Cleanroom
- Communication skills
- Computer literacy
- Computer skills
- English
- FDA regulations



Operations Supervisor

Operations Supervisor salary in Binghamton, NY

How much does an Operations Supervisor make in Binghamton, NY?

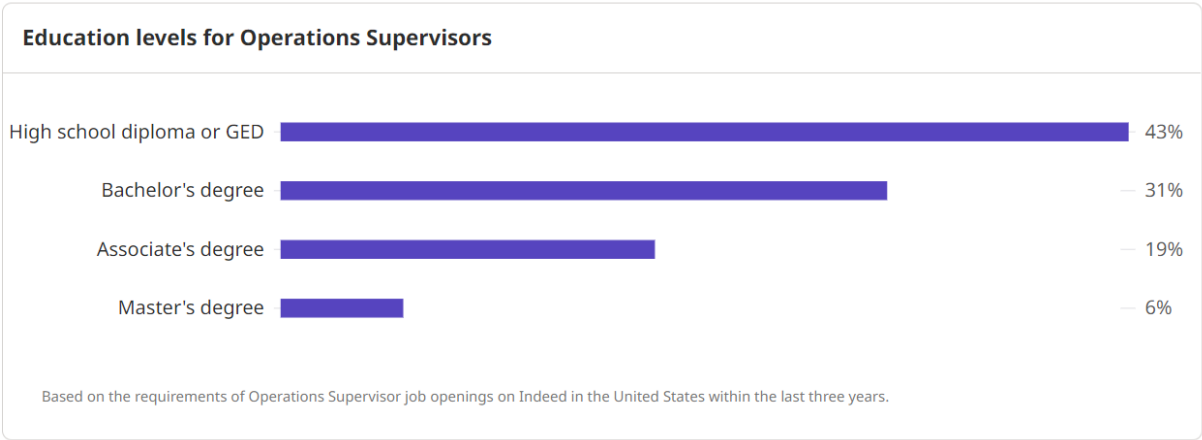
Estimated salaries
\$55,248

Profit sharing
\$5,000per year

Non-cash benefit
401(k)

Skills

- Administrative experience
- Analysis skills
- Bilingual
- Communication skills
- Computer literacy
- Computer skills
- Customer service
- English
- Forklift
- Leadership
- Logistics
- Management



How much does a Production Worker make in Binghamton, NY?

Average base salary

\$16.64

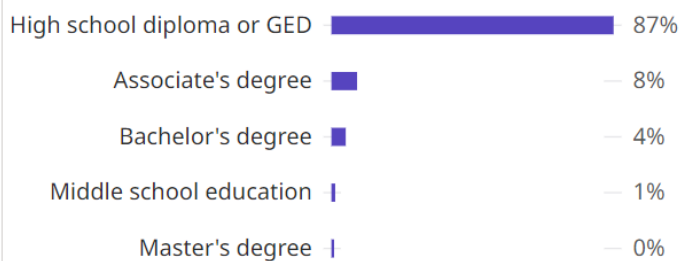
Non-cash benefit

401(k)

Skills

Assembly
Basic math
Bilingual
Calipers
Communication skills
Computer literacy
Computer skills
Construction
English
Food processing
Food production
Forklift

Education levels for Production Workers



Based on the requirements of Production Worker job openings on Indeed in the United States within the last three years.

Common Qualifications

- Forklift Certification
- Driver's License

Is a production worker considered to be an in-demand profession?

Production worker jobs are in demand in the U.S. for those who have a background in Science, Technology, Engineering and Mathematics (STEM). According to a 2015 report by the Manufacturing Institute and Deloitte, in the next decade, 3.4 million jobs are set to be created in manufacturing, and new workers are needed to replace retiring ones and take up positions in new manufacturing niches that need technology skills

How can a production worker remain competitive?

To remain competitive, production workers can increase their skills by studying courses in line with the new technology trends, like artificial intelligence and robotics that are being used in the manufacturing sector. Learning to operate, maintain and repair these systems can help production workers secure employment in the field

Quality Control (Food-Pharma)

Quality Technician salary in Binghamton, NY

How much does a Quality Technician make in Binghamton, NY?

Average base salary

\$19.19

Overtime

\$6,750 per year

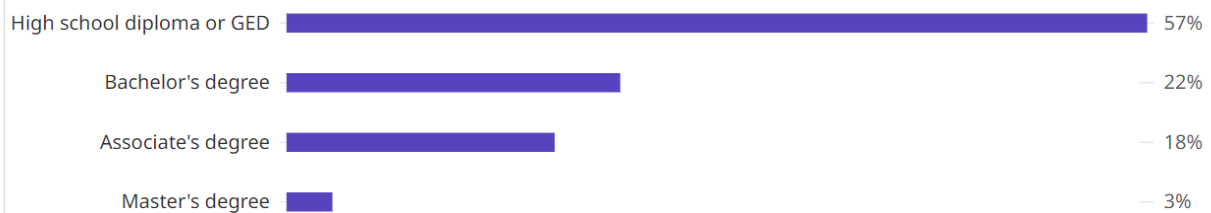
Non-cash benefit

401(k)

What skills help Quality Technicians find jobs?

Analysis skills
Basic math
CGMP
Calipers
Communication skills
Computer literacy
Computer skills
Coordinate measuring machine
Data collection
English
FDA regulations
GD&T

Education levels for Quality Technicians



Based on the requirements of Quality Technician job openings on Indeed in the United States within the last three years.

Qualifications

- Certified Quality Technician
- ISO

Master Skills Definition Chart

Skill / Position	Skills Definition	App. B Page No.	Assembler	Electrical Tech	Forklift Operator	General Maintenance	Industrial Maintenance	Laborer/Warehouse Worker	Machine Operator	Machinist	Manufacturing Tech	Operation Supervisor	Production Worker	Quality Control Technician	Welders, Cutters, Brazers, Solders	Quantity
Computer skills/Literacy	Digital Literacy	50	x	x	x	x	x	x	x	x	x	x	x	x	x	12
Communication skills	Essentials of Communication	54	x	x	x	x	x	x	x	x	x	x	x	x	x	12
Lean*	Lean Manufacturing	65	x	x	x	x	x	x	x	x	x	x	x	x	x	12
5S*	5S	41	x	x	x	x	x	x	x	x	x	x	x	x	x	12
Safety*	OSHA, Hand tools, Electrical	57, 63, 76	x	x	x	x	x	x	x	x	x	x	x	x	x	12
Basic math	Basic Math, Math Fractions and Decimals	43,69	x	x	x	x	x	x	x	x	x	x	x	x	x	11
Blueprint reading	Blueprint Reading	81	x	x		x	x		x	x	x		x	x	x	9
Calipers	Basic Measurements	44,80	x	x		x	x		x	x	x		x	x	x	9
Customer service	Quality and Customer Service	74,75	x	x	x	x	x	x			x	x	x			9
Assembly	Assembly	42	x	x	x			x	x	x	x		x		x	8
Forklift	Powered Industrial Truck Safety	73	x		x			x	x	x		x	x			7
CMMS	Coordinate Measuring Machine CMMS	48		x		x	x		x	x	x			x		7
Analysis skills	Troubleshooting	78		x					x	x	x	x		x		6
Hand tools	Tools for Threaded Fasteners	67	x			x	x		x	x			x			6
Electrical experience	Electrical Units, Electrical Wiring	51,52		x		x	x				x					4
Mechanical knowledge	Intro to Mechanical Systems and Properties	61,62	x			x	x					x				4
FDA/CGMP/ISO*	Various Requirements Based on Industry, Intro to ISO*, FDA Regulations	55,58		x							x			x		3
CNC	Computer Numerical Control	46							x	x						2
Maintenance	Intro to Maintenance	60				x	x									2
Machining	Intro to Machine Tools, Forces of Machines	56,71							x	x						2
All Positions*	Intro to Manufacturing	66														*

*Additional skills based on industry knowledge.

Class Name: 5S Overview 151

Description: "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.

Difficulty: Beginner

Class Outline

- Five S: Introduction
- Five S Steps
- Step 1: Sort
- Step 2: Set in Order
- Step 3: Sweep
- Step 4: Standardize
- Step 5: Sustain
- 5S Review
- 5S plus 1: Safety
- Implementing a 5S Program
- 5S Communication Boards
- Assessing the Situation
- Assessing the Situation: Spaghetti Diagrams
- Challenges to 5S Implementation
- Advantages of 5S

Class Objectives

- Define Five S.
- Identify the steps involved in 5S.
- Describe the Sort step of 5S.
- Describe the Set in Order step of 5S.
- Describe the Sweep step of 5S.
- Describe the Standardize step of 5S.
- Describe the Sustain step of 5S.
- Describe 5S plus 1.
- Describe the purpose of 5S implementation.
- Describe the purpose of communication boards to 5S.
- Identify ways to assess 5S success before, during, and after implementation.
- Describe the challenges to implementing a 5S program.
- Describe the advantages to implementing a 5S program.

Class Name: Introduction to Assembly 101

Description: The class “Introduction to Assembly” provides an overview of the processes and methods used to assemble components into finished parts. Assembly is often performed on assembly lines, which may be manual, automated, or a combination of both. The three main assembly methods are mechanical fastening, adhesive bonding, and welding. Mechanical fastening uses fasteners to join components. Fasteners can join dissimilar materials, are inexpensive, and allow for disassembly. Adhesive bonding uses materials such as gels, liquids, or tapes to form a joint. Welding uses pressure, heat, or a combination of energy sources to create a very strong, permanent joint. These methods are sometimes used together.

The information presented in this class serves as a foundation for users to learn more about, and eventually perform, fastening and assembly. Understanding the differences between different assembly methods prepares users to learn about the more detailed and complex aspects of each method.

Difficulty: Beginner

Class Outline

- Assembly Methods
- Assembly Site
- Manual Assembly Lines
- Automated Assembly Lines
- Automated Assembly Systems
- Review: Assembly
- Mechanical Fastening
- Mechanical Fastening Tools
- Advantages and Disadvantages of Mechanical Fastening
- Review: Mechanical Fastening
- Adhesive Bonding
- Advantages and Disadvantages of Adhesive Bonding
- Welding
- Advantages and Disadvantages of Welding
- Review: Adhesive Bonding and Welding

Class Objectives

- Describe common assembly methods.
- Describe an assembly site.
- Describe manual assembly lines.
- Describe automated assembly lines.
- Describe common automated assembly systems.
- Describe mechanical fastening.
- Describe common tools used for mechanical fastening.
- Describe the advantages and disadvantages of mechanical fastening.
- Describe adhesive bonding.
- Describe the advantages and disadvantages of adhesive bonding.
- Describe welding.
- Describe the advantages and disadvantages of welding.

Class Name: Math Fundamentals 101

Description: 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.

Difficulty: Beginner

Class Outline

- Mathematics
- Addition and Subtraction
- Addition and Subtraction Review
- Positive and Negative Integers
- Rules for Adding and Subtracting with Negative Numbers
- Ordering Integers
- Addition and Subtraction with Negative Integers Review
- Multiplication
- The Rules of Multiplication
- Division
- Multiplication and Division Review
- Exponents
- Roots
- Exponents and Roots Review
- Order of Operations
- Grouping
- Order of Operations Review

Class Objectives

- Describe the importance of mathematics for manufacturing employees.
- Solve addition and subtraction problems.
- Describe integers and negative numbers.
- Solve addition and subtraction problems with negative integers.
- List integers in order from least to greatest.
- Solve basic multiplication problems using integers.
- Explain the rules for multiplying with negative integers.
- Solve basic division problems containing integers.
- Describe exponents.
- Describe roots.
- List the correct order of mathematical operations.
- Explain the rules for grouping symbols.

Class Name: Basic Measurement 101

Description: “Basic Measurement 101” offers an overview of common gaging and variable inspection tools and methods. Variable inspection provides a specific measurement of a part dimension using common devices such as calipers and micrometers. Both calipers and micrometers often include vernier scales, which are read by finding alignments between graduations on two graduated scales. Gaging devices, such as gage blocks, plug gages, ring gages, and thread gages, determine whether a dimension is acceptable or unacceptable without providing a specific measurement. Both variable and gaging inspection devices should be properly calibrated and maintained to ensure accuracy.

Measurement is one of the most fundamental activities of part inspection. Successful inspection ensures that out-of-tolerance parts do not reach customers. After taking this class, users will be able to describe several common inspection instruments and how they are used in the production environment.

Difficulty: Beginner

Class Outline

- Inspection Measurements
- Gaging and Variable Inspection
- Accuracy and Precision
- Comparing Accuracy and Precision
- Resolution
- Inspection and Measurement Basics Review
- The Steel Rule
- The Vernier Scale
- Calipers
- Reading Calipers
- Micrometers
- Micrometer Types
- Reading Micrometers
- Measurement Devices Review
- Plug, Ring, and Snap Gages
- Height Gages
- Mastering and Calibration
- Gage Blocks
- Gages Review

Class Objectives

- Describe the relationship between measurement, inspection, and tolerance.
- Distinguish between gaging and variable inspection.
- Distinguish between accuracy and precision.
- Describe resolution for measuring instruments.
- Describe the steel rule and the graduated scale.
- Describe the vernier scale.
- Identify basic caliper types and their uses.
- Explain how to read calipers.
- Describe micrometers and their uses.
- Explain how to read micrometers.
- Describe plug, ring, and snap gages and their uses.

Appendix B: Tooling U-SME, Skills Definitions

- Describe height gages.
- Describe mastering and calibration for measuring instruments.
- Describe gage blocks.

Class Name: Introduction to CNC Machines 201

Description: "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.

Difficulty: Intermediate

Class Outline

- CNC for Modern Manufacturing
- History of CNC
- CNC Machine Movement
- CNC Machine Variety
- CNC Coordinates
- Positive and Negative Directions
- Rotational Axes
- Contouring
- CNC Machines
- Machine Control Unit
- Control Systems
- PTP and Continuous Path Systems
- Open-Loop and Closed-Loop Systems
- Control System Categorization
- Servomotors
- Feedback Devices
- Closed-Loop Error Correction
- Input Methods
- Control and Operation Features
- CNC Machine Components

Class Objectives

- Describe how CNC machines have benefited modern manufacturing.
- Describe the origin of CNC machines.
- Identify common methods of CNC movement.
- Identify different varieties of CNC machines.
- Explain the role of axes in the Cartesian coordinate system.
- Identify positive and negative movement along machine axes.
- Describe rotational axes and movement.
- Describe contouring movements.
- Describe the role of the machine control unit.
- Distinguish between point-to-point positioning and continuous path movement.
- Contrast open-loop and closed-loop systems.

Appendix B: Tooling U-SME, Skills Definitions

- Describe the role of servomotors.
- Distinguish between different feedback devices.
- Describe various input methods.
- Describe different control and operation features available to the CNC machine.

Class Name: Inspecting with CMMs 361

Description: "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.

Difficulty: Advanced

Class Outline

- Coordinate Measuring Machines
- CMM Components
- Measured and Constructed Features
- Datums
- Parts of the CMM Review
- Machine and Part Coordinates
- Alignment
- CMM Software
- CMM Programming
- Environmental Factors
- Bearings
- Types of CMMs
- CMM Inspection
- The Probe
- Manual Controls
- Direct Computer Controls
- Scales and Encoders
- Contact Probes
- Noncontact Probes
- Measuring with Noncontact Probes
- CMM Applications and Advantages
- Operator Involvement

Class Objectives

- Describe the CMM and its main components.
- Distinguish between measured and constructed features.
- Define datum.
- Distinguish between the machine coordinate system and the part coordinate system.
- Describe the purpose of alignment.
- Identify types of software used on a coordinate measuring machine and describe their purpose.
- Describe different methods for programming a coordinate measuring machine.
- Describe how coordinate measuring machines prevent or compensate for environmental influences.
- Compare the characteristics of air bearings, magnetic bearings, and mechanical bearings.
- Identify the common types of CMMs.
- Describe the probe.
- Compare the characteristics of manual and joystick controls.

Appendix B: Tooling U-SME, Skills Definitions

- Describe the operation of a direct computer control.
- Describe the interaction of the scale with the encoder.
- Describe how a contact probe inspects a part.
- Describe how a noncontact probe inspects a part.
- Describe the methods and benefits of incorporating CMMs into production processes.

Class Name: Digital Literacy

Description: These programs will prepare you for a career in Information Technology or career advancement in any industry.

Difficulty: Beginner

Class Outline

- Using a keyboard and mouse
- Browsing files on a computer
- Understanding file pathing
- Using and managing email and calendars
- Browsing the web
- Internet safety practices
- Search Engines
- Attachments
- Word
- Excel
- PowerPoint
- Tables.

Class Objectives

- Use of office productivity software including Microsoft Office and Google Suite

Class Name: Electrical Instruments 251

Description: "Electrical Instruments 251" describes the various roles of electrical testing instruments in maintaining the safety of electrical workers. From the basic galvanometer to today's digital multimeters, electrical instruments are primarily used to determine if electricity is flowing properly and safely through devices and circuits. Most meters made today are digital. Watt and watt-hour meters are used to measure power or energy. Many other meters, such as oscilloscopes, decibel meters, and "wiggies," are designed for specialized uses.

All electrical instruments offer a better understanding of the operating conditions of electricity. Various organizations that set manufacturer standards ensure the accuracy of electrical instruments. Upon taking this course, students will be able to describe how to use electrical measuring instruments to safely and accurately measure electrical variables.

Difficulty: Intermediate

Class Outline

- The Importance of Electrical Instruments
- Basic Principles and Instruments
- Ohm's Law
- Electrical Instruments and Ohm's Law Review
- Ammeters
- Voltmeters
- Ohmmeters
- Multimeters
- Basic Meters Review
- Wattmeters
- Watt-Hour Meters
- Other Specialized Meters
- Direct Current and Alternating Current
- Additional Meters and Measuring Current Review
- Common Safety Practices
- Standards and Organizations
- Safety, Standards, and Organizations Review

Class Objectives

- Describe various meters and their uses.
- Describe basic electrical meters.
- Describe Ohm's law.
- Describe the ammeter.
- Describe the voltmeter.
- Describe the ohmmeter.
- Describe the multimeter.
- Describe the wattmeter.
- Describe the watt-hour meter.
- Identify less common electrical meters.
- Distinguish between DC and AC meter readings.
- Describe common safety practices for using electrical meters.
- Identify the various organizations that set electrical industry standards.

Class Name: Electrical Units 101

Description: "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.

Difficulty: Beginner

Class Outline

- Electricity
- Parts of an Atom
- Positive and Negative Charges
- Atomic Numbers, Electrons, and Shells
- Electricity and Atoms Review
- Bonding
- Conductivity
- Producing Electricity
- Circuits
- Electrical Theory
- Electron Transfer and Current Flow Review
- Amperage
- Voltage
- Resistance
- Ohm's Law
- Wattage
- Electrical Measurements Review
- Direct Current and Alternating Current
- Advantages of Alternating Current
- Final Review

Class Objectives

- Describe electricity.
- Identify the parts of an atom.
- Describe how positive and negative charges behave.
- Define atomic number. Describe electrons in relation to shells.
- Describe how atoms bond. Describe electron transfer.
- Describe how valence electrons relate to conductivity.
- Describe methods of producing electricity.
- Identify the parts of a circuit.
- Distinguish between conventional current theory and electron theory.
- Define coulomb.
- Describe amperage.
- Describe voltage.
- Describe resistance.

Appendix B: Tooling U-SME, Skills Definitions

- Define Ohm's Law.
- Describe wattage.
- Define Watt's Law.
- Distinguish between direct current and alternating current.
- Describe advantages of alternating current.

Class Name: Essentials of Communication

Description: 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.

Difficulty: Beginner

Class Outline

- Objectives
- Communication Is a Process
- The Role of the Listener
- Listening to Understand: Empathetic Listening
- Listening to Understand: Clarifying the Message
- Verbal Communication
- Nonverbal Communication
- Written Communication
- Preparing for Communication in Different Settings
- Common Roadblocks to Communication
- Communicating as a Team Leader
- Fostering Healthy Conflict
- Managing Unhealthy Conflict
- Summary

Class Objectives

- Describe communication.
- Describe key steps involved in listening.
- Describe empathetic listening.
- Explain how to clarify a message.
- Describe verbal communication.
- Describe nonverbal communication.
- Describe written communication.
- Describe how to prepare for communicating in different settings.
- Identify common roadblocks to communication.
- Identify steps for successfully running a team.
- Describe conflict stimulation.
- Identify steps for resolving unhealthy conflict.

Class Name: FDA Regulations

Description: Good manufacturing practice (GMP) is a system for ensuring that products are consistently produced and controlled according to quality standards. It is designed to minimize the risks involved in any food/pharmaceutical production that cannot be eliminated through testing the final product.

Difficulty: Intermediate

Class Outline

- PPE
- Plant and grounds.
- Sanitary operations.
- Sanitary facilities and controls.
- Equipment and utensils.
- Processes and controls.
- Warehousing and distribution.
- Holding and distribution of human food and pharmaceuticals.
- Defect action levels.

Class Objectives

- Quality Assurance Activities
- Facility Design
- Environmental and Personnel Monitoring
- Equipment
- Containers and Closures
- Components
- Regulatory Policy Regarding Testing
- General Production and Process Controls
- Product Sterilization
- Release Testing
- Laboratory Controls
- Packaging and Labels
- Reserve Samples
- Complaint Handling

Class Name: Forces of Machines 121

Description: "Forces of Machines" provides a comprehensive overview of the physical forces behind machine functions. All machines are based on the science of mechanics, which deals with the effects of different forces that either cause or prevent motion. Understanding the different types of forces, the physical laws that define them, and the ways in which they are measured is crucial to understanding machine functions.

Understanding how machines work is essential to working with and performing maintenance upon any type of machinery. This includes the ability to distinguish between contact and non-contact forces, linear and rotary motion, speed and velocity, and scalar and vector quantities, all of which serve as a basis for more advanced mechanical topics. After completing this class, users will be prepared to both work with and study more complex aspects of mechanical systems.

Difficulty: Beginner

Class Outline

- Mechanical Systems and Work
- Energy: Potential and Kinetic
- Newton's Laws of Motion
- Scalar and Vector Quantities
- Review: Energy and Motion
- Forces: Non-Contact and Contact
- Gravity
- Friction
- Torque
- Review: Types of Forces
- Forces and Equilibrium
- Motion: Direction
- Linear Speed and Velocity
- Rotary Speed and Velocity
- Momentum
- Review: Motion

Class Objectives

- Define work.
- Distinguish between potential and kinetic energy.
- Describe Newton's Laws of Motion.
- Distinguish between scalar and vector quantities.
- Describe non-contact and contact forces.
- Describe gravity and its effect on machines.
- Describe friction and its effect on machines.
- Describe torque.
- Contrast equilibrium and dynamic forces.
- Distinguish between linear and rotary motion.
- Distinguish between linear speed and velocity.
- Distinguish between rotary speed and velocity.
- Describe momentum.

Class Name: Hand and Power Tool Safety 201

Description: 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.

Difficulty: Intermediate

Class Outline

- The Importance of Hand and Power Tool Safety
- Hand and Power Tool Basics
- Worksite Organization
- Tool Maintenance and Handling
- Personal Protective Equipment
- Hand and Power Tool PPE
- Point of Operation Safety
- Hand Tool Safety
- Electric Power Tool Safety
- Abrasive Wheel Tool Safety
- Pneumatic Tool Safety
- Fuel and Hydraulic Tool Safety
- Powder-Actuated Tool Safety
- Power Tool Safety
- Ergonomics
- Repetition, Force and Vibration
- Final Review

Class Objectives

- Describe general guidelines for hand and power tool safety.
- Describe the characteristics of a well-organized worksite.
- Describe proper tool maintenance and handling.
- Identify the personal protective equipment used in hand and power tool applications.
- Describe procedures for point of operation safety.
- Describe dangerous hand tool conditions.
- Describe general guidelines for proper electric tool safety.
- Describe general guidelines for proper abrasive wheel tool safety.
- Describe general guidelines for proper pneumatic tool safety.
- Describe general guidelines for proper fuel and hydraulic tool safety.
- Describe general guidelines for powder-actuated tool safety.
- Describe ergonomics.
- Identify the safety risks of tasks that require repetition, force, or vibration.

Class Name: ISO 9000 Review 121

Description: "ISO 9000 Overview" provides an introduction to the key components and requirements of ISO 9001:2015. This class discusses the standard's eight sections, along with describing the role of a Quality Management System (QMS) and ISO 9001:2015'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 9001:2015 is an internationally recognized standard that outlines the requirements of an effective, organized quality system. Many organizations are becoming ISO 9001:2015 certified to prove their commitment to product quality and customer service. Although streamlining documentation and implementing change can be a challenge, ISO 9001:2015 can create a more goal-oriented, connected, and efficient organization. This class helps new practitioners familiarize themselves with ISO 9001:2015's structure, content, and purpose in quality management.

Difficulty: Beginner

Class Outline

- What is ISO 9000?
- Understanding ISO 9000
- ISO 9000 Background
- ISO 9000 Contents
- Versions of ISO Documents
- ISO 9000 Review
- Quality Management Principles
- ISO 9001:2008 Components
- ISO 9001:2008 Components: In Detail
- Quality Management System
- The Importance of Documentation
- Required Documentation
- ISO 9001:2008 Components Review
- Management Responsibility
- Resource Management
- Product Realization
- The Importance of Process
- Measurement, Analysis, and Improvement
- QMS Requirements Review
- Types of ISO 9000 Companies
- Advantages of ISO Registration
- ISO Registration Steps
- The Audit Process
- ISO 9001:2008 Registration Review
- Continual Improvement

Class Objectives

- Define ISO 9000.
- Describe ISO 9000.
- Describe the role of the International Organization for Standardization.
- Identify the documents comprising the ISO 9000 series.
- Distinguish between the different versions of ISO 9000.
- Describe the eight Quality Management Principles.
- Describe the key components of ISO 9001:2008.

- Define the Quality Management System.
- Describe the importance of documentation in a QMS.
- Identify key documents of a QMS.
- Describe the role of management in a Quality Management System.
- Define resource management in a Quality Management System.
- Define product realization for a Quality Management System.
- Describe process design.
- Describe process analysis and improvement for a Quality Management System.
- Identify industries suitable for ISO 9000 certification.
- Identify the advantages of ISO 9000 certification and registration.
- Describe the steps required to obtain ISO 9001:2008 certification and registration.
- Describe the auditing process.
- Define continual improvement.

Class Name: Approaches to Maintenance 131

Description: "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.

Difficulty: Beginner

Class Outline

- What is Maintenance?
- The Importance of Maintenance
- Reactive Maintenance
- Corrective Maintenance
- Disadvantages of RM and CM
- Preventive Maintenance
- The Limitations of PM
- Maintenance Review
- Predictive Maintenance
- PdM Techniques
- Reliability-Centered Maintenance
- Elements of RCM
- Elements of RCM In Action
- Total Productive Maintenance
- The Benefits of TPM
- The Benefits of Planned Downtime
- Selecting a Maintenance Approach

Class Objectives

- Define maintenance.
- Describe the importance of maintenance.
- Define reactive maintenance.
- Define corrective maintenance.
- Describe the disadvantages of RM and CM.
- Define preventive maintenance.
- Describe the limitations of a PM approach.
- Define predictive and condition-based maintenance.
- Describe PdM techniques.
- Define reliability-centered maintenance.
- Describe the reliability-centered maintenance approach.
- Define total production maintenance.
- Describe the benefits of a TPM system.
- Describe the significance of planned downtime on maintenance.
- Describe factors involved in selecting a maintenance approach.

Class Name: Introduction to Mechanical Properties 111

Description: "Introduction 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 Introduction 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.

Difficulty: Beginner

Class Outline

- Manufacturing Materials
- Mechanical and Physical Properties
- The Role of Mechanical Properties
- Material Properties Review
- Stress and Strain
- Elastic Deformation and Plastic Deformation
- Types of Mechanical Stress
- Mechanical Stress Review
- Stress-Strain Graphs
- Important Mechanical Properties
- Tensile Strength
- Tensile Testing
- Ductility
- Toughness
- Impact Strength Tests
- Hardness
- Hardness Testing
- Mechanical Properties Review

Class Objectives

- List the four types of manufacturing materials.
- Define physical properties and mechanical properties.
- Describe how mechanical properties relate to manufacturing applications.
- Describe stress and strain.
- Distinguish between elastic deformation and plastic deformation.
- Define tensile stress, compressive stress, and shear stress.
- Describe aspects of a stress-strain graph.
- List several important mechanical properties.
- Define tensile testing.
- Describe ductility.
- Describe toughness.
- Describe hardness.
- Define the major types of hardness tests.

Class Name: Introduction to Mechanical Systems 101

Description: "Introduction to Mechanical Systems" provides a foundational overview of mechanical systems. Simple machines, such as the lever, incline planed, and wheel, are the building blocks of even the most complex mechanical systems. Both simple and complex machines manipulate mechanical forces, including distance and friction, in order to achieve mechanical advantage.

Understanding how simple machines work is essential to understanding and working with any type of machinery. This includes being familiar with each type of simple machine as well as its components, function, and mechanical advantage, all of which serve as the basis for understanding advanced mechanical topics. Without the foundational information presented in this class, users will not be prepared to study more complex aspects of mechanical systems.

Difficulty: Beginner

Class Outline

- Mechanical Systems
- Mechanical Advantage
- Levers
- Review: Levers and Mechanical Advantage
- The Wheel and Axle
- Fixed Pulleys
- Movable Pulleys
- Movable Pulley Arrangements
- Review: Pulleys
- Inclined Planes
- Wedges
- Screws
- Review: Inclined Planes
- Gears
- Gear Types
- Cams
- Other Mechanical Devices
- Review: Mechanical Devices

Class Objectives

- Describe mechanical systems.
- Describe the factors affecting mechanical advantage.
- Describe the three classes of levers.
- Describe the wheel and axle.
- Describe a fixed pulley.
- Describe a movable pulley.
- Describe the difference in mechanical advantage between movable pulley systems.
- Describe the inclined plane.
- Describe the wedge.
- Describe the screw.
- Describe the gear.
- Describe different types of gears.
- Describe the cam.
- Distinguish between other devices used in mechanical systems.

Class Name: Introduction to OSHA 101

Description: "Introduction to OSHA 101" provides an overview of the purpose of OSHA and how its standards and guidelines affect employers and employees. While some states and industries have their own safety regulations, most workplaces in the U.S. are covered by OSHA. OSHA standards are enforceable by law and have greatly improved workplace safety. Compliance with OSHA standards is verified through inspections and recordkeeping, which have specific steps and requirements. Both employers and employees are entitled to legal rights and must uphold responsibilities regarding OSHA standards.

Manufacturing professionals 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. After completing this course, users will have a basic awareness of the standards, rights, and responsibilities that bolster workplace safety and keep the workplace legally compliant.

Difficulty: Beginner

Class Outline

- OSHA
- OSHA Coverage
- OSHA Standards
- Hazards
- Review: OSHA Basics
- Compliance and Inspection
- Inspection Priorities
- Inspection Steps
- Employee Involvement in Inspections
- Review: OSHA Inspections
- Employer Responsibilities
- Employer Rights
- Employee Responsibilities
- Employee Rights
- Review: Rights and Responsibilities
- Variances
- Statistics and Reporting
- Recordable Incidents
- Information and Training
- Final Review

Class Objectives

- Define OSHA.
- Distinguish between workplaces that are and are not covered by OSHA.
- Describe OSHA standards.
- Describe common hazards covered by OSHA standards.
- Describe OSHA compliance and inspections.
- List the order of priorities for OSHA inspections.
- List the steps in an OSHA inspection.
- Describe the involvement of employees in OSHA onsite inspections.
- Describe employer safety responsibilities established by OSHA.
- Describe the employer rights granted by OSHA.
- Describe employee safety responsibilities established by OSHA.
- Describe the employee rights granted by OSHA.

Appendix B: Tooling U-SME, Skills Definitions

- Define "variance." Distinguish between the types of variances.
- Describe the effect that OSHA has had on workplace accidents. Describe OSHA recordkeeping and reporting requirements for employers.
- Describe recordable incidents.
- Describe methods of obtaining further information on workplace safety.

Class Name:	Lean Manufacturing Overview 101
Description:	"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.
Difficulty:	Beginner

Class Outline

- What is Lean Manufacturing?
- What is Waste?
- Types of Waste
- Lean Manufacturing Review
- High-Volume and Multiple Batch Lean Companies
- Reduction of Process Variation
- Product Changeover
- Inventory Reduction
- Product Flow
- Product Flow and Cycle Time
- Pull Systems
- Cells
- Error Detection
- Pull Systems and Error Detection Review
- Implementing Lean Principles
- The Five S Approach
- Continuous Improvement

Class Objectives

- Define lean manufacturing.
- Define waste in terms of lean manufacturing.
- Identify common types of waste.
- Describe goals for high-volume and multiple batch lean companies.
- Identify sources of process variation.
- Describe the importance of reducing product changeover times.
- Describe the importance of reducing inventory.
- Describe how lean companies achieve continuous product flow.
- Describe a pull system.
- Describe a cell.
- Distinguish between inspection and error detection.
- Describe the necessity of employee involvement.
- List the activities of the Five S Approach.
- Describe the importance of continuous improvement.

Class Name: Manufacturing 101

Description: “Manufacturing 101” provides a broad overview of the manufacturing process and industry. Manufacturing involves a wide range of processes that are used to turn materials into products. Many organizations work together in a supply chain to produce a product. Products start out as designs and are then produced from materials and assembled to create the final product.

The manufacturing industry is a vast, diverse network of organizations that offers a wide variety of career opportunities. After taking this class, users will have a foundational understanding of the manufacturing industry and the various activities that are required to create a product. This will prepare them for further learning about specific manufacturing processes and considerations, as well as pursuing a career in manufacturing.

Difficulty: Beginner

Class Outline

- Manufacturing
- Product Lifecycle
- Supply Chain
- Review: Introduction to Manufacturing
- Development and Design
- Materials
- Part Production
- Assembly
- Other Manufacturing Tasks
- Review: The Manufacturing Process
- Manufacturing Careers
- Career Pathways

Class Objectives

- Describe manufacturing.
- Describe the product lifecycle.
- Describe the manufacturing supply chain.
- Describe the development and design stages of manufacturing.
- Describe materials for manufacturing.
- Describe production processes used in manufacturing.
- Describe the assembly stage of manufacturing.
- Describe other important manufacturing tasks.
- Describe the different career opportunities in manufacturing.
- Describe different pathways that can lead to manufacturing careers.

Class Name: Tools for Threaded Fasteners 235

Description: The class “Tools for Threaded Fasteners” provides a comprehensive overview of the different tools that are used to assemble threaded fasteners. There are many different types of tools used with threaded fasteners, but they all operate by applying torque. Manually powered hand tools include wrenches and screwdrivers. Power tools include battery-operated tools, electric tools, and pneumatic tools. Many power tools use clutches to control operation. These may be continuous-drive tools or discontinuous-drive tools.

Threaded fasteners are the most commonly used fasteners in assembly, and assemblers must be familiar with the different tools they require. After taking this class, users will have foundational knowledge of the different types of tools used with threaded fasteners and their advantages and disadvantages. Users will also be able to identify some of the factors that go into selecting a tool for a threaded fastener application.

Difficulty: Intermediate

Class Outline

- Threaded Fastener Tool Selection
- Types of Fastening Tools
- Hard Joints and Soft Joints
- Tool Ergonomics
- Review: Tool Selection
- Hand Tools
- Types of Wrenches
- Types of Screwdrivers
- Review: Hand Tools
- Battery-Powered Tools
- Electric Tools
- Pneumatic Tools
- Review: Power Tools
- Clutch Operation
- Continuous-Drive Tools
- Types of Continuous-Drive Tools
- Discontinuous-Drive Tools
- Types of Discontinuous-Drive Tools
- Review: Continuous- and Discontinuous-Drive Tools

Class Objectives

- Describe threaded fastener tools and selection factors.
- Distinguish between different types of tools for threaded fasteners.
- Distinguish between hard and soft joints.
- Describe ergonomics for fastening tools.
- Describe common hand tools.
- Distinguish between common wrenches.
- Distinguish between common screwdrivers.
- Describe battery-powered tools.
- Describe electric tools.
- Describe pneumatic tools.
- Define clutch.
- Describe continuous-drive tools.
- Distinguish between common continuous-drive tools.
- Describe discontinuous-drive tools.

- Distinguish between common discontinuous-drive tools.

Class Name: Math: Fractions and Decimals 111

Description: "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.

Difficulty: Beginner

Class Outline

- Fractions
- Parts of a Fraction
- Reducing Fractions
- Adding Fractions
- Subtracting Fractions
- Multiplying Fractions
- Dividing Fractions
- Fraction Calculations Review
- Improper Fractions and Mixed Numbers
- Converting Improper Fractions and Mixed Numbers
- Adding Mixed Numbers
- Subtracting Mixed Numbers
- Multiplying Mixed Numbers
- Dividing Mixed Numbers
- Mixed Numbers and Improper Fractions Review
- Decimals
- Rounding Decimals
- Adding and Subtracting Decimals
- Multiplying Decimals
- Dividing Decimals
- Math Operations with Decimals Review
- Converting Fractions and Decimals
- Percentages
- Determining Percentages: Sample Problem
- Determining Percentages Review

Class Objectives

- Define fraction.
- Distinguish between the two parts of a fraction.
- Explain how to reduce a fraction to its lowest terms.
- Solve an addition problem using fractions.
- Solve a subtraction problem using fractions.
- Solve a multiplication problem using fractions.
- Solve a division problem using fractions.
- Contrast improper fraction and mixed number.
- Explain how to convert improper fractions and mixed numbers.

Appendix B: Tooling U-SME, Skills Definitions

- Solve addition problems using mixed numbers.
- Solve subtraction problems using mixed numbers.
- Solve multiplication problems using mixed numbers.
- Solve division problems using mixed numbers.
- Define decimal.
- Explain how to round a decimal.
- Solve addition problems using decimals. Solve subtraction problems using decimals.
- Solve a multiplication problem using decimals.
- Solve a division problem using decimals.
- Explain how to convert a fraction to a decimal and a decimal to a fraction.
- Define percentage. Explain how to convert a percentage to a decimal and a decimal to a percentage.
- Calculate a percentage.

Class Name: Overview of Machine Tools 121

Description: "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.

Difficulty: Beginner

Class Outline

- Introduction to Metal Cutting Machines
- Saws
- Broaching Machines
- Broaching Action
- Saw and Broach Review
- Lathes
- Lathe Components
- Lathe Review
- Moveable Components of the Lathe
- Cutting Tools for the Lathe
- Reviewing Lathe Tools and Movement
- Milling Machines
- Milling Machine Components
- Mill Basics Review
- Moveable Components of the Milling Machine
- Cutting Tools for the Milling Machine
- Drill Presses
- Final Review

Class Objectives

- Describe metal cutting tools.
- Describe various sawing methods.
- Describe broaching.
- Describe lathes.
- Describe the basic components of a lathe.
- Describe how a lathe's carriage and compound rest operate.
- Identify different cutting tools for the lathe.
- Describe various types of milling machines.
- Contrast vertical and horizontal milling machines.
- Identify the adjustable parts of the milling machine.
- Identify different types of milling cutting tools.
- Describe drill presses.

Class Name: Powered Industrial Truck Safety 221

Description: "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.

Difficulty: Intermediate

Class Outline

- Powered Industrial Trucks
- Powered Industrial Truck Regulations
- Powered Industrial Truck Types and Classifications
- Training Requirements
- PIT Basics
- Maintenance Requirements
- Traveling Requirements
- Attended Vehicle Requirements: Operation
- Attended Vehicle Requirements: Pedestrians
- Requirements for Unattended Vehicles
- Loading Requirements
- PIT Requirements
- Principles of Stability
- Weight and Distance
- The Stability Triangle and Center of Gravity
- Vertical Stability Line and Load Center
- Vertical Stability Line Movements
- Longitudinal Stability
- Balance and Stability
- Calculating Longitudinal Stability
- Lateral Stability
- Maintaining Lateral Stability
- Dynamic Stability
- Final Review

Class Objectives

- Describe powered industrial trucks.
- Describe regulations for operating powered industrial trucks.
- Describe the primary classifications of powered industrial trucks.
- Describe OSHA's training requirements for powered industrial truck operators.
- Describe OSHA's maintenance requirements for powered industrial trucks.
- Describe OSHA's traveling requirements for powered industrial trucks.

- Describe attended vehicle operation requirements that protect operators.
- Describe attended vehicle operation requirements that protect pedestrians.
- Define unattended vehicle. List operation requirements for unattended vehicles.
- Describe OSHA'S primary loading requirements for PITs.
- Identify the factors that influence vehicle stability.
- Describe how distance and weight both affect stability.
- Define stability triangle. Explain center of gravity.
- Identify the vertical stability line and the load center.
- Describe the relationship between the vertical stability line and the load center.
- Describe how to maintain longitudinal stability.
- Calculate maximum allowable load weight for maintaining longitudinal stability.
- Describe how to maintain lateral stability.
- Describe how to maintain dynamic stability.

Class Name: Quality and Customer Service 175

Description: 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.

Difficulty: Beginner

Class Outline

- Quality and Customer Service
- Quality Systems and Standards
- ISO 9001
- Statistics
- Probability
- Statistical Control Methods
- Metrology
- Calibration and Traceability
- Capability Analysis
- Acceptance Sampling
- Problem Analysis and Solving
- Factor Analysis
- Inspection and Validation
- Reliability Analysis
- Continuous Improvement
- Customer and Field Service
- Summary

Class Objectives

- Describe quality assurance.
- Distinguish between the MBNQA and ISO 9000.
- Describe ISO 9001.
- Describe statistics.
- Describe probability.
- Explain statistical process control.
- Distinguish between types of measuring error.
- Describe calibration.
- Calculate process capability.
- Describe acceptance sampling.
- Distinguish between methods of problem analysis.
- Describe factor analysis.
- Distinguish between types of inspection.
- Describe reliability analysis.
- Describe principles of continuous improvement.
- Describe customer and field service.

Class Name: Quality Overview 111

Description: "Quality Overview" provides a comprehensive introduction to the importance of quality and how to achieve it in both processes and products. A quality organization meets the needs of both internal and external customers. To do this, all the departments of an organization must work together and be equally focused on quality. Organizations use various methods, such as quality management systems and quality standards to ensure quality.

After completing this class, users will have a greater understanding of how each department of an organization plays a role in achieving quality as well as common approaches to improving quality. This knowledge helps emphasize the importance of quality and prepares users to learn more about specific quality management methods so that they can help contribute to quality efforts. This leads to cost reduction and improved organizational success.

Difficulty: Beginner

Class Outline

- The Importance of Quality
- Quality Products and Processes
- Internal and External Customers
- Quality Organizations
- Review: Quality Introduction
- Quality and Engineering
- Quality and Purchasing
- Quality and Production
- Quality and Sales
- Review: Quality Across Organizations
- Quality Management Systems and Standards
- Lean
- Six Sigma
- Total Quality Management
- Review: Quality Management

Class Objectives

- Describe the importance of quality.
- Describe quality in products and processes.
- Distinguish between internal and external customers.
- Describe traits of an organization committed to quality.
- Describe the role of engineering in quality.
- Describe the role of purchasing in quality.
- Describe the role of production in quality.
- Describe the role of sales in quality.
- Describe quality management systems and standards.
- Describe lean manufacturing.
- Describe Six Sigma.
- Describe total quality management.

Class Name: Safety for Electrical Work 111

Description: "Safety for Electrical Work" provides an overview of the risks of working with electricity, as well as safety precautions. Electricity can cause shock, burns, and fires. Electric shock occurs when current passes through a person's body. Overheating electrical components can cause burns and fires. To prevent electrical injuries, circuits and components must be properly grounded and maintained and employees must observe lockout/tagout practices and wear the appropriate personal protective equipment.

Employees must understand and practice precautionary and preventative measures in order to safely and effectively work with electricity. After completing this course, users will be able to describe the best practices for maintaining safety and preventing injury while working with electrical systems.

Difficulty: Beginner

Class Outline

- Electrical Safety
- The Three-Stage Safety Model
- Electricity Basics
- Conductors and Insulators
- Amperage, Voltage, and Resistance
- Electricity Basics Review
- Electric Shock
- The Effects of Electric Shock
- Burns Caused by Electricity
- Electrical Fires
- Electric Shock, Burns, and Fires Review
- Grounding
- Common Grounding Practices
- Chassis Grounds
- Lockout/Tagout
- Personal Protective Equipment
- Personal Protective Equipment for the Eyes and Ears
- Personal Protective Equipment for the Head and Body
- Grounding Practices and Safety Precautions Review

Class Objectives

- Describe the importance of following electrical safety standards and practices. List the organizations and texts that govern electrical safety.
- Describe the three-stage safety model.
- Describe the basic principles of electricity.
- Describe conductors and insulators.
- Describe electrical variables.
- Describe electric shock.
- Describe the effects of electric shock.
- Describe the different burns caused by electricity.
- Describe electrical fire causes and prevention.
- Describe grounding.
- Identify wires in a basic grounded circuit.
- Describe a chassis ground.
- Describe lockout/tagout procedures.

Appendix B: Tooling U-SME, Skills Definitions

- Describe the guidelines to follow when using PPE for electrical work.
- List the different pieces of PPE for the eyes and ears.
- List the different pieces of PPE for the head and body.

Class Name: Troubleshooting 181

Description: “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.

Difficulty: Beginner

Class Outline

- What Is Troubleshooting?
- Troubleshooting Teams
- The Root Cause
- The Root Cause: In Action
- Deviations and Problems
- Identifying Early Warning Signs
- Troubleshooting Review
- Gathering Data
- Troubleshooting Tools: Check Sheets
- Troubleshooting Tools: Cause and Effect Diagrams
- Troubleshooting Tools: Pareto Charts
- Troubleshooting Tools: 5 Why
- 5 Why: In Action
- Troubleshooting Tools: Brainstorming
- Troubleshooting Tools Review
- Prioritizing Solutions
- Testing for Long-Term Solutions
- Prioritizing and Testing Solutions: In Action
- The Importance of Documentation
- Procedures for Documentation
- Advantages and Challenges of Standard Troubleshooting Procedures

Class Objectives

- Define troubleshooting.
- Describe troubleshooting teams.
- Define root cause.
- Distinguish between deviations and problems.
- Describe common early warning signs.
- Describe the purpose of collecting troubleshooting data.
- Describe the uses of a check sheet for gathering data.
- Describe the uses of cause and effect diagrams. Identify the different categories in 5 Ms and 1 P.
- Describe the uses of a Pareto chart.
- Describe the 5 Why technique.

Appendix B: Tooling U-SME, Skills Definitions

- Describe the process of brainstorming.
- Describe rationales for prioritizing solutions.
- Describe the purpose of testing solutions.
- Describe the importance of documentation.
- Describe procedures for documentation.
- Describe advantages and challenges with standard troubleshooting procedures.

Class Name: Units of Measurement 112

Description: 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.

Difficulty: Beginner

Class Outline

- The English System
- The Metric System
- Common Base Units
- Derived Units
- The English System: Length
- Converting from Inches to Feet
- English Units of Length: Sample Problems
- The Metric System: Length
- Converting Metric Units of Length
- Converting Length Between English and Metric
- Converting Length from Feet to Meters and Centimeters to Inches
- Converting Length from Metric to English
- Area
- Volume
- Mass and Weight
- Converting Between Metric and English Derived Units
- Conversion Problems

Class Objectives

- Identify common units in the English System.
- Identify common units in the Metric System.
- List common base units of measurement.
- Describe derived units.
- List common units of length for the English System.
- Convert length measurements within the English System.
- List common units of length for the Metric System.
- Convert length measurements within the Metric System.
- Explain how to convert length measurements between English and Metric.
- Explain how to convert length from feet to meters and centimeters to inches.
- Describe the characteristics of area.
- Describe the characteristics of volume.
- Describe the characteristics of mass and weight.
- Explain how to convert between Metric and English derived units.
- Convert between English and Metric measurements.

Class Name Blueprint Reading 131

Description 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.

Difficulty Beginner

Class Outline

- Blueprints
- Orthographic Views
- Auxiliary Views and Section Views
- Types of Section Views
- Section View Types Review
- Object Lines and Hidden Lines
- Center Lines
- Dimension Lines and Extension Lines
- Phantom Lines, Leader Lines, and Break Lines
- Cutting Plane Lines and Section Lines
- Line Types Review
- Blueprint Dimensions
- Types of Dimensions
- Tolerances
- Notes: Title Blocks and Change Blocks
- Notes: Scale and Tolerance
- Final Review

Class Objectives

- Describe blueprints.
- Describe orthographic views.
- Distinguish between auxiliary views and section views.
- Distinguish between types of section views.
- Distinguish between object lines and hidden lines.
- Describe center lines.
- Distinguish between dimension lines and extension lines.
- Describe phantom lines, leader lines, and break lines.
- Describe cutting plane lines and section lines.
- Describe blueprint dimensions.
- Distinguish between types of dimensions.
- Describe tolerances.
- Describe the title block and change block.
- Explain scale and tolerance information in the notes section.