NORTH CAROLINA MANUFACTURING CERTIFICATION PROGRAM

North Carolina Community College System

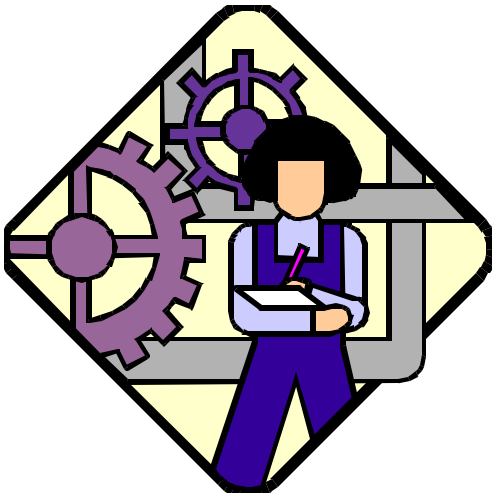
January 2001

Program recommended by:

NCCBI

CENTER FOR Workforce Success
The Manufacturing Institute

NAM National Association of Manufacturers



North Carolina Manufacturing Certification Program

The North Carolina Manufacturing Certification Program is a unique new training program, offered through North Carolina's community colleges, designed to provide North Carolinians with enhanced career opportunities in manufacturing, and to provide North Carolina's manufacturers with a world-class workforce. It was developed utilizing industry-based skill standards and national certification programs, manufacturing skill surveys, and interview feedback from representatives of leading North Carolina manufacturing companies. The program has garnered the recommendation of the National Association of Manufacturers' Center for Workforce Success, and the North Carolina Citizens for Business and Industry.

The Manufacturing Certification Program consists of both a ***Level I*** *fundamentals program, and* ***Level II*** *industry-specific programs. The* ***Level I: Fundamental Skills*** *program provides successful completers with a solid base of fundamental manufacturing knowledge, and preparation to further develop industry-specific skills. The* ***Level II: Industry-Specific Skills*** *programs offer participants the opportunity to obtain more advanced skills in specific industry or manufacturing skills disciplines, as well as preparation to obtain industry-recognized skill certifications.*

The ***Level I: Fundamental Skills*** *program is an approximate 96-hour training program consisting of four core courses and four electives:*

Core Courses

- Manufacturing Concepts
- Measurements and Math
- Teamwork and Communications
- Problem Solving

Electives

- Statistical Process Control
- Blueprint Reading
- The Business of Manufacturing
- Computers in Manufacturing

*The **Level I: Fundamentals** program introduces trainees to the basic concepts of manufacturing by emphasizing the importance of quality and its role in company profitability and job sustainability. To successfully complete the Fundamentals program and receive recognition of successful completion, a participant must complete all four core modules and two of the four electives with an 80% assessment score or higher.*

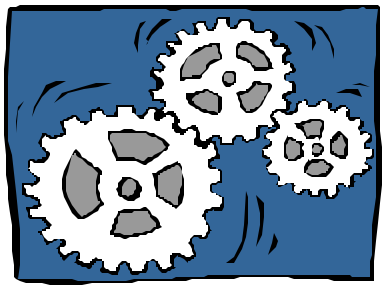
*The Level I program provides preparation for **Level II: Industry-Specific** programs currently under development in the areas of:*

- Metals
- Plastics
- Textiles
- Electronics

Wherever possible, these Level II programs offer participants the preparation to sit for industry-recognized skill certification exams.

For more information on the North Carolina Manufacturing Certification Program, contact:

Rick Kimrey, Sr. Customized Training Director 336/386-9062



LEVEL I: FUNDAMENTAL SKILLS INTRODUCTION

Have you ever bought a new pair of shoes and found that the stitching in one area became frayed and loose after just a few days of wear, or retiled a floor and discovered that some of the pieces were slightly off-color from the rest, or been inconvenienced by a car door that sticks and is difficult to open? These and countless similar events that we have all experienced are the result of poor quality.

"Quality" means that a product meets the customer's needs:

- The product performs to serve a function (we start, accelerate, steer, and brake an automobile as we drive it from work);
- The product performs that function reliably (the automobile starts each day and performs well over a long period of time);
- The product looks and feels good (the automobile's finish is unblemished, the controls are easy to reach, there are no rattles, the "feel" is solid).

Each of these aspects of quality is built into the product by *design* and by *manufacturing*. A product is designed to meet the needs of the customer – quality is *defined by the design specifications*. Manufacturers must then produce the goods to meet these specifications - quality is *achieved by manufacturing*.

Achieving quality by manufacturing requires careful attention to all operations:

- production machines can lose their settings (corrected by adjustment and preventive maintenance);
- tools can wear (corrected by refurbishment or replacement);
- incoming materials can be defective (screened by inspection);
- machine operators and assemblers can make mistakes (corrected by carefully following instructions).

The actions of each of us affect the quality of the final product, whether we produce the materials used in its parts, form the individual parts of the product, assemble the parts, apply a finish to the product, inspect and package the product, or maintain the machines that perform each of these operations. The importance of focusing on quality by each individual cannot be overemphasized, and has a very strong personal element for each of us involved in manufacturing. In short, no quality means no sales; no sales mean no profits; no profits means no jobs.

This series of courses for ***Level I: Fundamental Skills*** of the ***Manufacturing Certification Program*** will introduce participants to the basic concepts of manufacturing, including a focus on safety, measurements, math, teamwork and communications, and problem solving. In addition, participants have the opportunity to learn about manufacturing economics, and/or develop skills in blueprint reading, statistical process control, or computer use.

Manufacturing Concepts

Manufacturing involves the transformation of materials into parts, and parts into finished products. Working in manufacturing, a person may be involved in making the metal, glass, paper, or plastic that is used to form the parts of the final product. They may be involved in making the parts from these materials, or assembling the parts into the final product. On the other hand, they may finish the product by painting or polishing, or package the product for shipment. In any case, they will be using machines, tools, and procedures to do their job.

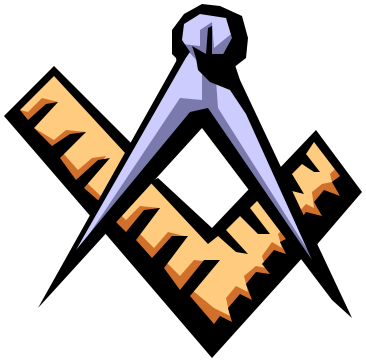
In this course, we will focus on the cost factors in manufacturing and how poor quality reduces the profits of a manufacturer. Special attention will be paid to safe work practices in a manufacturing environment, and participants will be introduced to the types of machines and equipment commonly found at manufacturing workplaces. Quality standards and safety concerns define proper operating procedures, so attention will also be given to issues such as proper preventive maintenance and the importance of reading and following instructions in the operation of machines.

Concepts introduced: quality, value added, profit, revenue, fixed costs, variable costs, equity, scrap, productivity, materials, material quality, metals, plastics, ceramics, personal protective equipment, housekeeping, hazard communications, material safety data sheets, machines, ergonomic principles, machine guarding, lockout/tagout, electrical safety, heating, coating, joining, mechanization, automation, standards, ISO 9000, OSHA standards and laws.

Manufacturing Concepts
Objectives

In a test concluding Manufacturing Concepts, successful learners will be able to state, recognize, recall, name, identify, define, list, or distinguish the following:

1. Quality and its role in manufacturing
2. Learning styles and their characteristics
3. Value added
4. Profitability concepts and accounting terms
5. Impact of quality, safety, and productivity on profit
6. Continuous process, safety, and product improvement
7. Material, machine, and people variables
8. Ways in which machines change materials
9. Preventive maintenance
10. Mechanization, automation, and computerization
11. People problems that affect quality
12. Safe work practices and related requirements, including
    - Lockout/Tagout
    - Hazard Communication
    - Material Safety Data Sheets
13. Safety and quality standards and governing bodies, including
    - OSHA
    - ISO
    - UL



Measurements and Math

Designers determine the specifications of a product and its parts (materials, shapes, weights, and dimensions) so that the product functions properly, performs reliably, and looks and feels good, i.e., has high quality. These design specifications are given in definite numerical terms, and manufacturing must produce the products to these numerical values. For example, the diameter of an engine piston may be specified as 2.755 inches, plus or minus 0.002 inches. If the piston is manufactured above this value, it will not fit into the cylinder of the engine; if the piston is manufactured below this value, it will be too loose and not contain the combustion that makes the engine function properly. Likewise, the piston material must be a specific steel alloy with definite numerical values of strength and hardness so that the piston doesn't break due to the repeated impact of combustion in the cylinder. Meeting these design specifications in manufacturing requires that we are able to set numerical values on machine controls, read numerical values on measuring instruments, and interpret numerical values on charts and graphs.

In this course, we will examine the tools commonly used for measurement tasks in manufacturing, and the systems of units for such measurements. In addition, we will develop basic math and computation skills so that we can manage the numbers from measurements and machine settings. Finally, we will learn to read charts and graphs, which are convenient ways to represent large amounts of numbers.

Concepts introduced: scales, gauges, readouts, linear measurements, steel rule, micrometer, caliper, variation, tolerance, addition, subtraction, multiplication, division, fractions, decimals, percents, metric measurement, ratios, estimating, bar graphs, pie charts, process flow charts, run charts.

Measurements and Math
Objectives

In a test concluding Measurements and Math, successful learners will be able to state, recognize, recall, name, identify, define, list, or distinguish the following:

1. Basic types of manufacturing measurements
2. Various types of readouts
3. Measuring devices common to manufacturing and their uses
4. Product variation and tolerance and their impact in manufacturing
5. Purposes and techniques of:
    - Addition
    - Subtraction
    - Multiplication
    - Division
    - Averages
    - Fractions
    - Decimals
    - U.S. Measurement System
    - Metric Measurement System
    - Ratios
    - Percents
    - Estimates
6. Purposes and uses of flow, run, and pie charts and bar graphs

Teamwork and Communication

Quality is the responsibility of everyone in a manufacturing organization, and each individual must contribute through his or her own efforts. At the same time, modern manufacturing operations are complex, involving several interconnected systems, and cooperation among all members of the operation is a must. Many times, collaboration among multiple individuals is required to solve complex problems or perform complex functions. Cooperation requires clear communication among all members involved so that team approaches to problem solving, decision making and quality improvements can be made quickly and easily.

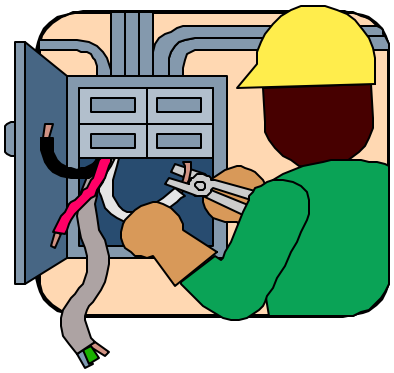
In this course, we will focus on individual and team behaviors in the workplace for effective quality management and productivity. We will emphasize reading, listening, writing, and speaking skills for improved two-way communications among team members. In addition, we will discuss the techniques for avoiding and resolving conflicts arising in team interactions, and practice following both verbal and written instructions.

Concepts introduced: team building, forming, storming, norming, performing, team success factors, conflict resolution, nonverbal communication, active listening, reading comprehension, effective speaking, following directions.

Teamwork and Communication
Objectives

In a test concluding Teamwork and Communication, successful learners will be able to state, recognize, recall, name, identify, define, list, or distinguish the following:

1. Team and teamwork
2. Stages of team development
3. Team member roles
4. Characteristics of an effective team
5. Conflict and ways to help reduce or resolve it
6. Team success factors and accountabilities
7. Successful communication
8. Influences on communication of:
    - Perception
    - Non-verbal behavior
    - Listening
    - Responding
    - Reading
9. Following and providing directions
10. Preparing and making effective presentations



Problem Solving

In the normal course of manufacturing operations, problems arise that interfere with our ability to continue to produce materials, parts, or products with high quality. One of our machines may break or one of our operators may become sick and have to leave his or her post, causing a backup in flow of parts on one production line. Or, our supply of shipping containers may be depleted and we will need to temporarily store the finished products without damaging them until more shipping containers arrive. Sometimes the thickness of a part produced by a forming machine may suddenly go beyond its allowed numerical limit because of a malfunction of the machine, and the parts have to be scrapped. These and a myriad of other problems may confront manufacturers every day, and the problems must be solved quickly so that quality production can be restored.

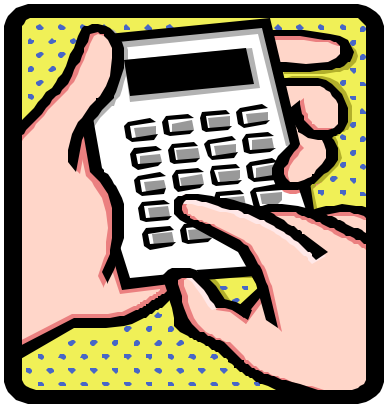
In this course, we will emphasize a seven-step process for effective manufacturing problem solving. In addition, we will introduce tools and techniques for problem solving to address the types of situations that arise in a manufacturing environment. Brainstorming, for example, will be used to identify the problem and possible causes, suggest alternative solutions, and then recommend the best approach to solving the problem.

Concepts introduced: problems and their impact, the 7-step problem-solving process, problem definitions, prevention, team approach to problem solving, data, check sheets, process maps and flow charts, brainstorming, cause-and-effect diagrams, and five why's technique

Problem Solving
Objectives

In a test concluding Problem Solving, successful learners will be able to state, recognize, recall, name, identify, define, list, or distinguish the following:

1. Impacts of problems in manufacturing
2. Seven-step problem-solving technique:
    - Define the problem
    - Study the process
    - Find the root cause
    - Develop the solution
    - Implement the solution
    - Review and evaluate results
    - Follow up
3. Problem-solving tools:
    - Check sheets
    - Process maps
    - Brainstorming
    - Cause-and-effect diagrams
    - Five why's



Statistical Process Control

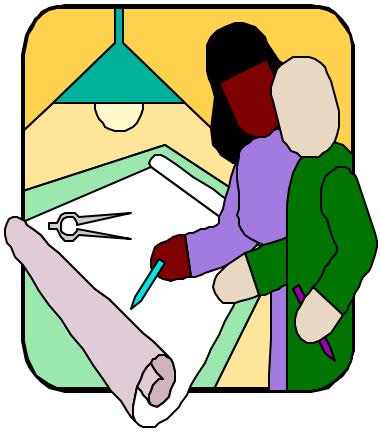
Maintaining quality requires knowing when variations occur that are outside of allowable limits. Statistical methods allow us to collect, classify, present, and interpret numbers. They are tools that we need to make accurate and reliable predictions about numerical data. This course provides a basic understanding of statistical methods to enable someone to make accurate manufacturing decisions based on reliable data. The concepts of variation and probability are emphasized, with discussion of natural and unnatural variation, and expected and actual occurrences.

Concepts introduced: variation, probability, histogram, normal distribution, standard deviation, range, quality, control charts, X-R charts, p charts.

Statistical Process Control
Objectives

In a test concluding Statistical Process Control, successful learners will be able to state, recognize, recall, name, identify, define, list, or distinguish the following:

1. Variation (natural and unnatural)
2. Probability
3. Expected occurrences and actual occurrences
4. A histogram
5. The normal distribution curve
6. How the area under the normal curve is divided into standard deviations, or “sigma” units
7. Mean and range
8. Standard deviation
9. The definition of quality
10. The importance of the customer in defining quality
11. Statistical process control and improving quality
12. The relationship between the distributions of individuals and sample averages
13. The control chart
14. The central line and the difference between control limits and specification limits
15. The power of the control chart
16. Process capability studies
17. Variables and attributes
18. X/bar and R charts, p charts
19. The pattern of points that shows the presence of a normal distribution
20. The three characteristics of control charts that show process control
21. The five signs that show a process may be out of control



Blueprint Reading

A product is designed to meet the needs of the customer, and therefore, quality is defined by the design specifications. Manufacturing workers must then produce the goods to meet the design specifications, so therefore, quality is achieved by manufacturing. Understanding design specifications often requires a working knowledge of blueprint reading. This course enables participants to learn the basics of reading an engineering drawing or blueprint, with focus on line drawings and special part features and configurations.

Concepts introduced: title block, features, dimensions, scale drawings, fractional and decimal dimensions, diameter, angle, section drawings, undercuts and grooves, rounds and fillets, chamfers, tapers, beveled surfaces, knurls, slots, keyways and flats, bosses, pads, finishing marks, holes, threads.

Blueprint Reading
Objectives

In a test concluding Blueprint Reading, successful learners will be able to state, recognize, recall, name, identify, define, list, or distinguish the following:

1. Basic information in the title block
2. Different projections or views shown on a blueprint
3. Basic part characteristics from the views shown
4. The various types of lines on the object
5. The purpose of common part features
6. The two types of dimensions: dimensions of size and dimensions of location
7. The difference between fractional and decimal dimensions
8. Tolerances
9. Dimensions of diameter and angle
10. The scale used in a drawing
11. Full-section and half-section drawings
12. Part materials in section drawings
13. Undercuts, grooves, rounds, fillets, chamfers, tapers, beveled surfaces, knurls
14. Slots, keyways, flats, bosses, pads, finishing marks
15. Pitch diameter, major diameter, minor diameter, straight threads, tapered threads, thread forms, thread callouts

The Business of Manufacturing

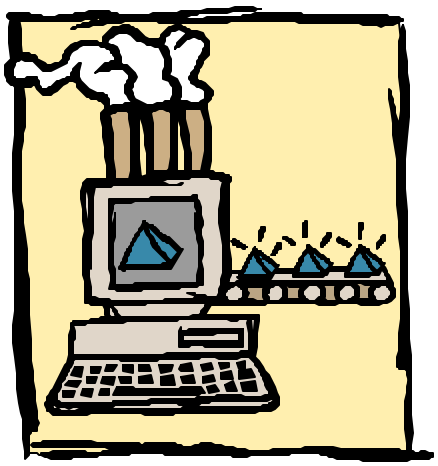
Bluntly speaking, no quality means no sales, no sales means no profits, and no profits means no jobs. The ultimate goal of any manufacturing company is to make a profit, which leads to jobs for employees and returns for stockholders. It is very helpful when all employees in the organization understand the big picture of how their company makes money, and the factors that influence how much money the company makes. It is very important for everyone in the company to understand the influence their specific actions and decisions play in the ultimate profitability of the company. This course communicates the importance of understanding manufacturing as a business, and presents basic business concepts using decision-oriented exercises built around a fictitious company, The Yo-Yo Company. The program was developed specifically for the North Carolina Community College System by *The Great Game of Business*, a training subsidiary of Springfield Remanufacturing Company that is recognized as a national model of the benefits of manufacturing-based economic literacy training.

Concepts addressed: types of business, types of business organizations, the basic accounting equation, recording tools, income statements, balance sheets, cash flow statements, cost of goods sold, inventory valuation, manufacturing cost terms, costing systems, planning and budgeting, variance analysis

The Business of Manufacturing
Objectives

In a test concluding Business of Manufacturing, successful learners will be able to state, recognize, recall, name, identify, define, list, or distinguish the following:

1. Characteristics of different types of business organizations, including proprietorships, partnerships, and corporations
2. The basic accounting equation
3. Asset, liability, and equity
4. The difference between income and expense
5. The differences between account, chart of accounts, general ledger, and journal
6. Materials, work in process, and finished-goods inventory
7. Elements that make up cost of goods sold (COGS)
8. Importance of variance analysis
9. Benefits of budgeting
10. The difference between cash flow and profit
11. The difference between cash and accrual accounting



1.

Computers in Manufacturing

Like many elements of society, computers are revolutionizing manufacturing workplaces. Through mechanization, computers enable mechanized processes to replace those formerly performed by hand. Through automation, computers enable machine operations to be self-controlled. And through computer controls, machines can be easily programmed to produce individual parts that differ from one another. More and more, producing quality manufacturing products requires workers who are comfortable and familiar with computers. This course provides an introduction to computers and basic computer applications. Participants have the opportunity to replicate a manufacturing document using word processing and spreadsheet software. The course also provides a special focus on the role of computers in different aspects of manufacturing, including design, production, quality control, and inventory control.

Concepts introduced: hardware, software, monitor, keyboard, mouse, central processing unit, microprocessor, memory, storage, peripherals, modem, network, server, operating systems, business applications, Internet, e-commerce, design, computer-aided drawing, prototyping, validation, simulation and modeling, manufacturing planning, computer-integrated manufacturing, materials requirements planning, computer-aided manufacturing, facility-management systems, Manufacturing Automation Protocol, computer numerical control, computer-controlled machinery, computer-assisted quality control, robotics, programmable logic controllers, human-machine interface, inventory control and distribution.

Computers in Manufacturing
Objectives

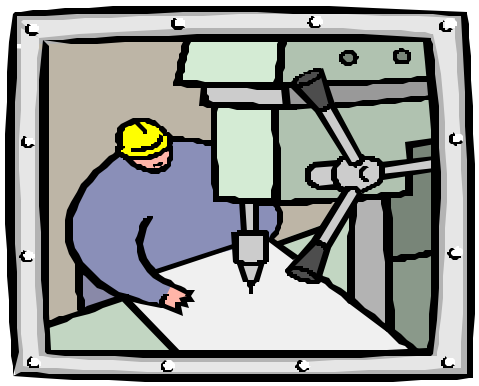
In a test concluding Computers in Manufacturing, successful learners will be able to state, recognize, recall, name, identify, define, list, or distinguish the following:

1. Basic computer functions
2. Personal Computer
3. Hardware, software, and data
4. Computer components
   - Monitor
   - Keyboard
   - Mouse
   - Central Processing Unit (CPU)
   - Microprocessor
   - Memory
   - Memory Capacity
   - Storage
   - Peripherals
5. Computer operating systems
   - MS-DOS
   - Windows
   - MAC-OS
   - UNIX
6. Computer business applications
   - Word processing
   - Presentations
   - Spreadsheets
   - Databases
   - E-mail
   - Internet
   - Electronic commerce
7. Computer manufacturing applications
   - Design
   - Document Control
   - Planning
   - Inventory Control
   - Processes
   - Inspection
   - Quality Control
   - Assembly
   - Distribution

LEVEL II: Industry-Specific Programs

Currently in various stages of development, Level II: Industry-Specific programs are designed to build upon the prerequisite knowledge of the Level I: Fundamental Skills program, and provide participants with deeper skills and knowledge in industry sectors key to North Carolina's manufacturing economy. All Level II programs are based upon national skill standards, certification requirements, and/or criteria and standards specified through feedback from leading North Carolina manufacturing companies. Specific colleges with well-regarded programs in each industry area have taken responsibility for developing the Level II programs, and eventually will provide train-the-trainer opportunities for trainers at colleges throughout the state.

(Note: The Level II: Textiles program is provided by the Center for Advanced Textile Technologies in partnership with local community colleges).



LEVEL II: METALS

The Level II: Metals program is an approximate 48-hour training program that provides metals-specific training in advanced measurement, safety, layout and tooling. The program was developed by the Piedmont Triad Center for Advanced Manufacturing (PTCAM) in partnership with Guilford Technical Community College. PTCAM, a state-sponsored non-profit and partner of North Carolina's community colleges, is recognized as a national leader in skill standards-based metals-manufacturing training.

Once trainees have successfully completed the Level I: Fundamental Skills program, the Level II: Metals program prepares them to take the certification exams from the National Institute of Metalworking Skills (NIMS) in *Material, Measurement*, *and Safety* and *Job Planning, Benchwork, Layout*, and pursue further advanced training in CNC and other metals-manufacturing skills.

LEVEL II: TEXTILES

The Level II: Textiles program was developed and is provided by the Center for Advanced Textile Technologies, the 59th institution of the North Carolina Community College System located in Belmont, North Carolina. The program was developed based on standards and criteria set forth by an advisory panel made up of North Carolina's leading textile manufacturers. The Level I: Fundamental Skills program serves as a prerequisite to certification programs in the following areas:

Introduction to Textile Technology

- quality control, fiber science, physical testing, preventive maintenance, legal issues

Yarn Manufacturing

- textile fundamentals, fiber science, physical testing, draft, twist, quality, and waste control, energy basics, yarn manufacturing calculations, air handling

Weaving Technology

- warp preparation, weaving principles, jacquard weaving, fabric quality, weave-room calculations, preventive maintenance

Knitting

- fundamentals of textiles, fiber science, physical testing, quality control, preventive maintenance, knitting technology, line-fixer training

Wet Processing

- fundamentals of textiles, fiber science, color development, preparation, dyeing theory, dye classification, finish technology, cost improvement, AATCC test methods, calculations for wet processing

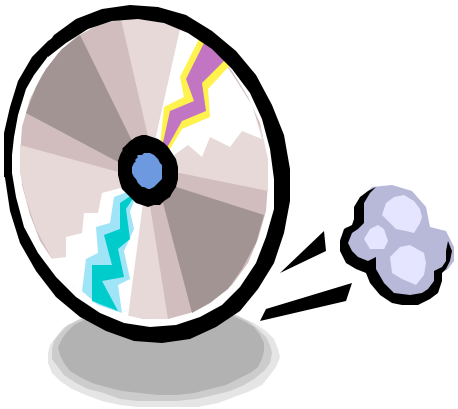
Physical Testing

- fundamentals of textiles, fiber science, math/textile calculations, fiber and yarn testing, quality control

Textile Industrial Maintenance

- preventive maintenance, basic mechanics, welding techniques, basic electricity

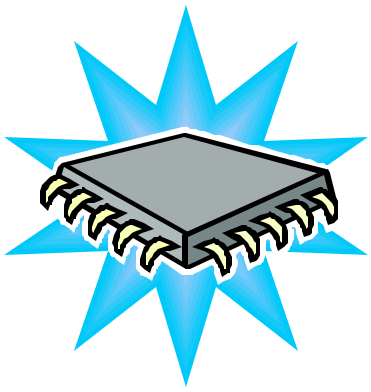
For more information on the Level II: Textile Manufacturing Certification Programs, contact Dr. Jim Lemons, Director, Center for Applied Textile Technology 704/825-3737



LEVEL II: PLASTICS

The Level II: Plastics program was initiated through a partnership between Asheville-Buncombe Technical Community College and the Mountain Area Workforce Development Board, and is currently being further developed and refined by Davidson County Community College. The program is being designed to prepare trainees to successfully qualify for the national plastics certification through the Society of Plastics Industries.

Building on a prerequisite of the Level I: Fundamental Skills program, the Level II: Plastics program will provide participants with 16 hours of additional general training in general plastics knowledge, quality assurance, tools and equipment and safety, and 12 hours of process core training in each of four areas: injection, extrusion, blow molding, and thermoforming. Training in the process core modules is followed by approximately 216 hours of process-specific training, including injection processes (molding machine components, plastic process variables, machine operation, and quality control), extrusion (machine components and operation, basic die design, downstream equipment, and process control and documentation), blow molding (extrusion, injection, and stretch blow-molding processes, basic equipment and operation, mold materials and construction, product quality control and documentation), and thermoforming (basic equipment and operation, process variables, starting materials, mold-making materials, process control and documentation).



LEVEL II: ELECTRONICS

The Level II: Electronics program is currently under development by Durham Technical Community College, a college with experience in providing electronics training to many of the nation's leading high-tech companies.

In developing the Level II: Electronics program, which will also utilize the Level I: Fundamental Skills program as a prerequisite, Durham Tech has surveyed over 70 leading North Carolina companies. The program is being designed based on national standards for electronics manufacturing, including those of the American National Standards Institute (ANSI), and the Institute for Interconnecting and Packaging Electronics (IPC).

ECONOMIC & WORKFORCE DEVELOPMENT

NORTH CAROLINA
COMMUNITY COLLEGE SYSTEM