

CNC Machinist (Level 1) Selection & Learning Program

Expected Technical Learning Outcomes (TLOs)

INTRODUCTION

The intent of the program is to prepare individuals to be CNC Machinists [Level 1] through a combination of classroom and direct on the job experience

- such that their level of performance at the end of the program is defined as being competent across a wide range of basic manufacturing and CNC sector and firm- specific practices and
- will be assessed as such by industry experts other than the firm where the participants were principally trained.

The purpose of this document is to outline the industry-agreed technical learning outcomes in terms of measurable competencies that define a competent level of performance for a CNC Machinist [Level 1].

The learning outcomes, to the degree possible, will be defined as competencies, not as job duties or tasks. Thus, the learning outcomes listed below are described as levels of performance, as capabilities and as the levels of knowledge required to perform required tasks.

Each of the learning outcomes has been defined in a precise fashion such that it can be assessed at the end of the program as part of a certification of technical competence. Where necessary, the definitions allow for interpretation to address specific sectors' various mixes of businesses and manufacturing processes and technology.

TECHNICAL LEARNING OUTCOMES FRAMEWORK

For purposes of clarity and analysis, a framework that categorizes each of the proposed/expected outcomes was developed.

The learning outcome framework categorizes the outcomes into three separate elements –

- The employee's capability to operate a CNC machine and produce completed product as per the work order or approved drawings, meeting all required quality standards and scrap standards – consistent and repetitive output is the goal. The employee will also be expected to be meeting efficiency standards at this point assuming the employee is producing regular production. Learning objectives in this section of the framework can be primarily assessed by visual inspection.
- The employee's knowledge of CNC specific technical work practices, such as blueprint reading, applied math concepts, tools and measurement concepts. While closely related to the objectives in the first component of the framework, learning objectives in this section of the framework can be primarily assessed by testing.
- The employee's knowledge of general manufacturing technical practices and procedures, that are applicable to all sectors of manufacturing. Learning objectives in this section of the framework can be primarily assessed by testing.

CNC MACHINE OPERATION

- 1] Capable of operating the machine and producing finished product for high volume/repetitive work or relatively simple unique, one-off jobs.
- 2] Capable of correctly completing the required set-up for either a range of high volume/repetitive work or relatively simple unique, one-off jobs, without supervision.
- 3] Can explain the operation of a CNC machine, and demonstrate knowledge of the interaction amongst the program, fixture and tool offsets on the outcome of the part.
- 4] Able to read and interpret part drawings and GD&T callouts correctly, without supervision. In terms of complexity, these drawings will not be of great or significant complexity.
- 5] Able to manually program correctly a CNC machine.
- 6] Able to operate more than one machine of the same type at the same time, in appropriate circumstances.
- 7] Demonstrates a working knowledge of programs including conversation and M&G codes by “reading” the program and knowing what action the machine intends to take thereby confirming the intended action.
- 8] Able to exercise judgment about modifying speeds, feeds, M&G codes to improve efficiency or to produce conforming parts.
- 9] Able to place and secure work on the machine correctly, efficiently without supervision.
- 10] Able to demonstrate general knowledge of the machining characteristics of the various materials commonly machined.
- 11] Able to demonstrate the correct selection of the most appropriate cutting tool for a variety of common cutting procedures and materials to be machined.
- 12] Reviews tools prior to their use, selects the most appropriate one to use, can determine if it is in a condition to be used for the application and, if not, is able to sharpen a variety of drills, not including carbide or refer the tool e.g. end mill to the shop foreman for assessment.
- 13] Able to demonstrate proficient use of measuring tools – choosing the correct one and its application.
- 14] Can demonstrate knowledge of tool holders by selecting the correct holder for a range of tools.
- 15] Able to use hand tools as required.
- 16] Able to demonstrate the correct use and handling of measurement instruments.

The specific machines that the employee has demonstrated capability on will be noted on the certificate.

CNC APPLIED TECHNICAL KNOWLEDGE COMPETENCIES

- 1] Passed the assessments in each of the CNC Applied Math, Tools, Blueprint Reading and Measurement units at both the classroom training and the on-the-job training phases of the program.

The required minimum level of knowledge at the completion of the program is listed below.

Applied Math: is able to correctly calculate and perform mathematical functions listed below and is knowledgeable of terminology:

Basic math – addition, subtraction, multiplication, division; statistics such as percentages and averages; basic geometry; basic trigonometry ; pitch circle diameters; speed/feeds; weights; graphs, including Cartesian coordinate system; addition and subtraction of positive and negative numbers; Imperial measurement and metric conversions

Tools: for the tools listed below is able to operate the tool safely and competently and knows its intended use.

- Types – Cutting, Hand, Holders, Inserts
- Material Handling – quality inspection of the material prior to beginning to machine, cleaning and deburring, orientation, part changes.

Blueprint Reading: is able to demonstrate knowledge of the following terms and how to read and interpret them correctly.

- Drawing representation
- 1ST and 3RD angle projection
- Title, supplementary, change blocks, revision blocks on drawings
- Implications of drawing notes/other operations
- Inch and metric prints
- Threads and thread nomenclature
- Surface finish callouts
- Geometric Dimensioning and Tolerances callouts
- Tolerances and dimensions
- Understanding datum points/callouts

Measurement: is able to demonstrate, using the instruments listed below, how to make the various measurements listed and in doing so correctly demonstrates the characteristics of handling

- Handling – maintenance, care,
 - zeroing
 - determining tolerance and accuracy
 - reading
- Types – reference, direct, internal/external, radius/diameter – external/internal, flatness, parallels, inch and metric
- Instruments – hand held – Vernier, micrometer, calipers, gauges such as “go/no go” gauges, thread gauges, radius gauges, bore gauges
 - Surface plates, standard height gauge, angle plates ,cylinder square
 - Gauge blocks, 5in sine bar
 - Dial indicator
 - Inspection pins
 - Bore gauges

GENERAL MANUFACTURING TECHNICAL KNOWLEDGE COMPETENCIES

- 1] Passed the Safety/WHMIS assessment and demonstrated an appropriate safety consciousness while at work.
- 2] Passed the assessments in each of the General Manufacturing Machines, Terminology, Materials, and Quality/SPC units at both the classroom training and the on-the-job training phases of the program.
- 3] Demonstrates a general knowledge of a variety of machines that are commonly used in manufacturing environments and of their intended uses.

The required minimum level of knowledge at the completion of the program is listed below.

Machines: for the machines listed below is able to operate the machine safely and competently and knows its intended use.

Manual/conventional lathes; drills; grinders; material handling lifts; manual/conventional mills; saws.

In this category, is included the knowledge of oils – all types commonly in use – as they are used for daily routine machine maintenance and preparation of coolants.

Terminology: for the words and phrases listed below is able to correctly define, understand and use correctly with fellow employees.

annealed; bill of materials/ BOM calibration; CAD; change order/request; chip load; engineering change order/notice; end mills; ERP; item; gun drill; heat treatment; hydraulic chucks; indicate [datum]; part name/number; mean/medium; redline; revision control; surface finishes; SKU; surface speed; tool setter; vendors/vices in line warp;

Materials: for the materials listed below is knowledgeable of their machining characteristics.

- Aluminum
- Mild steels and speciality steels
- Stainless Steel
- Copper/brass
- Titanium
- Bronze
- Cast iron
- Cast metals
- Machinable plastics

Quality/SPC: is able to explain the importance to a successful manufacturing firm of producing quality product and is knowledgeable of appropriate quality and SPC systems and processes.

- Quality – definition and importance of the concept; role of the worker; awareness of ISO
- Overview, application and terminology of SPC
- Control charts
- Sequencing of events and approvals