ONTARIO COLLEGE OF TRADES

ORDRE DES MÉTIERS DE L'ONTARIO

Apprenticeship Curriculum Standard

Industrial Mechanic (Millwright)

Level 3

Trade Code: 433A

Date: 2005

Please Note: Apprenticeship Training and Curriculum Standards were developed by the Ministry of Training, Colleges and Universities (MTCU). As of April 8th, 2013, the Ontario College of Trades (College) has become responsible for the development and maintenance of these standards. The College is carrying over existing standards without any changes.

However, because the Apprenticeship Training and Curriculum Standards documents were developed under either the *Trades Qualification and Apprenticeship Act* (TQAA) or the *Apprenticeship and Certification Act, 1998* (ACA), the definitions contained in these documents may no longer be accurate and may not be reflective of the *Ontario College of Trades and Apprenticeship Act, 2009* (OCTAA) as the new trades legislation in the province. The College will update these definitions in the future.

Meanwhile, please refer to the College's website (http://www.collegeoftrades.ca) for the most accurate and up-to-date information about the College. For information on OCTAA and its regulations, please visit: http://www.collegeoftrades.ca/about/legislation-and-regulations

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Introduction

The curriculum has been developed in keeping with the prescribed training standards of Workplace Training Branch, Ministry of Training, Colleges and Universities. The curriculum will allow for easy adaptation to the current reporting structures for the respective program phases and for alternate delivery formats.

For easy reference, a time allocation has been included for each respective unit, along with the Theory/Practical breakdown for the delivery of the performance outcomes.

The continual introduction of innovative techniques and more complex equipment is resulting in increasing demands for tradespeople who are not only skilled in the practical aspects of the trade, but who also have a sound theoretical knowledge of the requirements to inspect, diagnose, repair and service. The curriculum has been developed to provide this theoretical knowledge and to offer some practical applications to complement the on-the-job work experiences of the Industrial Mechanic (Millwright) apprentice.

The outcomes of the curriculum, therefore, are to provide a basis for:

a. sound theoretical training to meet the challenges presented by the increasingly more complex designs and testing techniques.

b. the acquisition of fundamental trade skills through exposure to practical applications.

c. developing in the apprentices high standards of craftsmanship, problem-solving skills and personal pride in their respective trades.

d. developing desirable work attitudes and a keen sense of responsibility, particularly in regard to public and personal safety.

The curriculum has also been designed to give the instructor every reasonable opportunity for flexibility and innovation, without unnecessary deviation from the course requirements (as determined by the Industry and as prescribed in the regulation for the trades). Since the scope of the prescribed curriculum is quite extensive, the apprentices will be expected to reinforce the acquired knowledge through regular, independent out-of-classroom assignments. In keeping with sound teaching methodologies, the curriculum has been presented in a chronological sequence. However, the actual application of the sequence may differ somewhat between colleges because of scheduling, staffing and utilisation of facilities.

The curriculum includes specific references to the training standards of Workplace Training Branch, Ministry of Training, Colleges and Universities. While the references to various terminal performance outcomes in the Training Standards have been linked to the respective in-school outcomes, employers should not assume complete coverage in all aspects of the outcome. The in-school delivery focuses primarily on the knowledge required to master the respective performance outcomes outlined in the Training Standards. Employers, therefore, are expected to complete the delivery of these respective outcomes by applying the prescribed in-school knowledge to the required practical learning experienced in the work setting.

To ensure that successful students will be able to satisfy the individual outcomes according to the performance criteria, specific times have been allocated in the respective areas to allow for some application enhancement. It is of utmost importance that all application assignments relate to prescribed experiences only. Time constraints will not permit engaging students in irrelevant tasks of limited learning benefits that are unrelated to the curriculum outcomes.

Regular evaluations of the apprentices' learning achievements must be performed in both theory and application throughout the program to assure consistency in learning outcome expectations.

Implementation Date:
September 2006

Summary of Total Program In-School Training Hours

Reportable Subjects	Total	Theory	Practical
1. Workshop Practice III	54	18	36
2. Machine Technology III	48	36	12
3. Fluid Power	81	53	28
4. Electrical & Electronic Controls III	24	20	4
5. Welding & Fabrication III	33	5	28
TOTAL	240	132	108

Number: 1

Title: Workshop Practice III

Duration: 54 Total Hours

Theory: 18 Hours Practical: 36 Hours

Prerequisites: Successful completion of Level II

Co-requisites:

1.1 – Mechanical Theory

15 Total Hours Theory: 15 Hours Practical: 0 Hours

1.2 – Machine Tools III & Work Project

30 Total Hours Theory: 0 Hours Practical: 30 Hours

1.3 – Machine Installation and Set-Up

9 Total Hours Theory: 3 Hours Practical: 6 Hours

1.1 - Mechanical Theory

Cross-Reference to Learning Outcomes:

4604.02, 4611.01, 4618.02

Duration: 15 Total Hours Theory: 15 Hours Practical: 0 Hours

General Learning Outcome:

To develop the apprentice's knowledge of the principles of applied mechanics and thermodynamics, as it pertains to the trade Industrial Mechanic (Millwright).

Learning Outcomes and Content:

Upon successful completion, the apprentice is able to:

1.1.1 Describe and apply the basic principles of applied mechanics, such as:

- mechanical advantage
- work
- power
- force
- torque
- efficiency
- levers
- moments
- friction
- potential
- kinetic energy

1.1.2 Describe and apply the basic principles of strength of materials, such as:

- composition and properties of materials
- stress and strain
- tension
- compression
- shear
- torsion
- stresses in beams and columns

1.1.3 Describe and apply the basic principles of thermodynamics, such as:

- heat transfer
- specific heat
- temperature coefficients
- thermal expansion
- latent heat
- conduction
- convection heat
- radiant heat

1.2 - Machine Tools III & Work Project

Cross-Reference to Learning Outcomes:

4604

Duration: 30 Total Hours Theory: 0 Hours Practical: 30 Hours

General Learning Outcome:

To develop the apprentice's ability to set up and operate shop equipment and tools to produce component parts to prescribed tolerances and standards; to use all shop equipment to complete a specific work project.

Learning Outcomes and Content:

Upon successful completion, the apprentice is able to:

1.2.1 Set up and operate conventional machine tools, such as:

- lathe
- milling machine
- surface grinder
- radial drill
- pedestal drill
- cut-off saw
- band saw

1.2.2 Set up and operate machine tool accessories including:

- three and four jaw chucks
- dividing heads
- face plates
- magnetic chucks
- taper turning attachments

1.2.3 Read and interpret drawings to produce components to prescribed tolerances.

1.2.4 Complete specific work project as required.

1.3 - Machine Installation & Set-Up

Cross-Reference to Learning Outcomes:

4605

Duration: 9 Total Hours Theory: 3 Hours Practical: 6 Hours

General Learning Outcome:

To develop the apprentice's knowledge about, and basic skill in, the use of precision measuring equipment as it pertains to machine installation and set up.

Learning Outcomes and Content:

Upon successful completion, the apprentice is able to:

1.3.1 Set-up and operate laser alignment equipment.

1.3.2 Set-up and operate optical levels and transits.

1.3.3 Maintain and store precision measuring devices.

1.3.4 Identify, select and use appropriate measuring devices to:

- align equipment
- establish datum lines
- establish reference points
- establish bench marks
- measure acute, obtuse and compound angles

1.3.5 Understand the basic principles of foundation preparation, such as:

- concrete foundations and grouting
- vibration isolation techniques
- anchoring, shimming and leveling

Evaluation Structure:

Theory Testing:	33 %
Application Experiences:	67 %
Final Assessment:	100 %

Instructional/Delivery Strategies:

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the eight-week term.
- Final exam at end of term.
- Periodic quizzes.

Number: 2

Title: Machine Technology III

Duration: 48 Total Hours

Theory: 36 Hours Practical: 12 Hours

Prerequisites: Successful completion of Level II

Co-requisites:

2.1– Material Handling Systems

12 Total Hours Theory: 8 Hours Practical: 4 Hours

2.2– Prime Movers & Ancillary Equipment

7 Total Hours Theory: 7 Hours Practical: 0 Hours

2.3– Fans & Blowers

5 Total Hours Theory: 5 Hours Practical: 0 Hours

2.4– Preventive & Predictive Maintenance

24 Total Hours Theory:16 Hours Practical: 8 Hours

2.1 - Material Handling Systems

Cross-Reference to Learning Outcomes:

4610

Duration: 12 Total Hours Theory: 8 Hours Practical: 4 Hours

General Learning Outcome:

To develop the apprentice's knowledge of the types and principles of operation of various material handling systems.

Learning Outcomes and Content:

Upon successful completion, the apprentice is able to:

2.1.1 Describe the principles and importance of correct site preparation.

2.1.2 Identify type, purpose and installation procedure for the following material handling systems:

- belt
- roller
- chain
- screw
- bucket
- air

2.1.3 Identify and select for specific applications:

- conveyor supports and trusses
- drive terminals and power drives
- pulley drives

2.1.4 Identify and select for specific applications:

- screw take-ups
- fixed tail end
- chain adjusted gravity take-up
- internal take-up
- telescoping take-up
- chain take-up

2.1.5 Describe and perform methods of belt splicing and fastenings for specific applications.

2.1.6 Describe and perform methods of aligning and tracking conveyor systems.

2.1.7 Identify type and describe the function and application of the following bucket elevators:

- centrifugal discharge
- continuous bucket
- super-capacity
- positive discharge

2.1.8 Identify type and describe the function and application of the following bucket elevator components:

- casings
- boot
- head
- chain
- belt

2.1.9 Identify type and describe the function and application of screw conveyors and their components to include:

- screws, type of flight and pitch
- troughs and covers
- hangers
- drive assemblies
- screw conveyor designations

2.1.10 Identify and describe the function and application of the following types of pneumatic conveyors:

- vacuum systems
- pressurized systems
- low, medium, high pressure systems

2.1.11 Identify and describe the function and application of the following pneumatic conveyor components:

- feeders
- blowers and fans
- regulating gates
- air slides
- blow tanks
- cyclones

2.1.12 Identify type and describe the function and application of the following roller conveyors:

- gravity roller
- live roller
- roller bed

2.1.13 Identify and describe the function and application of the following roller conveyor components:

- rollers
- belts
- roll cases
- drivers
- bearings
- roller curves

2.2 - Prime Movers & Ancillary Equipment

Cross-Reference to Learning Outcomes:

4613

Duration: 7 Total Hours Theory: 7 Hours Practical: 0 Hours

General Learning Outcome:

To develop the apprentice's knowledge of the types, applications and maintenance procedures of prime movers and ancillary equipment.

Learning Outcomes and Content:

Upon successful completion, the apprentice is able to:

2.2.1 Identify and describe types of prime movers including:

- steam turbines
- gas turbines
- water turbines
- internal combustion engines
- electric motors

2.3 - Fans & Blowers

Cross-Reference to Learning Outcomes:

4616

Duration: 5 Total Hours Theory: 5 Hours Practical: 0 Hours

General Learning Outcome:

To develop the apprentice's knowledge concerning the function of fans and blowers.

Learning Outcomes and Content:

Upon successful completion, the apprentice is able to:

2.3.1 Identify and explain the operation and function of fans and blowers for:

- ventilation
- cooling towers
- material handling
- induced and forced draft
- dust collection

2.4 - Preventive & Predictive Maintenance

Cross-Reference to Learning Outcomes:

4619

Duration: 24 Total Hours Theory: 16 Hours Practical: 8 Hours

General Learning Outcome:

To develop the apprentice's knowledge of procedures, equipment used, and the benefits that accrue from a preventive and predictive maintenance program.

Learning Outcomes and Content:

Upon successful completion, the apprentice is able to:

2.4.1 Describe vibration and how it affects the mechanical condition of rotating equipment.

2.4.2 Describe equipment monitoring techniques by:

- individual machine
- equipment routes or circuits
- alarm levels for each monitoring point

2.4.3 Understand and describe the characteristics of vibration:

- frequency
- displacement
- velocity
- acceleration
- bearing defect energy
- phase

2.4.4 Identify vibration characteristics of when to measure:

- velocity
- displacement
- acceleration
- bearing defect energy
- frequency related to r.p.m.

2.4.5 Identify and operate fixed and portable vibration measurement equipment and accessories, including velocity, acceleration and non-contact transducers.

2.4.6 Assess vibration severity by:

- using general vibration severity charts
- spectral signatures
- trending
- troubleshooting

2.4.7 Describe machinery maintenance programs:

- breakdown
- preventative (scheduled)
- predictive
- proactive

2.4.8 Identify the benefits of a predictive maintenance program which:

- prolongs machinery life
- minimizes unscheduled down time
- reduces maintenance costs
- reduces noise
- eliminates unnecessary overhauls and standby equipment
- improves the quality of performance, thereby improving safety

2.4.9 Identify the significance of recording equipment history (to maximize reliability and life span):

- maintenance data
- failure analyses findings
- outages

2.4.10 Describe methods of recording footprint/signature of machinery.

2.4.11 Describe/demonstrate proper preventive and predictive maintenance procedures for the lubrication of equipment by:

- ensuring that all equipment is pre-lubed before start-up
- monitoring/adjusting drip, constant, bath splash type lubrication systems
- installing the correct lubricant and filter for each application
- identifying proper sample point positioning to obtain a representative sample for oil analysis
- conduct oil analysis-moisture, fluoroscopic
- oil handling and storage

2.4.12 Identify and describe the use of non-destructive test equipment, such as:

- dye penetrant
- visual inspection
- magnetic particle (magnaflux)
- ultrasonics
- hydrostatic testing
- x-ray
- infrared thermal imaging/temperature measurement
- acoustic emission
- decibel meter

2.4.13 Describe basic computer concepts as they pertain to maintenance software programs.

2.4.14 Use computer software programs to administer, record, schedule and monitor predictive and maintenance activities, in conjunction with:

- vibration measurement (history, projected failure)
- equipment history (overhaul, spare parts)
- maintenance and shut down scheduling

2.4.15 Describe methods and procedures for start up and run-in ensuring that all safety devices, relief valves and lock-outs are installed and operational.

Evaluation Structure:

Theory Testing:	75 %
Application Experiences:	25 %
Final Assessment:	100 %

Instructional/Delivery Strategies:

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the eight-week term.
- Final exam at end of term.
- Periodic quizzes.

Number: 3

Title: Fluid Power

Duration: 81 Total Hours

Theory: 53 Hours Practical: 28 Hours

Prerequisites: Successful completion of Level II

Co-requisites:

3.1 – Pneumatic Systems

24 Total Hours Theory: 12 Hours Practical: 12 Hours

3.2 – Hydraulic Systems

57 Total Hours Theory: 41 Hours Practical: 16 Hours

3.1 - Pneumatic Systems

Cross-Reference to Learning Outcomes

4617

Duration: 24 Total Hours Theory: 12 Hours Practical: 12 Hours

General Learning Outcome:

To develop the apprentice's knowledge of the basic principles and applications of pneumatics and compressed air safety as it relates to pneumatic systems. To develop the apprentice's ability to identify, select and install pipe systems and valves for specific applications.

Learning Outcomes and Content:

Upon successful completion, the apprentice is able to:

3.1.1 Describe and apply safety procedures when working on pneumatic systems.

3.1.2 Describe the basic principles and applications of pneumatics.

3.1.3 Explain Boyle's Law and Charles' Law as they apply to pneumatics.

3.1.4 Read and interpret symbols for all pneumatic components using both ANSI and ISO systems.

3.1.5 Build and troubleshoot pneumatic systems using drawings and test instruments.

3.1.6 Identify and explain the operation of various types of cylinders:

- single and double acting
- single and double rod

3.1.7 Identify and explain the operation of various types of pneumatic motors.

3.1.8 Identify and explain the operation and function of various pressure control valves:

- unloading
- relief
- sequence
- pressure reducing

3.1.9 Identify and explain the operation and function of various directional control valves:

- sliding spool, poppet and rotary types
- two, three and four position
- two, three, four and five way valves
- different methods of actuation

3.1.10 Identify and explain the operation and function of various flow control valves and their method of operation:

- meter in
- meter out

3.1.11 Identify and explain the operation and function of the following types of pneumatic valves:

- quick exhaust
  and/or
- time delay

3.2 - Hydraulic Systems

Cross-Reference to Learning Outcomes:

4618

Duration: 57 Total Hours Theory: 41 Hours Practical: 16 Hours

General Learning Outcome:

To develop the apprentice's knowledge of basic hydraulic principles and the ability to perform pertinent hydraulic calculations, installations, maintenance and troubleshooting.

Learning Outcomes and Content:

Upon successful completion, the apprentice is able to:

3.2.1 Describe and apply safety procedures when working on hydraulic systems.

3.2.2 Define the following:

- Pascal's Law
- Bernoulli's Principle

3.2.3 Perform calculations and define the following hydraulic terms:

- pressure
- force/torque
- area
- cylinder speed/flow rate

3.2.4 Describe and apply the basic principles of fluid mechanics including properties of fluids, flow patterns, pipe losses and Bernoulli's Principle.

3.2.5 Read and interpret symbols for all hydraulic components using both ANSI and ISO systems.

3.2.6 Assemble and troubleshoot hydraulic systems using circuit drawings

3.2.7 Identify and explain the operation of the following types of cylinders:

- single and double acting
- single and double rod
- differential
- cushioned

3.2.8 Identify and explain the operation and function of the following types of hydraulic motors:

- vane
- gear
- axial piston
- fixed and variable displacement

3.2.9 Identify and explain the operation and function of the following types of check valves:

- in line
- right angle
- pilot to open
- pilot to close

3.2.10 Identify and explain the operation and function of the following types of pressure control valves:

- relief
- unloading
- counterbalance
- sequence
- pressure reducing
- back pressure
- brake

3.2.11 Identify and explain the operation and function of the following types of directional control valves:

- sliding spool, poppet and rotary
- two, three and four position
- two, three, four and five way
- servo and proportional
- solenoid, manual and pilot actuated
- open, closed, tandem and float centre

3.2.12 Identify and explain the operation and function of the following types of flow control valves and circuits:

- needle, restrictor, pressure and temperature compensated
- meter in
- meter out
- bleed-off

3.2.13 Identify and explain the operation and function of the following types of hydraulic pumps:

- gear
- vane
- reciprocating piston
- plunger
- axial piston
- bent axis
- radial piston
- fixed and variable displacement

3.2.14 Explain proper installation procedures.

3.2.15 Explain cavitation.

3.2.16 Identify and explain the operation and function of hydraulic intensifiers.

3.2.17 Identify and explain the operation and function of various types of hydraulic accumulators:

- weight
- spring
- gas

3.2.18 Explain the installation and charging procedures for gas accumulators.

3.2.19 Identify and explain the operation and function of heat exchangers in hydraulic systems.

3.2.20 Identify and explain the operation and function of various types of:

- filters
- strainers
- hydraulic reservoirs

3.2.21 Identify and classify various hydraulic fluids appropriate for different hydraulic circuits.

3.2.22 Identify and select the various sizes and types of piping, tubes and hoses available for specific hydraulic systems.

3.2.23 Identify and explain the following sealing components available for hydraulic piping:

- "O" rings
- quad rings
- compression fittings

Evaluation Structure:

Theory Testing:	65 %
Application Experiences:	35 %
Final Assessment:	100 %

Instructional/Delivery Strategies:

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the eight-week term.
- Final exam at end of term.
- Periodic quizzes.

Number: 4

Title: Electrical & Electronic Controls III

Duration: 24 Total Hours

Theory: 20 Hours Practical: 4 Hours

Prerequisites: Successful completion of Level II

Co-requisites:

4.1 – Electrical & Electronic Controls III

24 Total Hours Theory: 20 Hours Practical: 4 Hours

4.1 - Electrical & Electronic Controls III

Cross-Reference to Learning Outcomes:

4618

Duration: 24 Total Hours Theory: 20 Hours Practical: 4 Hours

General Learning Outcome:

To develop the apprentice's basic knowledge of electric and electronic terminology, schematics and applications of Programmable Logic Controllers (PLC's).

Learning Outcomes and Content:

Upon successful completion, the apprentice is able to:

4.1.1 Describe and discuss types of electrical and electronic devices using appropriate terminology, such as:

- magnetism
- coils
- transformers: step up, step down, and isolation
- contacts
- push button switches, jog, start up

4.1.2 Apply electric/electronic theory to controls.

4.1.3 Describe the principles and operations of:

- AC and DC motors
- stepping motors

4.1.4 Describe hook-up of single and three phase motors with a control circuit.

4.1.5 On a basic level interpret electrical schematic symbols and ladder diagrams.

4.1.6 On a basic level introduce main logic gates.

4.1.7 On a basic level describe the function and application of PLC's and processors including:

- PLC documentation and addressing
- rungs: start/stop, latch, timer, interlocking
- menus, ladder diagrams
- diagnostic program checking to use the PLC as a tool

4.1.8 Describe the application and operation of sensors, relays, limit, micro, pressure, time delay and proximity switches.

Evaluation Structure:

Theory Testing:	83 %
Application Experiences:	17 %
Final Assessment:	100 %

Instructional/Delivery Strategies:

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the eight-week term.
- Final exam at end of term.
- Periodic quizzes.

Number: 5

Title: Welding & Fabrication III

Duration: 33 Total Hours

Theory: 5 Hours Practical: 28 Hours

Prerequisites: Successful completion of Level II

Co-requisites:

5.1 – Welding & Fabrication III

33 Total Hours Theory: 5 Hours Practical: 28 Hours

5.1 - Welding & Fabrication III

Cross-Reference to Learning Outcomes:

4614

Duration: 33 Total Hours Theory: 5 Hours Practical: 28 Hours

General Learning Outcome:

To develop the apprentice's knowledge and ability to read welding drawings, apply safety rules, layout, measure, cut, tack, weld and assemble metal and other components to specification.

Learning Outcomes and Content:

Upon successful completion, the apprentice is able to:

5.1.1 Read and interpret drawings.

5.1.2 Select correct tools and instruments to measure, cut, and layout materials to specifications.

5.1.3 Select and use correct arc and gas welding equipment including rods to tack, weld and shape components as specified.

5.1.4 Select and use forming and bending equipment, disc sanders, grinders, pneumatic hammers and chippers to shape and finish components to specifications.

5.1.5 Plan and sequence erection procedures and job assembly to specifications using appropriate tools and equipment.

5.1.6 Complete various shop projects with industrial and construction applications.

5.1.7 Stress relieve component as required and to specifications.

5.1.8 List and describe safety rules and procedures pertaining to operations performed on shears and universal ironworker.

5.1.9 Describe the machining functions normally performed on shears and universal ironworker.

5.1.10 Identify the component parts, holding devices, and accessories of shears and universal ironworker, and describe the function of each.

5.1.11 Identify the appropriate cutting blades in relation to the material being cut, taking into consideration feeds, speeds, and coolants.

5.1.12 Safely set up and operate equipment such as shears and ironworker to crop, notch, bend, shear, and roll material to drawing specifications.

Evaluation Structure:

Theory Testing:	15 %
Application Experiences:	85 %
Final Assessment:	100 %

Instructional/Delivery Strategies:

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the eight-week term.
- Final exam at end of term.
- Periodic quizzes.

Master Tool List

The Master Tool List has been developed in conjunction with the Industrial Mechanic (Millwright) Curriculum Advisory Committee and the Industrial Mechanic (Millwright) Industry Committee as a requirement for Training Delivery Agents delivering of the program. Actual numbers of tools or equipment required would depend upon method of delivery and number of students in a program.

Level	Description
I	Socket Sets
I	Torque Wrenches
I	Punch Sets
I	Pairs of Pliers
I	Ball Peen Hammers
I	Screwdriver Sets
I	Chisel Sets
I	Pry Bar Sets
I	Scrapers
I	Assorted Files
I	Hacksaws
I	Drill Indexes with Twist Drills
I	Metric Tap & Die Sets
I	Standard Tap & Die Sets
I	Tap Handles
I	Reamer Sets
I	Tin Snips
I	Rivet Guns
I	Grease Guns
I	Funnel
I	Steel Rules
I	Tape Measures
I	Squares
I	Plumb Bobs
I	0 – 1” Micrometers
I	0 – 25mm Micrometers
I	0 – 150mm Metric Depth Micrometers
I	Sets of Standard Depth Micrometers
I	0 – 6’’ Inside Micrometers
I	0 – 150mm Inside Micrometers
I	1 - 2” Micrometers
I	25 – 50mm Micrometers
I	3” Micrometers
I	12” Vernier Height Gauges
I	Sine Bars
I	Precision Measurement Rigs

Level	Description
I	Standard 6” Vernier Calipers
I	Metric Vernier Micrometer
I	Master Level
I	Telescoping Gauge Sets
I	Hole Gauge Sets
I	Radius Gauge Sets
I	Standard Gauge Block Set
I	Metric Gauge Block Set
I	.001” Dial Indicators
I	.0001” Dial Indicators
I	Standard Thread Gauge Sets
I	Metric Thread Gauge Sets
I	3/8” Power Hand Drills
I	3/8” Angle Drills
I	Magnetic Drills
I	4” Angle Grinders
I	Die Grinders
I	Impact Wrenches
I	Powder Actuated Gun
I	Lock Out & Isolation Simulators
I	Safety Harnesses & Fall Arrest Equipment
I	Scott Air Packs*
I	Different Examples of Fire Extinguishers
I	Face Shields
I	Arc Welding Shields
I	Safety Locks
I	Safety Glasses (Student Supplied)
I	Hearing Protectors (Student Supplied)
I	First Aid Kits
I	Welders Gloves (Student Supplied)
I	Welding Glasses
I	Air Tool Compressor (May be a Plant Compressor)
I	Metal Cutting Lathes with Threading Capability
I	Vertical Milling Machines
I	Radial Drill Presses
I	Drill Presses
I	Power Hacksaw
I	Bandsaw
I	Cut Off Saws
I	Hydraulic Press
I	Pedestal Grinders
I	Granite Surface Tables
I	V Blocks
I	Angle Plates

Level	Description
I	Heat Treat Oven*
I	Oil Quench Tank
I	Forge
I	Rockwell or Brinell Hardness Tester*
I	Automatic Lubrication System Trainers*
I	Overhead Crane / Hoist*
I	Pneumatic Hoist
I	Lifting Slings
I	Lifting Chains
I	Assortment of Lifting Hardware
I	Load Skates
I	Hydraulic Jacks
I	Assortment of Blocks
I	Chainfalls
I	Portable Hydraulic Lift
I	Fork Lift*
I	Arc Welding Units
I	Oxy-acetylene Units
I	Brooms
I	Shovels
I	Lathe Brushes
I	Various Lathe High Speed Cutting & Parting Tools
I	Various Lathe Carbide Cutting Tools
I	Pedestal Grinder Wheels
I	Standard Bolt, Nut & Washer Assortment
I	Metric Bolt, Nut & Washer Assortment
I	Dowel Pin Assortment
I	Circlip Assortment
I	Cotter Pin Assortment
I	Loctite Assortment
I	Rivet Assortment
I	Grease Assortment
I	Oil Assortment
I	Drafting & Sketching Kits
I	Tap Drill Charts
I	Cutting Speed Charts
I	Load Charts
I	Tubing Benders
I	Tubing Cutters
I	Pipe Cutters
I	Bearing Pullers
I	Straightedge
I	Induction Bearing Heater
II	Pipe Bender

Level	Description
II	Power Jacks
II	Pipe Threading Machine
II	Power Shear
II	Horizontal Milling Machine
II	Boring Heads
II	Surface Grinders
II	Surface Grinder Magnetic Chunks
II	Dividing Head
II	Laser Alignment Units
II	Arbor Press
II	Power Hone
II	Various End Mills
II	Carbide Insert Milling Cutters
II	Surface Grinder Wheels
II	O Ring Assortment
II	Assortment of Pipe Fittings
II	Different Examples of Various Plain, Journal & Sleeve Bearings
II	Different Examples of Bearing Housings & Gearboxes
II	Examples of Various Anti-friction Bearings and Assorted Failures
II	Different Examples of Seals
II	Different Examples of Packing
II	Example of V Belt Drive
II	Example of Chain Drive
II	Example of Magnetic, Fluid or Centrifugal Coupling
II	Example of Piston Compressor
II	Example of Screw Compressor
II	Example of Wet and Dry Compressor
II	Example of Roots Blower or Lobe Compressor
II	Assortment of Filter Examples
II	Example of Dryer
II	Example of Cooler
II	Bearing Installation Set ups
II	Gearbox Training Units with Motors, Couplings, etc.
II	Coupling Alignment Units
II	Compressor Training Units
II	Pneumatic Training Units
II	Dumpy Levels
II	Tilting Levels
II	Transit
II	Auto Level
II	12” Precision Levels
II	Block Level
III	Theodolite Rings
III	Vibration Analyzers

Level	Description
III	Dust Collector*
III	Programmable Logic Controllers
III	Computers with PPM Programs
III	Computer Printer
III	Assortment of Anchors
III	Electrical Multi-testers
III	Tachometer*
III	Ultrasonic Gun*
III	Thermographic Unit*
III	Roller Conveyor System Trainer
III	Belt Conveyor System Trainer
III	Example of Vibrator*
III	Example of Screw, Chain, Monorail or Bucket Conveyor
III	Fly Ball Governor
III	Example of AC Motor
III	Example of DC Stepping Motor
III	Example of Internal Combustion Motor*
III	Example of Turbine*
III	Example of Multi-stage Fan*
III	Example of Shaker Bagger*
III	Assortment of Pneumatic Valves
III	Assortment of Pneumatic Actuators
III	Different Examples of Hydraulic Piston Pumps
III	Different Examples of Hydraulic Vane Pumps
III	Different Examples of Hydraulic Pumps Other Than Piston or Vane
III	Assortment of Filters and Contamination Control Devices
III	Different Examples of Directional Valves
III	Different Examples of Proportional Valves
III	Example of Mechanical Hydraulic Servo Proportioning
III	Different Examples of Linear Hydraulic Actuators
III	Example of Rotary Hydraulic Actuator
III	Example of Electrical Servo Proportioning Valves
III	Example of Fiber Optics*
III	Hydraulic Training Units
III	Hydraulic Pump Test Units
III	Hydraulic Troubleshooting Unit
III	Ironworker
III	Brake
III	Shears
III	Rollers
III	Various Electrical Sensors
III	Electrical Breakers
III	Electrical Fuses

***** These items are considered desirable, but not absolutely necessary.