ONTARIO COLLEGE OF TRADES

ORDRE DES MÉTIERS DE L'ONTARIO

Apprenticeship Curriculum Standard

Industrial Mechanic (Millwright)
Trade Code: 433 A

Construction Millwright
Trade Code: 426A

Level 2 Common Core

Date: 2004

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 to 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) and Construction 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 skills of the trade 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 deviations from the course requirements (as determined by the Industry Committee and Provincial Advisory Committee, 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.

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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 2005

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Summary of Total Program In-School Training Hours

	Reportable Subjects	Total	Theory	Practical
1.	Drawings & Schematics II	32	32	0
2.	Workshop Practice II	52	28	24
3.	Power Transmission	56	40	16
4.	Machine Technology II	40	32	8
5.	Welding & Fabrication II	44	14	30
6.	Electrical & Electronic Controls II	16	12	4
	TOTAL	240	158	82

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Number: 1

Title: Drawings & Schematics II

Duration: 32 Total Hours

Theory: 32 Hours Practical: 0 Hours

Prerequisites: Successful completion of Level I

Co-requisites:

1.1 Drawings and Schematics II

32 Total Hours Theory: 32 Hours Practical: 0 Hours

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1.1 - Drawings & Schematics II

Cross-Reference to Learning Outcomes:

CM 1304
IMM 4602

Duration: 32 Total Hours Theory: 32 Hours Practical: 0 Hours

General Learning Outcome:

To develop the apprentice's ability to effectively use manufacturers' manuals, and to sketch and draw machine component parts, including sectional views.

Learning Outcomes and Content:

Upon successful completion, the apprentice is able to:

1.1.1 Read and extract necessary information from manufacturers' manuals to enable trainee to order replacement parts.

1.1.2 Apply information extracted from technical and manufacturers' manuals to build, rebuild, install and maintain equipment to specifications.

1.1.3 Read and interpret mechanical engineering drawings.

Evaluation Structure:

Theory Testing:	100 %
Application Experiences:	0 %
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.

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Number: 2

Title: Workshop Practice II

Duration: 52 Total Hours

Theory: 28 Hours Practical: 24 Hours

Prerequisites: Successful completion of Level I

Co-requisite:

2.1 - Machine Tools II

24 Total Hours Theory: 4 Hours Practical: 20 Hours

2.2 - Bearing & Seals

28 Total Hours Theory: 24 Hours Practical: 4 Hours

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2.1 - Machine Tools II

Cross-Reference to Learning Outcomes:

CM 1306
IMM 4605

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

General Learning Outcome:

To develop the apprentice's knowledge of the function, component parts, holding devices, accessories, cutting tools, and machining operations on the milling machine/surface grinder.

Learning Outcomes and Content:

Upon successful completion, the apprentice is able to:

2.1.1 List and describe safety rules and procedures pertaining to milling/surface grinding operations.

2.1.2 Describe the machining functions normally performed on a mill/surface grinder.

2.1.3 Identify the component parts, holding devices, and accessories of the mill/grinder and describe the function of each.

2.1.4 Identify the appropriate cutting tools for specific cutting requirements.

2.1.5 Identify and select the appropriate grinding wheels for specific grinding operations.

2.1.6 Set up and safely operate a milling machine using High Speed Steel and Carbide cutting tools to perform the following machining operations within a unit of tolerance:

- face
- slot
- gear cutting
- cut keyways

2.1.7 Set up and safely operate surface grinders.

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2.2 - Bearings & Seals

Cross-Reference to Learning Outcomes:

CM 1317
IMM 4608

Duration: 28 Total Hours Theory: 24 Hours Practical: 4 Hours

General Learning Outcome:

To develop the apprentice's knowledge to select, install, and maintain friction/plain and anti-friction bearings, and static and dynamic seals. To be able to interpret ISO charts and bearing catalogues.

Learning Outcomes and Content:

Upon successful completion, the apprentice is able to:

2.2.1 Identify and describe the make-up of each type of liner material, and describe the reasons for using the following bearing materials:

- bronze
- cast iron
- ryertex
- teflon
- Babbitt
- aluminum
- plastics and phenolaminates
- wood (birch-ligna vitae)

2.2.2 Identify and describe the function of the following lubrication types and elements:

- oil grooves
- gravity feed
- jacking oil
- chamfers
- hydraulic shock/cushion
- pressure feed
- set up and maintain oil wedge

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2.2.3 Describe the fitting and adjusting of friction bearings with respect to the following:

- fits and tolerances
- fits and tolerances with respect to speeds and loads
- line reaming
- area of contact
- care and use of Prussian blue
- scraping tools, groove cutting
- lubrication entrance
- boring

2.2.4 List and describe the purpose of various alloying elements in Babbitt:

- low pressure Babbitt
- extreme pressure Babbitt

2.2.5 List and describe with respect to Babbitt bearings:

- safety precautions
- pouring procedures
- cleaning and preparation
- various types of Babbitt bearing housings

2.2.6 Demonstrate the installation, fitting and alignment of friction/plain bearings.

2.2.7 Identify and list causes of friction bearing failures and list remedial action.

2.2.8 Identify type and describe the function and application of the following anti-friction bearings:

- ball
- roller
- needle

2.2.9 Identify and describe load conditions:

- radial
- thrust (axial)
- combination radial and axial

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2.2.10 Identify anti-friction bearing codes and their meanings according to manufacturers' catalogues with regard to:

- bore diameters
- suffix designations
- rolling elements
- service weight
- use of sealed and shielded bearings
- prefix designations
- mounting procedures

2.2.11 Identify component construction of anti-friction bearings with respect to the following:

- inner and outer races
- rolling elements
- cage or separators
- filling slots
- angular contact
- deep groove
- self aligning
- separable/non-separable
- split bearings

2.2.12 Identify and describe the function and application of the following bearing housings:

- pillow block
- flange
- extended inner ring and collar
- eccentric locking collars

2.2.13 Describe the following procedures with respect to anti-friction bearings:

- mounting bearings with interference fits
- mounting bearings with taper bore
- tandem mounting bearings with regard to;
- back to back
- face to face
- face to back
- mounting bearings with withdrawal sleeves
- hydraulic mounting/demounting bearings
- lubrication procedures
- held and free bearings
- cleaning, inspecting and storing bearings

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- describe and demonstrate installation and removal of bearings using presses, jacks and pullers of various types
- demonstrate various methods of heating bearings
- bearing failure using vibration analysis

2.2.14 Identify and describe type and function of the following static seals:

- gaskets
- gasket forming compounds
- copper and other metals
- "O" rings

2.2.15 Describe and demonstrate installation and removal procedures for static seals:

- make gaskets
- install gaskets and seals using torque wrench

2.2.16 Use manufacturers' catalogues to select materials and styles for static seals with regard to:

- compatibility with medium being sealed
- stability over required temperature range

2.2.17 Identify and describe types and uses of dynamic seals:

- lip seals
- V ring
- U cup
- cup seals
- square ring
- O ring and backup washer
- T ring

2.2.18 Describe and demonstrate installation and removal procedure for various dynamic and mechanical seals.

2.2.19 Use and interpret manufacturers' catalogues in the selection of seal types with regard to the following:

- compatibility with medium being sealed
- gap extrusion
- sealing at high pressure

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Evaluation Structure:

Theory Testing:	54 %
Application Experiences:	46 %
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.

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Number: 3

Title: Power Transmission

Duration: 56 Total Hours

Theory: 40 Hours Practical: 16 Hours

Prerequisites: Successful completion of Level I

Co-requisites:

3.1 - Power Transmission

56 Total Hours Theory: 40 Hours Practical: 16 Hours

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3.1 - Power Transmission

Cross-Reference to Learning Outcomes:

CM 1314
IMM 4610

Duration: 56 Total Hours Theory: 40 Hours Practical: 16 Hours

General Learning Outcome:

To develop the apprentice's ability to identify, select and install the appropriate transmission system and/or components for a specific application.

Learning Outcomes and Content:

Upon successful completion, the apprentice is able to:

3.1.1 Identify, select and apply installation techniques for the following belt drives using common measuring tools, belt and sheave gauges and/or manufacturer's catalogues:

- conventional V belts and sheaves
- high capacity V belts and sheaves
- multiple V belts and sheaves
- positive drive belts and sheaves
- variable speed belts and sheaves
- fractional H.P. belts and sheaves

3.1.2 Identify and select the types and sizes of the following chain drives using common measuring tools and/or manufacturers' catalogues:

- roller and multiple roller chains and sprockets
- silent chains and sprockets
- extended pitch roller chains and sprockets

3.1.3 Identify and select the types and sizes of the following gears and/or gear reducers:

- spur
- cycloidal
- bevel
- hypoid
- harmonic drive

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- spiral bevel
- internal spur
- herringbone
- helical

3.1.4 Describe the installation and maintenance procedures for the following clutches/brakes:

- positive contact
- overrunning
- magnetic
- centrifugal
- friction

3.1.5 Identify, select and install the following shaft couplings:

- rigid
- universal
- magnetic
- flexible
- friction
- fluid

3.1.6 Calculate V belt and chain lengths using formulae.

3.1.7 Calculate speed ratios of different drives.

3.1.8 Perform basic alignment procedures using trade formulas.

3.1.9 Calculate horsepower requirements for drives.

3.1.10 Perform gear calculations.

3.1.11 Describe and perform the installation, alignment and tensioning of belt and chain drives.

3.1.12 Check belt and chain drives for wear, misalignment and improper tensioning.

3.1.13 Describe the procedures for installing clearance and interference fit couplings.

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3.1.14 Perform preliminary alignment checks for:

- shaft runout and end play
- magnetic centred motors
- coupling rim and face runout
- soft foot
- thermal growth
- piping strain

3.1.15 Align shafts using methods such as:

- feeler and straight-edge
- two dial indicators
- computer-laser

3.1.16 Describe lubrication and maintenance functions for couplings.

3.1.17 Describe coupling removal procedures.

3.1.18 State the purpose of radial and cylindrical cams.

3.1.19 Describe the installation, adjustment, lubrication, alignment and maintenance procedures for cams and followers.

3.1.20 Describe the procedures for checking for cam wear, speed, follower pressure and backlash.

3.1.21 Describe shafting installation and alignment procedures including computer laser alignment.

3.1.22 Describe methods for testing the straightness of shafts.

3.1.23 Describe the following methods for repairing shafts.

- filing
- welding
- sleeving
- polishing
- metalizing
- turning

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3.1.24 Explain the purpose of splines.

3.1.25 Describe the procedure for the installation and removal of tapered bushings on sheaves and sprockets.

Evaluation Structure:

Theory Testing:	71 %
Application Experiences:	29 %
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.

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Number: 4

Title: Machine Technology II

Duration: 40 Total Hours

Theory: 32 Hours Practical: 8 Hours

Prerequisites: Successful completion of Level I

Co-requisites:

4.1 - Pumps, Valves & Piping

28 Total Hours Theory: 20 Hours Practical: 8 Hours

4.2 - Compressors

12 Total Hours Theory: 12 Hours Practical: 0 Hours

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4.1 - Pumps, Valves & Piping

Cross-Reference to Learning Outcomes:

CM 1315, 1318
IMM 4612, 4615

Duration: 28 Total Hours Theory: 20 Hours Practical: 8 Hours

General Learning Outcome:

To develop the apprentice's knowledge of the different applications, maintenance and types of pumps, valves, piping and ancillary equipment.

Learning Outcomes and Content:

Upon successful completion, the apprentice is able to:

4.1.1 Identify and describe the function, application and components of industrial pumps, such as:

- centrifugal
- piston
- screw
- turbine
- diaphragm
- gear
- jet
- vane
- plunger
- peristaltic
- axial flow
- progressive cavity

4.1.2 Describe procedures for the installation, overhaul and maintenance of industrial pumps.

4.1.3 Inspect, replace or maintain packing and mechanical seals.

4.1.4 Care for and use pipe cutters, benders and threaders.

4.1.5 Identify and select pipe, tubing and valves for specific applications and to specifications.

4.1.6 Select hangers and brackets to specifications.

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4.1.7 Select specialized fittings, and screwed, welded, cemented and bolted flanges.

4.1.8 Select, cut, and fit gaskets.

4.1.9 Identify and select expansion joints for specific applications.

4.1.10 Identify and select valves for specific applications including:

- ball valves
- gate valves
- globe valves
- butterfly valves
- needle valves
- check valves
- plug valves
- diaphragm valves

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4.2 – Compressors

Cross-Reference to Learning Outcomes:

CM 1315
IMM 4612

Duration: 12 Total Hours Theory: 12 Hours Practical: 0 Hours

General Learning Outcome:

To develop the apprentice's knowledge of the regulations, types, applications and maintenance of compressors and ancillary equipment.

Learning Outcomes and Content:

Upon successful completion, the apprentice is able to:

4.2.1 Identify and describe types of rotary and reciprocating compressors.

4.2.2 Explain the function and application of compressors.

4.2.3 Identify component parts of compressors and describe the maintenance procedures for overhaul and repair.

4.2.4 Describe the function and maintenance of:

- primary filters
- secondary filters
- intercoolers
- aftercoolers

4.2.5 Describe the function, installation and maintenance of separators and receivers.

4.2.6 Describe the functions of check isolating, by-pass and moisture dump valves.

4.2.7 Inspect and maintain pressure gauges, by-pass set-ups and pipe systems.

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4.2.8 Describe the function of unloading devices and their components, including:

- diaphragms
- springs
- valves
- seals
- control linkages

Evaluation Structure:

Theory Testing:	80 %
Application Experiences:	20 %
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.

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Number: 5

Title: Welding & Fabrication II

Duration: 44 Total Hours

Theory: 14 Hours Practical: 30 Hours

Prerequisites: Successful completion of Level I

Co-requisites:

5.1 - Welding & Fabrication II

44 Total Hours Theory: 14 Hours Practical: 30 Hours

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5.1 - Welding & Fabrication II

Cross-Reference to Learning Outcomes:

CM 1311
IMM 4614

Duration: 44 Total Hours Theory: 14 Hours Practical: 30 Hours

General Learning Outcome:

To develop the apprentice's knowledge and additional skills in welding and fabrication practices, techniques and pertinent regulations.

Learning Outcomes and Content:

Upon successful completion, the apprentice is able to:

5.1.1 Describe the types of welded joints and tacking techniques.

5.1.2 Describe and apply welding and fabrication techniques including:

- interpret drawings and understand welding symbols
- layout, tack and fabricate materials to assemble components using drawings
- layout procedures and set-up
- prevention and correction of distortion
- joint preparation
- alignment procedures and use of jigs and templates
- peening, flame shrinkage and proper fabrication techniques
- selection of correct electrode for specific application
- oxyacetylene and plasma methods
- tungsten inert gas (T.I.G.) welding (GTAW)
- metal inert gas (M.I.G.) welding (GMAW)

5.1.3 Demonstrate SMAW welding in vertical and horizontal positions.

5.1.4 Describe the use and operation of the guided bend to test weld quality.

5.1.5 Calculate geometric formulae and layout as applied to fabrication.

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Evaluation Structure:

Theory Testing:	32 %
Application Experiences:	68 %
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.

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Number: 6

Title: Electrical & Electronic Controls II

Duration: 16 Total Hours

Theory: 12 Hours Practical: 4 Hours

Prerequisites: Successful completion of Level I

Co-requisites:

6.1 - Electrical & Electronic Controls II

16 Total Hours Theory: 12 Hours Practical: 4 Hours

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6.1 - Electrical & Electronic Controls II

Cross-Reference to Learning Outcomes:

CM 1301, 4613.03, 1316, 1320, 1321, 1322
IMM 4600.01, 4613.03, 4617.08, 4618.10

Duration: 16 Total Hours Theory: 12 Hours Practical: 4 Hours

General Learning Outcome:

To develop the apprentice's basic knowledge concerning electric and electronic theory.

Learning Outcomes and Content:

Upon successful completion, the apprentice is able to:

6.1.1 Review the use of basic electrical testing instruments. Review and safely demonstrate the trouble shooting, removal, and resetting of electrical and electronic overload devices such as:

- fuses
- circuit breakers and ground fault interrupter (GFI)
- lock-outs and tagouts
- shut off procedures

6.1.2 Introduce open and closed loop control systems.

6.1.3 Differentiate between analog and digital signals.

6.1.4 Describe, briefly, the electronic devices used in control systems such as:

- thermal devices: thermostats,thermocouples, bemetallic strip devices, metal resistance thermometers, thermistors, and thermal expansion devices
- limit switches
- proximity switches
- photo cells
- inductive and capacitive sensors
- solenoids
- linear variable differential transformers (LVDT)
- miscellaneous transducers such as: bourdon tube, pressure switches, diaphragm, bellows, piezoelectric, strain gauges and capsules

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- vibration transducers
- displacement, velocity and accelerometer devices

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.

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Master Tool List

The Master Tool List has been developed in conjunction with the Industrial Mechanic (Millwright) and Construction Millwright Curriculum Advisory Committee and the Industrial Mechanic (Millwright) Industry Committee and Construction Millwright Provincial Advisory 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

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Level	Description
I	Precision Measurement Rigs
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

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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
II	Power Jacks

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Level	Description
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
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II	Auto Level
II	12” Precision Levels
II	Block Level
III	Theodolite Rings
III	Vibration Analyzers
III	Dust Collector*
III	Programmable Logic Controllers

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Level	Description
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.

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