



ONTARIO COLLEGE OF TRADES

ORDRE DES MÉTIERS DE L'ONTARIO

Apprenticeship
Curriculum Standard

Construction Millwright

Level 3

Trade Code: 426A

Date: 2011

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 Programs 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 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 the apprentice's 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 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.

The curriculum includes specific references to the training standards of the 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: August 2011

PROGRAM SUMMARY OF REPORTABLE SUBJECTS

Number	Reportable Subjects	Hours Total	Hours Theory	Hours Practice
S1721	Drawings and Schematics 3	16	16	0
S1722	Workshop Practice 3	33	3	30
S1723	Machine Installation, Set-up and Field Layout	80	42	38
S1724	Machine Technology 3	33	28	5
S1725	Fluid Power	78	58	20
	Total	240	147	93

Number: S1721

Reportable Subject: **DRAWINGS AND SCHEMATICS 3**

Duration: Total Hours: 16 Theory: 16 Practical: 0

Prerequisites: Level 1 and Level 2

Content: S1721.1 Drawings and Schematics 3

Evaluation Structure:

Theory Testing	Practical Application Testing	Final Assessment
50%	0%	50%

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.

S1721.1 Drawings and Schematics 3

Duration: Total Hours: 16 Theory: 16 Practical: 0

Cross-Reference to Training Standard Performance Objectives: U6143.0

GENERAL LEARNING OUTCOMES

To develop the apprentice's ability to effectively read and interpret trade specific drawings.

LEARNING OUTCOMES AND CONTENT

- 1.1.1 Read, identify and determine size, location and elevation of items related to machine installation.
- 1.1.2 Draw and sketch machine layout and installation diagrams.
- 1.1.3 Read and interpret plant layout drawings.

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Number: **S1722**

Reportable Subject: **WORKSHOP PRACTICE 3**

Duration: Total Hours: 33 Theory: 3 Practical: 30

Prerequisites: Level 2

Content: S1722.1 Machine Tools 3 and Work Project

Evaluation Structure:

Theory Testing	Practical Application Testing	Final Assessment
45%	5%	50%

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.

S1722.1 Machine Tools 3and Work Project

Duration: Total Hours: 33 Theory: 3 Practical: 30

Cross-Reference to Training Standard: U6145.0

GENERAL LEARNING OUTCOME

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

LEARNING OUTCOMES AND CONTENT

2.1.1 Set-up and operate conventional machine tools, such as:

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

2.1.2 Set-up and operate machine tool accessories including:

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

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

2.1.4 Complete specific work projects as required.

Construction Millwright - Level 3

Number: **S1723**

Reportable Subject: **MACHINE INSTALLATION, SET-UP AND FIELD LAYOUT**

Duration: Total Hours: 80 Theory: 42 Practical: 38

Prerequisites: Level 2

Content: S1723.1 Machine Installation, Set-Up and Field Layout

Evaluation Structure:

Theory Testing	Practical Application Testing	Final Assessment
25%	25%	50%

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.*

S1723.1 *Machine Installation, Set-Up and Field Layout*

Duration: Total Hours: 80 Theory: 42 Practical: 38

Cross-Reference to Training Standard Performance Objectives: U6141.0, U6142.0, U6143.0, U6146.0, U6147.0, U6151.0, U6155.0

GENERAL LEARNING OUTCOME

To develop the apprentice's knowledge of safety procedures in rigging and machinery moving, final installation and setup, and field layout.

LEARNING OUTCOMES AND CONTENT

- 3.1.1 Describe elements of a safe hoisting and rigging operation as they pertain to machinery movement and installation, including:
- work crew planning and communication
 - ability to follow a critical path to final placement
 - international hand signals and overhead crane signals
 - load weight estimation
 - center of gravity
 - attachment, jacking and lifting points
 - floor and structural conditions
 - lifting equipment capacities
- 3.1.2 Perform calculations based on basic principles of strength of materials, such as:
- stress and strain
 - tension
 - compression
 - shear
 - torsion
 - stresses in beams and columns
- 3.1.3 Perform basic rigging operations using various sling configurations.
- 3.1.4 Inspect and maintain rigging and hoisting equipment.

3.1.5 Describe and practice safe usage of:

- jacks
- rollers
- come-alongs
- chain falls
- boom trucks
- overhead cranes
- lift trucks
- tuggers

3.1.6 Install machinery at a specified location according to engineering drawings.

3.1.7 Layout and establish datum lines for the location of machinery and equipment, using instruments and tools such as:

- piano wire
- plumb bobs
- chalk lines
- optical levels
- theodolite
- total station
- lasers

3.1.8 Maintain and store precision measuring devices.

3.1.9 Identify, select and use appropriate measuring devices to align equipment, establish datum lines, references points, and bench marks, and measure acute, obtuse and compound angles.

Number: **S1724**

Reportable Subject: **MACHINE TECHNOLOGY 3**

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

Prerequisites: Level 2

Content:

S1724.1	Material Handling Systems
S1724.2	Prime Movers and Ancillary Equipment
S1724.3	Fans and Blowers
S1724.4	Preventive and Predictive Maintenance

Evaluation Structure:

Theory Testing	Practical Application Testing	Final Assessment
45%	5%	50%

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.

S1724.1 *Material Handling Systems*

Duration: Total Hours: 13 Theory: 10 Practical: 3

Cross-Reference to Training Standard: U6152.0

GENERAL LEARNING OUTCOME

To develop the apprentice's understanding of the principles of operation for various material handling systems.

LEARNING OUTCOMES AND CONTENT

- 4.1.1 Describe the principles and understand the importance of proper site preparation.
- 4.1.2 Identify type, purpose, and installation and adjustment procedures for the following material handling systems:
- belt
 - chain
 - bucket
 - roller
 - screw
 - air
- 4.1.3 Identify and select for specific applications:
- conveyor supports and trusses
 - drive terminals and power drives
 - pulley drives
- 4.1.4 Identify and select for specific applications:
- screw take-ups
 - chain adjusted gravity take-up
 - internal take-up
 - telescoping take-up
 - chain take-up
 - fixed tail end

- 4.1.5 Describe methods of belt splicing and fastenings for specific applications.
- 4.1.6 Describe and perform methods of aligning and tracking conveyor systems.
- 4.1.7 Identify type and describe the function and application of the following bucket elevators:
- centrifugal discharge
 - continuous bucket
 - super-capacity
 - positive discharge
- 4.1.8 Identify type and describe the function and application of the following bucket elevator components:
- casings
 - head
 - boot
 - belt
 - chain
- 4.1.9 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
- 4.1.10 Identify and describe the function and application of the following types of pneumatic conveyors:
- vacuum systems
 - pressurized systems
 - low, medium, high pressure systems

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

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

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

- gravity roller
- live roller
- roller bed

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

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

S1724.2 ***Prime Movers and Ancillary Equipment***

Duration: Total Hours: 4 Theory: 4 Practical: 0

Cross-Reference to Training Standard: U6162.0

GENERAL LEARNING OUTCOME

To develop the apprentice's basic knowledge of the types and applications of prime movers.

LEARNING OUTCOMES AND CONTENTS

4.2.1 Identify and describe types of prime movers including:

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

S1724.3 ***Fans and Blowers***

Duration: Total Hours: 4 Theory: 4 Practical: 0

Cross-Reference to Training Standard: U6158.0

GENERAL LEARNING OUTCOME

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

LEARNING OUTCOMES AND CONTENT

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

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

S1724.4 Preventive and Predictive Maintenance

Duration: Total Hours: 12 Theory: 10 Practical: 2

Cross-Reference to Training Standard: U6163.0

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

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

4.4.2 Describe equipment monitoring techniques by:

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

4.4.3 Understand and describe the characteristics of vibration:

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

4.4.4 In reference to vibration characteristics, identify when to measure:

- velocity
- displacement
- acceleration
- bearing defect energy
- frequency related to rotations per minute (rpm).

- 4.4.5 Identify and operate fixed and portable vibration measurement equipment and accessories, including velocity, acceleration and non-contact transducers.
- 4.4.6 Assess vibration severity by:
- using general vibration severity charts
 - spectral signatures
 - trending
 - troubleshooting
- 4.4.7 Describe machinery maintenance programs:
- breakdown
 - preventative (scheduled)
 - predictive
 - proactive
- 4.4.8 Identify the benefits of a predictive maintenance program, such as:
- 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
- 4.4.9 Identify the significance of recording equipment history (to maximize reliability and life span):
- maintenance data
 - failure analyses findings
 - outages
- 4.4.10 Describe methods of recording footprint/signature of machinery.

4.4.11 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

4.4.12 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

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

4.4.14 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

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

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Number: **S1725**

Reportable Subject: **FLUID POWER**

Duration: Total Hours: 78 Theory: 58 Practical: 20

Prerequisites: Level 2

Content: S1725.1 Pneumatic Systems
S1725.2 Hydraulic Systems

Evaluation Structure:

Theory Testing	Practical Application Testing	Final Assessment
40%	10%	50%

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.

S1725.1 Pneumatic Systems

Duration: Total Hours: 24 Theory: 14 Practical: 10

Cross-Reference to Training Standard: U6160.0

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 CONTENTS

- 5.1.1 Describe and apply safety procedures when working on pneumatic systems.
- 5.1.2 Describe the basic principles and applications of pneumatics.
- 5.1.3 Explain Boyle's Law and Charles' Law as they apply to pneumatics.
- 5.1.4 Read and interpret symbols for all pneumatic components using both ANSI and ISO systems.
- 5.1.5 Build and troubleshoot pneumatic systems using drawings and test instruments.
- 5.1.6 Identify and explain the operation of various types of cylinders:
 - single and double acting
 - single and double rod
- 5.1.7 Identify and explain the operation of various types of pneumatic motors.
- 5.1.8 Identify and explain the operation and function of various pressure control valves:
 - unloading
 - relief
 - sequence
 - pressure reducing
- 5.1.9 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

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

- meter in
- meter out

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

- quick exhaust
- time delay

S1725.2 Hydraulic Systems

Duration: Total Hours: 54 Theory: 44 Practical: 10

Cross-Reference to Training Standard: U6161.0

GENERAL LEARNING OUTCOME

To develop the apprentice's knowledge of basic hydraulic principles and the ability to perform pertinent hydraulic calculations, and to install, maintain and troubleshoot components.

LEARNING OUTCOMES AND CONTENT

- 5.2.1 Describe and apply safety procedures when working on hydraulic systems.
- 5.2.2 Define the following:
- Pascal's Law
 - Bernoulli's Principle
- 5.2.3 Perform calculations and define the following hydraulic terms:
- pressure
 - force
 - area
 - horsepower
 - flow rate
- 5.2.4 Describe and apply the basic principles of fluid mechanics including:
- properties of fluids
 - flow patterns
 - pipe losses
 - Bernoulli's Principle
- 5.2.5 Read and interpret symbols for all hydraulic components using both ANSI and ISO systems.

5.2.6 Assemble and troubleshoot hydraulic systems using circuit drawings.

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

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

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

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

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

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

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

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

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

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

5.2.12 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

5.2.13 Identify and explain the operation and function of cartridge valves.

5.2.14 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

5.2.15 Explain proper installation procedures.

5.2.16 Explain cavitation.

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

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

- weight
- spring
- gas

5.2.19 Explain the installation and charging procedures for gas accumulators.

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

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

- filters
- strainers
- hydraulic reservoirs

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

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

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

- O rings
- quad rings
- compression fittings

Construction Millwright - Level 3

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 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. Items marked with an asterisk (*) are considered desirable, but not absolutely necessary.

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

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Level	Description
1	Telescoping Gauge Sets
1	Hole Gauge Sets
1	Radius Gauge Sets
1	Standard Gauge Block Set
1	Metric Gauge Block Set
1	.001 in. Dial Indicators
1	.0001 in. Dial Indicators
1	Standard Thread Gauge Sets
1	Metric Thread Gauge Sets
1	3/8 in. Power Hand Drills
1	3/8 in. Angle Drills
1	Magnetic Drills
1	4 in. Angle Grinders
1	Die Grinders
1	Impact Wrenches
1	Powder Actuated Gun
1	Lock Out and Isolation Simulators
1	Safety Harnesses and Fall Arrest Equipment
1	Scott Air Packs*
1	Different Examples of Fire Extinguishers
1	Face Shields
1	Arc Welding Shields
1	Safety Locks
1	Safety Glasses (student supplied)
1	Hearing Protectors (student supplied)
1	First Aid Kits
1	Welders Gloves (student supplied)
1	Welding Glasses
1	Air Tool Compressor (may be a Plant Compressor)
1	Metal Cutting Lathes with Threading Capability
1	Vertical Milling Machines
1	Radial Drill Presses
1	Drill Presses
1	Power Hacksaw
1	Bandsaw
1	Cut Off Saws
1	Hydraulic Press
1	Pedestal Grinders
1	Granite Surface Tables
1	V Blocks
1	Angle Plates
1	Heat Treat Oven*
1	Oil Quench Tank
1	Forge
1	Rockwell or Brinell Hardness Tester*
1	Automatic Lubrication System Trainers*
1	Overhead Crane / Hoist*
1	Pneumatic Hoist

Construction Millwright - Level 3

Level	Description
1	Lifting Slings
1	Lifting Chains
1	Assortment of Lifting Hardware
1	Load Skates
1	Hydraulic Jacks
1	Assortment of Blocks
1	Chainfalls
1	Portable Hydraulic Lift
1	Fork Lift*
1	Arc Welding Units
1	Oxy-acetylene Units
1	Brooms
1	Shovels
1	Lathe Brushes
1	Various Lathe High Speed Cutting and Parting Tools
1	Various Lathe Carbide Cutting Tools
1	Pedestal Grinder Wheels
1	Standard Bolt, Nut and Washer Assortment
1	Metric Bolt, Nut and Washer Assortment
1	Dowel Pin Assortment
1	Circlip Assortment
1	Cotter Pin Assortment
1	Loctite Assortment
1	Rivet Assortment
1	Grease Assortment
1	Oil Assortment
1	Drafting and Sketching Kits
1	Tap Drill Charts
1	Cutting Speed Charts
1	Load Charts
1	Tubing Benders
1	Tubing Cutters
1	Pipe Cutters
1	Bearing Pullers
1	Straightedge
1	Induction Bearing Heater

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Level	Description
2	Pipe Bender
2	Power Jacks
2	Pipe Threading Machine
2	Power Shear
2	Horizontal Milling Machine
2	Boring Heads
2	Surface Grinders
2	Surface Grinder Magnetic Chunks
2	Dividing Head
2	Laser Alignment Units
2	Arbor Press
2	Power Hone
2	Various End Mills
2	Carbide Insert Milling Cutters
2	Surface Grinder Wheels
2	O Ring Assortment
2	Assortment of Pipe Fittings
2	Different Examples of Various Plain, Journal and Sleeve Bearings
2	Different Examples of Bearing Housings and Gearboxes
2	Examples of Various Anti-friction Bearings and Assorted Failures
2	Different Examples of Seals
2	Different Examples of Packing
2	Example of V Belt Drive
2	Example of Chain Drive
2	Example of Magnetic, Fluid or Centrifugal Coupling
2	Example of Piston Compressor
2	Example of Screw Compressor
2	Example of Wet and Dry Compressor
2	Example of Roots Blower or Lobe Compressor
2	Assortment of Filter Examples
2	Example of Dryer
2	Example of Cooler
2	Bearing Installation Set ups
2	Gearbox Training Units with Motors, Couplings, etc.
2	Coupling Alignment Units
2	Compressor Training Units
2	Pneumatic Training Units
2	Dumpy Levels
2	Tilting Levels
2	Theodolite
2	Auto Level
2	12 in. Precision Levels
2	Block Level

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