SECTION 1 - ELECTRONIC TRAINING MODULES

QUANTITY – 2 Complete training systems including all necessary items to meet the specified teaching objectives. Sample specifications are included for each item.

Each complete training system must include all necessary hands-on training equipment, accessories, printed student curriculum, and CD ROM based interactive training curriculum. The training system must include student curriculum and equipment for teaching skills necessary to master programmable controllers Allen Bradley SLC 500/RS Logix 500. The topics covered must include: introduction to programmable controllers, basic PLC programming, PLC motor control, discrete I/O interfacing, introduction to PLC troubleshooting, PLC system troubleshooting, event sequencing, application development, PLC timer instructions, PLC counter instructions, program control instruction, and math and data move instructions.

The individual component specifications may vary as long as the system meets these general specifications:

ITEM 1: PLC TRAINING MODULES- QTY 2
** PLEASE NOTE: IVCC already owns Rockwell Automation’s TOOLKIT which includes copies of RSLogix 500 Professional for Allen Bradley Micrologix and SLC500 programmable controllers. This quote should not include any PLC Ladder diagram software.**

PROGRAMMABLE CONTROLLER TROUBLESHOOTING SYSTEM - Shall include mobile training station, start/stop station, applications unit, and computer-based fault insertion system, computerized troubleshooting software.

Mobile Training Station - to permit mounting and storage of the PLC training components.

Start/Stop Station - to permit control of the I/O power. This start/stop station shall consist of a circuit breaker, start pushbutton, stop pushbutton, indicator light, 24VDC power supply, 5VDC power supply, and power relay. The start/stop station will contain fault relays, which can be activated by the fault insertion system. Some will be pre-wired to produce power faults. The remaining should be accessed through removable connectors and can be configured by the user to produce specialized faults in their controller system.

Field Device Unit - to provide mounting of the applications stations. All connections shall be quick-connect type. The unit shall include connectors with I/O points. Molded connectors shall be provided for connection to PEC controller modules. Standard unit will include pre-wired fault relays, silk-screened overlay.

Computer Based Fault Insertion System - This system should consist of (1) PC-compatible fault controller, (1) computer-managed software, (1) installation/operation manual. This system shall be designed and programmed so that students automatically insert faults into the PLC training system to provide student practice in troubleshooting the system. The system should include the following:

Fault Controller
To include enclosure with PC digital I/O fault control card, fault insertion circuit board with 30 fault relays, 10A 115/230 VAC rating. The digital I/O card shall insert in a standard Windows-
based PC PCI slot and connect to the 40 relays via a ribbon cable. The fault insertion relay board shall be mounted inside an enclosure, which is attached to the trainer. Through the software the controller shall be able to insert faults into the field devices, I/O modules and PLC power supply.

**Computer Managed Software**
This software shall be a Windows 98-based or higher software program it should provide an online interface for student troubleshooting and database record keeping of student responses. This software package should give teachers the ability to create custom templates for each troubleshooting exercise so students are presented with an appropriated troubleshooting experience for each lab activity. Faults can be added or deleted to each exercise as needed. The software should feature an administrative section and a student section, both of which are password protected.

**ALLEN-BRADLEY SLC500 5/03 PROGRAMMABLE CONTROLLER SYSTEM** - Adds to the PLC troubleshooting trainer. Requires customer-supplied PC compatible computer, software and interface. Includes: (1) Allen-Bradley SLC500 5/03Model, (1) 7 slot rack, (32) opto-isolated 24VDC inputs, (32) opto-isolated 24VDC outputs, (1) modular power supply, (1) cable set. The minimum hardware specifications are as follows:

**Controller** - The controller shall be an industrial grade type, model Allen-Bradley Model SLC 500/03, with specifications as follows:
- Programming Language: Ladder Diagram
- Memory Capacity: 8K
- Memory Type; Battery-backed RAM
- Maximum I/O Capability: 4096 plus remote I/O capability
- Contacts: Normally open and normally closed
- Coils (Internal Control Bits): Regular and Latched
- 2-Discrete Input Module: sourcing type, 16 inputs total, 24 vdc
- 2-Discrete Output Module: sourcing type, 16 outputs total, 24 vdc
- Mounting Type: slot rack with slide in processor and I/O modules
- Rack Size: 7 slots
- Communications: DH-485, RS-232 and ASCII
- Add-on Capability: analog modules, remote I/O, and data highway communications
- Built-in RS-232 Channel for communication with Programming Terminal, DH-485 and ASCII I/O connection with other ASCII devices.
- Instruction set:
  - Relay control, basic math (eg add, multiply), comparison, BCD, program control (eg subroutine, master control relay), sequencer, Data Move, logic (eg and, or, not), timers, counters, immediate input/output, bit shift, multiplex
  - Stack (lifo and fifo), Interrupt, PID, communications (eg message read/write), fault routine, file manipulation
  - Additional 28 programming instructions including Trigonometric, PID (proportional), exponential, floating point and compute.

**ITEM 2: PLC INTERFACE APPLICATION DEVICES – QTY 2 each**
Steel gage panels with mounted industrial quality components pre-wired to a circuit board with a plug-in edge connector which allows easy plug-in of all I/O to the PLC trainer application unit.

**2a - INPUT/OUTPUT SIMULATOR APPLICATION STATION** - The components shall include (16) 24 VDC output lamps and (16) 2-position selector switches.

**2b - OPERATOR APPLICATION STATION** - The components shall include
- (2) Black momentary pushbuttons
- (3) 24 VDC indicator lamps
- (1) Green momentary pushbutton
Specifications

(1) Red mushroom pushbutton
(1) 2-position selector switch
(1) 3-position selector switch

Programmable Display Module
Adds to operator application station. The display unit shall include a 20 digit canned message display with pre-programmed messages.

2c - BCD/LED APPLICATION STATION - Components shall include (1) 4 digit BCD thumbwheel, (1) 4 digit LED readout and (1) 3/4 digit toggle switch.

2d - ELECTRO-PNEUMATIC APPLICATION STATION - The components shall include (1) single solenoid electro-pneumatic valve, (1) double solenoid electro-pneumatic valve, (4) limit switches, (2) cylinders, and (1) pressure switch.

2e - ELECTRO-MECHANICAL APPLICATION STATION - The components shall include (1) reversing contactor (24 VDC), (1) 24 VDC motor, (1) leadscrew assembly, and (2) limit switches.

2f - EXTERNAL INTERFACE STATION - The components shall include (8) keyed input connectors, (8) keyed output connectors, (8) input cable assemblies, (8) output cable assemblies.

ITEM 3: ADVANCED PLC EQUIPMENT – QTY 2 each
Include Student Curriculum and Teacher’s Assessment/Portfolio Guide for each. The student curriculum should be a skills-based format that focuses on teaching industrially-relevant tasks. The curriculum must be capable of completely self-directed and instructor-directed study. All subject content as well as hands-on activities shall be included in the student curriculum. All activities must correlate directly to the hardware supplied, with detailed illustrations and diagrams. All learning materials needed shall be contained in the curriculum including text material, laboratory equipment activities, and multimedia directions. No external text sources shall be required. A combination of step-by-step enabling activities and creative, problem-solving activities shall be provided. The Teacher’s Package should include quizzes for all topics. The Teacher’s Package shall include methods for both cognitive objective assessment and authentic skill assessment, with all skill assessment criteria explained in detail. Detailed instructions and any supplemental material shall be provided for the teacher to perform live assessment of each student.

3a - PANELVIEW SYSTEM FOR SLC500 WITH DH-485 - This system shall consist of Panelview Operator Interface Terminal, Panelbuilder 32 software, workstation console, cable set, student curriculum, and instructor’s guide to enable operation and training with the Allen-Bradley SLC 500 and DH-485 Data Highway network. Specifications for each item are as follows:
• PanelView Operator Terminal - Panelview 1000e model with 10-inch color screen and keypad data entry.
• PanelBuilder 32 Software - to consist of one station license for Panelbuilder 32 software capable of running on Windows-based PC with Windows 98 or higher operating system
• Workstation Console - to consist heavy duty steel console that mounts the Panleview terminal to separately-supplied PLC troubleshooting trainer. The console shall feature hinges that allow the panel to swivel.
• Cable Set - to consist of cables required to connect Panelview to separately-supplied SLC500 PLC. The student curriculum shall teach the following tasks related to Panelview: setup, connection, operation, programming, and diagnostics.

3b - PLC ANALOG APPLICATION SYSTEM FOR SLC500 - This system shall consist of one Analog Module, one Analog Application Station, cable set, student curriculum, and instructor’s guide to enable operation and training with the Allen-Bradley SLC 500 and analog control.

Analog I/O Application Station - Shall consist of a square panel with industrial quality components mounted on it. The panel shall be primed, painted and include silkscreened identification. The
components shall be prewired to a circuit board with a plug-in edge connector which allows easy plug-in of all I/O to the PLC trainer application unit. The panel shall have an input section with 3-1/2 digit LCD analog input display, 4 channel external analog input selector switch, internal potentiometer analog input with 0-10 VDC, internal/external analog input selector switch switch, voltage/current signal selector switch, 16 point external discrete IO plug-in connector with 16 indicator lights. The output section shall have a 3-1/2-digit LCD analog output display, 4-channel external analog output selector switch, and voltage/current signal selector switch. The external analog inputs and outputs shall have a single plug-in connector for connection to external analog IO. The external discrete inputs shall have a single plug-in connector for connection.

**Analog Module** - The module shall be a combination module compatible with the SLC500 PLC. It shall include single slot-mounted I/O module with (2) 4-20 ma input channels and (2) 4-20 ma output channels.

**The student curriculum shall teach the following tasks related to remote IO communications:** setup, connection, operation, programming, and diagnostics.

3c - **PLC Data Highway DH-485 System for SLC500/03** - This system shall consist of 2 Data Highway PLC link interface modules, one RS-232 to DH-485 interface module, cable set, student curriculum, and instructor’s guide to enable operation and training with the Allen-Bradley SLC 500 and DH-485 Data Highway network.

**The student curriculum shall consist of learning activities that teach the following tasks related to Data Highway communications:** setup, connection, operation, programming, and diagnostics.

3d - **PLC REMOTE IO SYSTEM FOR SLC500** - This system shall consist of one Remote IO Adapter Module, one Scanner Module, cable set, student curriculum, and instructor’s guide to enable operation and training with the Allen-Bradley SLC 500 and remote IO network.

**The student curriculum shall consist of learning activities that teach the following tasks related to remote IO communications:** setup, connection, operation, programming, and diagnostics.

**ITEM 4: PRINT-BASED CURRICULUM and TEACHER GUIDES LICENCES (if not included in the training module areas listed above) – QTY 1 each**

Shall consist of a license and curriculum material preferably on CDROM for user reproduction of up to a minimum of fifty (50) copies for each of the:

- 4a - CURRICULUM PRINT LICENSE – SLC500 Programmable Controllers
- 4b - CURRICULUM PRINT LICENSE – PLC Analog Application
- 4c - CURRICULUM PRINT LICENSE – Panelview Operator System DH-485
- 4d - CURRICULUM PRINT LICENSE – PLC Data Highway 485
- 4e - CURRICULUM PRINT LICENSE – PLC Remote IO

**ITEM 5: INTERACTIVE MULTIMEDIA (if not included in the training module areas listed above) – QTY 2**

**Interactive CDROM Curriculum- Programmable Controller Curriculum** - to include interactive computer-based instruction in CDROM format with both theory and hands-on tutorials consisting of text, digital video, voice, online self-review tests, interactive simulations and color diagrams and photos.

The curriculum shall be designed in a skill-based format that focuses on teaching industrially-relevant tasks. This curriculum shall be designed for use in a self-directed student learning environment or an instructor lead learning environment. All learning materials needed shall be contained in the package including text material and hands-on tutorials. No external text sources shall be required. Each lab activity shall be identified by the industrial task taught. A self-review of five to ten questions shall be provided after each segment. This software shall be provided as a one station license.
SECTION 2 - MECHANICAL TRAINING MODULES

The training systems must include all necessary items to meet the specified teaching objectives. Sample specifications are included for each item.

Each complete training system must include all necessary hands-on training equipment, accessories, printed student curriculum, and CD ROM based interactive training curriculum.

The individual component specifications may vary as long as the system meets these general specifications:

ITEM 6: HYDRAULIC/PNEUMATIC TRAINING MODULE – QTY 1
The training system must include student curriculum and equipment for teaching industry level skills covering applications of advanced hydraulic systems, installation, maintenance, troubleshooting.

HYDRAULIC TROUBLESHOOTING SYSTEM – This system shall teach troubleshooting of hydraulic components and systems as well as the operation of advanced hydraulic components and systems. It shall include a mobile workstation, control center, hydraulic power unit, overrunning load hydraulic circuit panel, compression load hydraulic circuit panel, power unit hydraulic circuit panel, running load hydraulic circuit panel, hydraulic troubleshooting and servicing package, student curriculum, and teacher’s guide.

Mobile Workstation - This workstation shall be designed to mount a hydraulic power unit to the frame and detachable hydraulic circuit panels to the frame. It shall have a sheet metal drip pan, which runs the length of the trainer.

Hydraulic Power Unit - This unit shall be completely assembled, plumbed, wired and tested to provide a minimum of 6 gpm flow at a maximum pressure to 1000 PSI/ 3450 kPa with both pumps or a minimum of 1 gpm flow with one pump. The minimum features shall include:
• Pump, fixed gear type, 1 gpm at 1750 rpm
• Pump, variable volume, pressure-compensated, vane type with max volume stop, 5 gpm at 1750 rpm
• Electric motor, 3 hp, 208/230 VAC, 50/60 Hz/, 3 phase
• C-Face pump adapter
• Reservoir, 20 gal./76Liters, JIC type
• 2-Suction filters, strainer type
• Suction gage
• Return Line Filter, canister type with indicator
• Filler-Breather cap
• Cavitation Valve
• Air Ingestion Valve
• Oil level gauge with temperature gauge

Hydraulic Circuit Panels- The hydraulic circuit panels supplied shall each consist of numerous heavy duty industrial hydraulic components which are mounted to a steel mounting panel. The components shall be connected to each other through steel tubing using ferule-type fittings and connected in such a way to simulate an industrial hydraulic application. Each panel shall be detachable to permit insertion of other panels for study of other applications. Each panel shall also include a number of manually inserted faults which recreate actual hydraulic component and system failures. The circuits shall also include realistic
troubleshooting test points so that students can perform systems-level troubleshooting without disassembling components. A minimum total of 21 electrical faults, 27 hydraulic faults, and 11 adjustment faults shall be provided to assure that students will be presented with realistic range of troubleshooting experiences.

- **Overrunning Load Hydraulic Circuit Panel** - This panel shall include the following components:
  - 1-Directional control valve, 4-way, 3-position, blocked center, pilot-operated, double solenoid,
  - subplate
  - 3-flow control valves, non compensated
  - 1-Counterbalance valve, cast body type with bypass check valve
  - 1-Cylinder, jic type, 12 in stroke, 1 inch bore, cylinder cushions
  - 1-2-way solenoid directional control valve
  - 3-Electrical limit switches, metal enclosure type, roller arm type
  - 1-Load device, 125-lb weight, attached to the cylinder rod, with guard

- **Compression Load Hydraulic Circuit Panel** - This panel shall include the following components:
  - 1-Directional control valve, 4-way, 3-position, free float center, direct-operated, double solenoid, subplate mounted
  - 2-Sandwich flow control valves, non compensated
  - 1-Pressure reducing valve, cast body type, subplate mounted with bypass check valve
  - 1-Cylinder, jic type, 6 in stroke, 1 inch bore,
  - 2-Electronic sensors
  - 1-Load device, spring type designed to simulate a compression load
  - 2-Pilot-Operated Check Valves, external, cast body

- **Power Unit Hydraulic Circuit Panel** - This panel shall include the following components:
  - 1-Unloader valve- cast body type, subplate mount
  - 3-Check valve
  - 1-Relief valve- cast body type with remote port, subplate mount
  - 1-Remote relief valve, direct operated, cartridge type
  - 1-Accumulator, bladder type, 60 cubic inch
  - 2-Vent valve, solenoid operated, 2-way
  - 4-Needle Valves
  - 1-Pressure Gage, 0-1500 psig, 2.5-inch liquid filled
  - 1-2-Way Shutoff Valve

- **Running Load Hydraulic Circuit Panel** - This panel shall include the following components:
  - 1-Directional control valve, 4-way, 3-position, blocked center, direct-operated, double solenoid
  - 1-Directional control valve subplate
  - 1-Flow control valve, non compensated
  - 1-Flow control valve, pressure compensated
  - 1-Dual cross cushion relief valve
  - 2-make-up check valve, 1 psi spring
  - 1-Hydraulic Motor, industrial type with drain line, .75 cu inch/rev displacement
  - 1-load device, caliper brake with pressure regulator and gage
  - 1-Flywheel
  - 1-Flywheel Guard

**Hydraulic Troubleshooting And Servicing Package** - The instrumentation shall provide measurement of pressure and flow for troubleshooting at various points in the system. The package should include:
- 1-Flow Meter with quick connect fittings
- 3-Pressure Gage, 0-1500 psig, 2.5-inch liquid filled, with quick connect fitting
- 1-Electrical Pressure Switch
Control Center: The control center shall provide control of the operation of the hydraulic system to provide a realistic machine operation experience. All components shall be mounted to an enclosure, which is in turn mounted to the system frame. It shall contain the following components:
1-Programmable Controller, 22 inputs and 18 outputs
1-Lockout/tagout
1-Circuit Breaker Switch
1-Thumbwheell switch with 8 selectable program sequences
1-Power On Indicator Light
1-Cycle Start Pushbutton
1-Cycle Stop Pushbutton
1-Manual Auto selector switch
1-Motor Starter
1-Emergency Stop Pushbutton
3-Manual Mode Selector Switches

Student Curriculum
The student curriculum supplied shall be designed in a skills-based format that focuses on teaching industrially-relevant tasks. This curriculum shall be designed for use in a self-directed student learning environment or an instructor lead classroom. All learning materials needed shall be contained in the curriculum including text material, laboratory equipment activities, and multimedia directions. No external text sources shall be required. A combination of step-by-step enabling activities and creative, problem solving activities shall be provided. A self-review should be provided after each segment. All activities must correlate directly to the hardware supplied, with detailed illustrations and diagrams.

Teacher’s Assessment/Portfolio Guides - A teacher’s guide shall be provided. It should contain student data sheets, data sheet solutions, self review answers, quizzes, quiz answers, student skill record sheets, and authentic assessment. All tasks listed in the packet shall be listed on personalized student record sheets. The Instructor’s Package shall include directions for authentic skill assessment.

ITEM 7: MECHANICAL TRAINING MODULES – QTY 2
ITEM 7 may be supplied as one training system or may be supplied broken into two or more training module systems that will work together. The sample minimum specifications are broken down into two systems.

The complete mechanical training system must include student curriculum and all necessary equipment for teaching industry level skills covering the following objectives:

- operation, setup and alignment of v-belts, roller chains, pillow block bearings, spur gears, shafts, key fasteners, flexible jaw couplings, and sleeve couplings.
- operation, maintenance, troubleshooting, design, and selection of mechanical drives systems including FHP v-belts, classic v-belts, wedge v-belts, single and double roller chains, cog belts, silent chain, lubrication, 5 types of couplings, and 2 types of indicator alignment methods.

7a - MECHANICAL DRIVES SYSTEM 1 – shall include the following components: mobile workstation, base motor package, motor control unit, shaft panel 1, shaft panel 2, belt drive panel, chain drive panel, gear drive panel, alignment/measurement package, indicator package, multi-drawer storage unit, student curriculum, and instructor’s guide. These components shall meet the following minimum specifications:

Mobile Workstation – constructed of welded tubular steel with at least three (3) 2-panel storage slots located below the work surface for storage of component panels. Each plate shall be drilled with a grid
pattern of slots and holes for mounting mechanical drive setups that are directly referenced in the curriculum. The workstation shall also be equipped with a dual-sided overhead mounting rack, which permits student access to the experiments from both sides of the table. These panels shall mount on each side of the trainer, permitting easy access for student activities. All panels shall be designed to be very visible and separated into specific groups of components. The workstation should have self-contained storage.

**Base Motor Package**-This package should include the following items: constant speed electric motor, adjustable motor base, mounting bolt package, and a prony brake. These components shall meet the following minimum specifications:

- **Adjustable Motor Base** – This unit shall be designed to position the constant speed electric motor in such a way that permits tensioning of a v-belt or chain drive system. This unit shall be designed with heavy-duty steel construction that uses one formed steel base that slides within another formed steel base. This design shall minimize misalignment due to side loading. It shall use a lead screw to position, locking mechanism, and adjustable slots.

- **Constant Speed Electric Motor** – shall be a .33 Hp, constant speed motor, capacitor start, .625-in. diameter inch shaft, 115VAC/60 Hz or 230VAC/50 Hz, 1 phase. It shall have a power cable with plug-in cable to motor control unit.

- **Prony Brake**- A shaft torque measurement and load device. It shall consist of a formed steel gage unit, aluminum brake drum with mounting for 5/8-inch motor shafts, balanced pulley, spring force gage, load adjustment knob, double set screw locking device, coolant spray bottle. Load range shall be 0-3.05 N-m.

- **Mounting Bolt Package** – shall include grade 5 or above bolts, plain washers, lock washers, and nuts of various sizes.

**Motor Control Unit** – This unit shall provide control of both a variable speed motor and a constant speed motor as well as providing measurement instruments to monitor the performance of the drive system. It shall have a NEMA enclosure. The components shall include a manual motor starter, safety switch with lockout/tagout device, speed control unit for variable speed motor, power on indicator, constant speed motor current meter, variable speed motor current meter, fuse and motor read switch. The unit shall have a main power cord, which plugs into a wall outlet and supplies power to all items in the motor control unit. Two plug-in connectors shall be mounted to the side of the unit to enable connection of the motors to the control unit.

- The motor starter shall be a single pole type with heater. It shall be rated for 7 amps. The constant-speed motor current meter shall be an AC analog type with 0-10 amp range. The variable-speed motor current meter shall be an AC analog type with a 0-5 amp range. The fuse shall be a slow blow type with a 5 amp rating. The lockout tagout assembly shall consist of safety lockout hasp, (2) locks, and (5) tags.

**Shaft Panel 1** - The panel shall be constructed of heavy duty steel with lift handles for easy handling. The panel shall have mounting devices and retainers to mount the following components for easy visual identification and storage, which shall be included:

- 1-Shaft, .625-in dia., 12-in long, stainless steel
- 2-Pillow block bearing, cast iron, .625-in bore, lock collar
- 4-Pillow block bearing standoff, aluminum
- 3-Constant speed motor riser, aluminum
- 1-Soft foot riser
- 1-Jaw coupling, type L with .625-in bore, with keyway, setscrew

The following additional items shall be supplied and shall be stored in the drawer unit:

- 20-Stainless steel shim, 2-in, 0.003-in thick
- 20-Stainless steel shim, 2-in, 0.005-in thick
- 20-Stainless steel shim, 2-in, 0.010-in thick
- 20-Stainless steel shim, 2-in, 0.020-in thick
- 8-Stainless steel shim, 2-in, 0.050-in thick
Shaft Panel 2 - The panel shall be constructed of heavy duty steel with lift handles for easy handling. The panel shall have mounting devices and retainers to mount the following components for easy visual identification and storage, which shall be included:
- 1-Flexible jaw coupling half, 0.5-in bore
- 1- Shaft, 0.625-in dia., 12-in long, stainless steel
- 1- Shaft, 0.625-in dia., 8-in long, stainless steel
- 1- Shaft, 0.625-in dia., 6-in long, stainless steel
- 6- Pillow block bearing, cast iron, 0.625-in bore, lock collar
- 12- Pillow block bearing standoff
- 1- Sleeve coupling, 0.625-in bore, with keyway, SS
- 4- Gear Motor Risers

Belt Drive Panel 1 - The panel shall be constructed of heavy duty steel with lift handles for easy handling. The panel shall have mounting devices and retainers to mount the following components for easy visual identification and storage, which shall be included:
- 1- Sheave, FHP, 0.625-in dia. fixed bore, 2-in P.D., keyway, set screw
- 1- Sheave, FHP, 0.625-in dia. fixed bore, 3-in P.D., keyway, set screw
- 1- Sheave, FHP, 0.625-in dia. fixed bore, 4-in P.D., keyway, set screw
- 1- Belt tension checker
- 1- Sheave gage

The following additional items shall be supplied and shall be stored in the drawer unit:
- 1- Classic V-belt, A size, 36-in length

Chain Drive Panel 1 - The panel shall be constructed of heavy duty steel with lift handles for easy handling. The panel shall have mounting devices and retainers to mount the following components for easy visual identification and storage, which shall be included:
- 1- Sprocket, 0.625-in dia. bore, 40 pitch, 30 teeth
- 1- Sprocket, 0.625-in dia. bore, 40 pitch, 20 teeth
- 1- Sprocket, 0.625-in dia. bore, 40 pitch, 15 teeth
- 1- Chain Puller, #35-#60 chain

The following additional items shall be supplied and shall be stored in the drawer unit:
- 1- Roller chain, #40, 0.5-in pitch 39.5-in long
- 1- Master link, #40 chain

Gear Drive Panel 1 - The panel shall be constructed of heavy duty steel with lift handles for easy handling. The panel shall have mounting devices and retainers to mount the following components for easy visual identification and storage, which shall be included:
- 1- Spur gear, 0.625-in dia. bore, 12DP, 24 teeth, 14-1/2 degree pressure angle (PA)
- 1- Spur gear, 0.625-in dia. bore, 12DP, 36 teeth, 14-1/2 degree P.A.
- 1- Spur gear, 0.625-in dia. bore, 12DP, 48 teeth, 14-1/2 degree P.A.
- 1- Spur gear, 0.625-in dia. bore, 16DP, 80 teeth, 14-1/2 degree P.A.
- 1- Spur gear, 0.625-in dia. bore, 16DP, 64 teeth, 14-1/2 degree P.A.
- 1- Spur gear, 0.625-in dia. bore, 16DP, 24 teeth, 20 degree P.A.
- 1- Spur gear, 0.625-in dia. bore, 16DP, 60 teeth, 20 degree P.A.
- 1- Gear Gage, involute

The following additional items will be supplied loose: Spray can, teflon spray and a variable speed motor.

Variable Speed Motor - right angle gear drive, 52:1 ratio gear drive, AC/DC universal motor, speed range 0-306 rpm at no load, 1.3 full load amps, 27 in-lbs full load torque, 1/15 Hp. The variable speed motor shall
include plug-in power cable, which is compatible with motor control unit. It shall also include mounting plate for attachment to workstation.

**Alignment Package Level 1** - A package of tools and devices shall be supplied that enables the student to perform alignment and measurement of mechanical drives. It shall include (1) Feeler Gage, 3.375-in spirit level, 36-in straight edge, 9-in torpedo level, and combination square. These items shall be stored in the drawer unit.

**Indicator Package Level 1** – This package shall be used to perform precision motor leveling and with added components precision shaft alignment. It shall include: (1) dial indicator with 90 degree tip, (1) set of adjustable mounting brackets and clamps for attachment of dial indicator, magnetic base, and magnetic base mounting plate with quick release attachment. These items shall be stored in the drawer unit.

**Phototachometer** - shall consist of an industrial grade phototachometer: hand-held unit, LCD display, record button, memory button. Speed range 1-10000 rpm

**Safety Cover** – The unit is to come with a totally enclosed plexi-glass cover (sides and top) to ensure student safety during the operation of the experiment. Access holes are allowed but limited to a small precision adjustment tool. Openings large enough to allow access by the human hand during operation will not be permitted.

**Student Curriculum** - The student curriculum shall consist of learning activities covering a variety of industry tasks. **Topics shall include operation, setup and alignment of v-belts, roller chains, pillow block bearings, spur gears, shafts, key fasteners, flexible jaw couplings, and sleeve couplings.** Students shall also learn system analysis.

The student curriculum supplied shall be designed in a skills-based format that focuses on teaching industrially-relevant tasks. This curriculum shall be designed for use in a self-directed student learning environment. All learning materials needed shall be contained in the curriculum including text material, laboratory equipment activities, and multimedia directions. No external text sources shall be required. A combination of step-by-step enabling activities and creative, problem solving activities shall be provided. A self-review of five to ten questions shall be provided after each segment. All activities must correlate directly to the hardware supplied, with detailed illustrations and diagrams.

**Teacher’s Assessment/Portfolio Guides** - A teacher’s guide shall be provided. It shall contain student data sheets, data sheet solutions, self review answers, quizzes, quiz answers, student skill record sheets, and authentic assessment. The Instructor’s Package shall include directions for authentic skill assessment.

**7b - MECHANICAL DRIVES SYSTEM 2** – This system shall add to the mechanical drives system 1 to provide study of heavy duty belt drives, heavy duty chain drives, right angle gears, bushings, lubrication, a variety of coupling types. Also covered shall be maintenance, troubleshooting, and selection of mechanical drives. The system shall include the following components: belt drive panel 2, belt drive panel 3, coupling panel, chain drive panel 2, grease gun, indicator package level 2, student curriculum, and instructor’s guide. These components shall meet the following minimum specifications:

**Belt Drive Panel 2**- The panel shall be constructed of heavy duty steel with lift handles for easy handling. The panel shall have mounting devices and retainers to mount the following components for easy visual identification and storage, which shall be included:

1. Conventional v belt sheave, single groove, 3.4 PD, QD bushed
2. Conventional v belt sheave, single groove, 4.4 PD, QD bushed
3. QD bushings
4. Conventional v belt sheave, double groove, 3.6 PD, split taper
5. Conventional v belt sheave, double groove, 5.5 PD, split taper
6. Split taper bushings
Belt Drive Panel 3 - The panel shall be constructed of heavy duty steel with lift handles for easy handling. The panel shall have mounting devices and retainers to mount the following components for easy visual identification and storage, which shall be included:

- 2-Timing Belt Pulley, 16 teeth, 3/8 inch pitch
- 1-HTD belt sprocket, 24 tooth, QD bushed
- 1-HTD belt sprocket, 30 tooth, QD bushed
- 2-QD bushings, .625-in bore
- 1-Kiss Idler Pulley, 4.5-in
- 1-Variable Pitch Sheave

The following additional items shall be supplied and shall be stored in the drawer unit:

- 1-Timing Belt, 1-inch x 36-in x .375-in pitch
- 1-HTD Belt, 8 mm pitch, 34-in

Coupling Panel 1 - The panel shall be constructed of heavy duty steel with lift handles for easy handling. The panel shall have mounting devices and retainers to mount the following components for easy visual identification and storage, which shall be included:

- 1-All Metal Gear Coupling with sleeve and seal kit
- 1-Chain Coupling with metal double roller chain
- 1-Chain Coupling Cover and seal kit
- 1-Grid Coupling
- 2-Taper lock bushing for grid coupling
- 1-Grid Coupling Cover and seal kit
- 1-Elastomer-in-shear coupling
- 1-Solid Metal Flange Coupling, 4-bolt type

Chain Drive Panel 2 - The panel shall be constructed of heavy duty steel with lift handles for easy handling. The panel shall have mounting devices and retainers to mount the following components for easy visual identification and storage, which shall be included:

- 1-Double Strand Roller Chain sprocket, 23 tooth, taper lock bushed
- 1-Double Strand Roller Chain sprocket, 15 tooth, taper lock bushed
- 2-Taper lock bushings
- 2-Silent Chain sprocket, 17 tooth
- 1-Chain breaker
- 1-Chain idler sprocket
- 1-Idler mounting bracket assembly

The following additional items shall be supplied and shall be stored in the drawer unit:

- 1-Silent Chain, 0.5-in pitch, 36-in L
- 1-Roller Chain, #40, 120-in L
- 1-Double Strand Roller Chain, 0.5-in pitch, 48-in L

Grease Gun - Shall include a hand operated grease gun, one (1) grease cartridge and a pack of MSDS sheets.
Indicator Package Level 2 - (1) dial indicator with 90 degree tip, (1) set of adjustable mounting brackets and clamps for attachment of dial indicator, and inspection mirror.

Indicator Package Level 1 – This package shall add to indicator package level 1 to perform precision motor shaft alignment. It shall include (1) dial indicator with 90 degree tip, (1) set of adjustable mounting brackets and clamps for attachment of dial indicator, and inspection mirror. These items shall be stored in the drawer unit.

Student Curriculum - Shall consist of learning activities covering various industry tasks. Topics shall include operation, maintenance, troubleshooting, design, and selection of mechanical drives systems including: FHP v-belts, classic v-belts, wedge v-belts, single and double roller chains, cog belts, silent chain, lubrication, 5 types of couplings, and 2 types of indicator alignment methods.

The student curriculum supplied shall be designed in a skills-based format that focuses on teaching industrially-relevant tasks. This curriculum shall be designed for use in a self-directed student learning environment. All learning materials needed shall be contained in the curriculum including text material, laboratory equipment activities, and multimedia directions. No external text sources shall be required. A combination of step-by-step enabling activities and creative, problem solving activities shall be provided. A self-review of five to ten questions shall be provided after each segment. All activities must correlate directly to the hardware supplied, with detailed illustrations and diagrams.

Teacher’s Assessment/Portfolio Guides - A teacher’s guide shall be provided. It shall contain student data sheets, data sheet solutions, self review answers, quizzes, quiz answers, student skill record sheets, and authentic assessment. The Instructor’s Package shall include directions for authentic skill assessment.

ITEM 8: PIPING SYSTEMS MODULE – QTY 1
The complete piping systems trainer must include student curriculum and all necessary equipment for teaching industry level skills covering the following objectives: sizing, installation, cutoff, bending and layout of steel tubing, hose, plastic piping, iron pipe, pipe hangers, expansion joints, pipe insulation. Students will also learn installation, operation, and maintenance of each of the sloan valves, 2-way valves, and check valves. Students will learn piping schematic reading.

PIPING SYSTEMS TRAINER - This system shall be designed to teach construction of fluid piping systems for both gas and liquid transmission. It shall contain the following items:

Mobile Workstation - Shall be a welded steel unit designed for mounting all components made of steel tubing. Four vertical tubing lengths shall be supplied which mount to movable mounts attached between the upper and lower horizontal parts of the frame. These mounts shall allow the vertical lengths to be positioned anywhere along the length of the frame. It should include four casters for mobility and shall use a double-sided design for multiple student access. A steel drip pan with drain shall be provided to capture liquid during disassembly of piping networks. The unit shall have (2) movable bulkhead units and (2) vertical hanger struts for use with construction projects.

Sloan Valve with Maintenance Kit - to include an operational manually-operated sloan valve with drain and water supply connection. Also included shall be a set of maintenance components consisting of: repair kit, rebuild kit, pushbutton assembly, vacuum breaker, bak-check stop and repair kit.

Fluid Testing Apparatus - A means of testing each piping network for integrity shall be provided consisting of centrifugal pump, electric motor 50/60 phase, 115/230 VAC, 1/4 hp, 50/60 hz, 2-port piping supply manifold, 2-port piping return manifold, 15-gallon reservoir, ground fault interrupter, safety switch
with on/off switch, lockout/tagout hasp with lock and tag, suction line made of 0.5-in iron pipe, 2-port pressure manifold using 0.5-in iron pipe, and (4) shutoff valves.

**Pipe Fitting Identification Kit**- An assortment of fittings shall be supplied to enable students to identify different types and sizes of pipe fittings. The types to be supplied are: elbows, couplings, unions, plugs, crosses, nipples, tees.

**Iron Pipe Identification Kit**- Assorted sizes of iron pipe shall be supplied to enable students to identify pipe sizes.

**Plastic Pipe Identification Kit**- Assorted sizes of plastic pipe shall be supplied to enable students to identify pipe sizes.

**Metal Tubing Identification Kit**- Assorted sizes and types of steel tubing shall be supplied to enable students to identify tubing sizes.

**Hydraulic Hose Identification Kit**- Assorted sizes of hydraulic hose shall be supplied to enable students to identify hose sizes.

**Plastic Fitting Construction Kit**- A set of PVC plastic pipe fittings shall be supplied for use in system construction including: elbows, unions, tees, nipples.

**Metal Tube Fitting Construction Kit**- A set of metal tube fittings shall be supplied for use in system construction including: elbows, unions, tees, nipples.

**Iron Pipe Construction Kit**- A set of iron pipe fittings shall be supplied for use in system construction including: elbows, unions, and tees, and nipples.

**Hydraulic Hose Construction Kit**- A set of hydraulic hose fittings shall be supplied for use in system construction including: elbows, unions, and tees, and nipples.

**Valve Construction Kit**- A set of valves shall be supplied for use during student construction projects including: Sloan valve, 2-way globe valve, check valve and (2) ball valves.

**Pipe Insulation Package**

**Pipe Thread Gage Kit**- to include pipes with (4) different thread sizes to enable identification of thread size

**Fitting Storage Unit**- ideally to consist of a metal panel with hangers for hanging 32 plastic bins of 3 different colors. This unit shall mount to the side of the mobile workstation.

**Student Curriculum** - The student curriculum shall consist of learning activities. **The topics covered shall include sizing, installation, cutoff, bending and layout of steel tubing, hose, plastic piping, iron pipe, pipe hangers, expansion joints, pipe insulation. Students will also learn installation, operation, and maintenance of each of the sloan valves, 2-way valves, and check valves. Students will learn piping schematic reading.**

The student curriculum supplied shall be designed in a skills-based format that focuses on teaching industrially-relevant tasks. This curriculum shall be designed for use in a self-directed student learning environment. All learning materials needed shall be contained in the curriculum including text material, laboratory equipment activities, and multimedia directions. **No external text sources shall be required.** A combination of step-by-step enabling activities and creative, problem solving activities shall be provided.
A self-review of five to ten questions shall be provided after each segment. All activities must correlate directly to the hardware supplied, with detailed illustrations and diagrams.

**Teacher’s Assessment/Portfolio Guides** - A teacher’s guide shall be provided. It shall contain student data sheets, data sheet solutions, self review answers, quizzes, quiz answers, student skill record sheets, and authentic assessment. The Instructor’s Package shall include directions for authentic skill assessment.

**ITEM 9: PUMP SYSTEMS MODULE – QTY 1**
The complete pump systems trainer must include student curriculum and all necessary equipment for teaching industry level skills covering the following objectives: centrifugal pump operation, seal maintenance, applications, installation, maintenance, troubleshooting, performance analysis, and component selection.

**PUMP SYSTEMS TRAINER** – This system shall teach operation, installation, performance analysis, troubleshooting, and maintenance of centrifugal pumps. It shall include a mobile workstation, reservoir, instrumentation panel, motor control center, electric motor unit, piping network, centrifugal pump, student curriculum, and teacher’s guide.

**Mobile Workstation** - This workstation shall be welded steel construction. It shall have a bottom shelf for storage of un-mounted pumps and the reservoir.

**Reservoir** - to be made of highly durable plastic, 30-gallon size, and mounted to mobile workstation. It shall have a drain connection with 2-way drain valve.

**Instrumentation Panel** - The instrumentation panel shall provide measurement of pressure and flow of the pump. The components shall be mounted on 11-gauge steel. It shall be mounted on the workstation and provide easy observation of instrumentation by the student. The instrumentation shall include:

1. Flow Meter Readout, digital, LCD
2. Pressure Gage, 0-15 psig, 4-inch liquid filled
3. Pressure Gage, 0-60 psig, 4-inch liquid filled
4. Pressure Gage, 0-160 psig, 4-inch liquid filled
5. Vacuum Gage, 0-30 psig, 4-inch liquid filled

The flow meter readout shall connect to the flow meter supplied as part of the piping network via a connecting cable. The pressure gage ports shall be connected to quick connect fittings, which are mounted to the instrumentation panel. Each gage shall have a unique type of quick connect that is color-coded to avoid incorrect connection of gages to the piping network.

**Motor Control Center** - The motor control center shall provide control of the operation of the electric motor, which is used to drive the pump. All components shall be mounted to an enclosure, which is in turn mounted to the instrumentation panel. It shall contain the following components:

1. Variable Speed AC Motor Drive, 0.5-5 Hp, 1-Phase 208 VAC, capable of driving two motors at the same time
2. Digital Readout for motor speed and current (torque analog), supplied with variable speed drive
3. Circuit Breaker Switch
4. Ground Fault Interrupter Switch
5. Motor On Indicator Light
6. Motor Start Pushbutton
7. Motor Stop Pushbutton
8. Motor Speed Control Adjustment Knob
9. Power Cable
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**Electric Motor Unit**—shall include industrial-grade electric motor, 1/3 Hp, 3-phase, induction motor type, foot mount, coupling guard, steel mounting rails with pre-drilled holes for pumps of various types and motor, plug-in cable to motor, and flexible jaw coupling.

**Piping Network**—a piping network shall be mounted and plumbed on the mobile workstation to operation, troubleshooting, and performance testing of fluid transfer pumps using suction lift conditions. This network shall include:

1. Flow meter, paddle wheel type, 0.5 to 35 gpm range
2. Cavitation valve, gate type
3. Priming port
4. Pseudo-cavitation valve, needle type
5. Load valve, gate type
6. Foot valve with strainer
7. Suction line, PVC construction with transparent section and vacuum gage connection quick connect fitting
8. Pressure line, PVC construction with transparent section and pressure gage connection quick connect fitting
9. Return line, PVC construction
10. Pressure gage hoses, polyurethane, 1/8-inch ID with color-coded quick connects on end
11. Pump vent valve
12. Suction line fill cap

**Centrifugal Pump**—This pump shall be a heavy duty industrial grade unit with foot mount, cast iron housing construction, mechanical seal, 13 gpm @ 9 ft head. Maximum head shall be at least 15 ft.

**Student Curriculum**—The student curriculum shall consist of learning activities which contain industry skills covering centrifugal pump operation, seal maintenance, applications, installation, maintenance, troubleshooting, performance analysis, and component selection.

The student curriculum supplied shall be designed in a skills-based format that focuses on teaching industrially-relevant tasks. This curriculum shall be designed for use in a self-directed student learning environment. All learning materials needed shall be contained in the curriculum including text material, laboratory equipment activities, and multimedia directions. No external text sources shall be required. A combination of step-by-step enabling activities and creative, problem solving activities shall be provided. A self-review of five to ten questions shall be provided after each segment. All activities must correlate directly to the hardware supplied, with detailed illustrations and diagrams.

**Teacher’s Assessment/Portfolio Guides**—A teacher’s guide shall be provided. It shall contain student data sheets, data sheet solutions, self-review answers, quizzes, quiz answers, student skill record sheets, and authentic assessment. A quiz shall be provided for each packet. The Instructor’s Package shall include directions for authentic skill assessment.

**ITEM 10:** PRINT-BASED CURRICULUM and TEACHER GUIDES LICENCES (if not included in the training module areas listed above) – Qty 1 each

Shall consist of a license and curriculum material preferably on CDROM for user reproduction of up to a minimum of fifty (50) copies for each of the:

10a - CURRICULUM PRINT LICENSE - Hydraulic Troubleshooting Training System
10b - CURRICULUM PRINT LICENSE – Mechanical Drives System 1
10c - CURRICULUM PRINT LICENSE – Mechanical Drives System 2
10d - CURRICULUM PRINT LICENSE – Piping Systems
10e - CURRICULUM PRINT LICENSE – Pump Systems

**ITEM 11:** INTERACTIVE MULTIMEDIA (if not included in the training module areas listed above) – QTY 1 each, except Mechanical Drives – QTY 2
Interactive CDROM Curriculum - to include interactive computer-based instruction in CDROM format with both theory and hands-on tutorials consisting of text, digital video, voice, online self-review tests, interactive simulations and color diagrams and photos.

The curriculum shall be designed in a skill-based format that focuses on teaching industrially-relevant tasks. This curriculum shall be designed for use in a self-directed student learning environment or an instructor lead learning environment. All learning materials needed shall be contained in the package including text material and hands-on tutorials. No external text sources shall be required. Each lab activity shall be identified by the industrial task taught. A self-review of five to ten questions shall be provided after each segment. This software shall be provided as a one station license.

11a - Interactive CDROM Curriculum - Hydraulic Troubleshooting Training System
The curriculum shall consist of learning activities which will cover industry skills including applications of advanced hydraulic systems, installation, maintenance, troubleshooting.

11b - Interactive CDROM Curriculum - Mechanical Systems 1
The student curriculum shall consist of learning activities for skills relating to industry tasks in Mechanical Systems including: Introduction to mechanical drive systems, key fasteners, power transmission systems, introduction to V-belt drives, introduction to chain drives, spur gear drives, multiple shaft drives.

11c - Interactive CDROM Curriculum - Mechanical Systems 2
The student curriculum shall consist of learning activities for skills relating to industry tasks in Mechanical Systems including: Heavy duty V-belt drives, V-belt selection and maintenance, synchronous belt drives, lubrication concepts, precision shaft alignment, couplings, and heavy duty chain drives.

11d - Interactive CDROM Curriculum – Piping Systems
The student curriculum shall consist of learning activities which will cover industry skills including sizing, installation, cutoff, bending and layout of steel tubing, hose, plastic piping, iron pipe, pipe hangers, expansion joints, pipe insulation. Students will also learn installation, operation, and maintenance of each of the Sloan valves, 2-way valves, and check valves. Students will learn piping schematic reading.

11e - Interactive CDROM Curriculum - Pump
The student curriculum shall consist of learning activities which cover industry skills including: centrifugal pump operation, seal maintenance, applications, installation, maintenance, troubleshooting, performance analysis, and component selection.

SECTION 3 - ELECTRICAL TRAINING MODULES
The training systems must include all necessary items to meet the specified teaching objectives. Sample specifications are included for each item.

Each complete training system must include all necessary hands-on training equipment, accessories, printed student curriculum, and CD ROM based interactive training curriculum.

The individual component specifications may vary as long as the system meets these general specifications:
ITEM 12: ELECTRICAL TRAINING MODULE – QTY 1
The complete piping systems trainer must include student curriculum and all necessary equipment for teaching industry level skills covering the following objectives: reading prints, selecting wiring sizes, installing industrial wiring, wire splicing, wire bundling, wire labeling, layout, wiring using conduit, and basic wiring of motor control circuits, safety devices, switches, and other related components.

ELECTRICAL WIRING TRAINING SYSTEM - This system shall be designed to teach industrial skills in electrical wiring. It should contain the following items: Mobile workstation, control panel, electropneumatic panel, operator station, (2) 3-phase induction motors, student curriculum, and instructor’s guide.

Mobile Workstation - Shall be a welded steel unit designed for mounting all components with casters for mobility and shall use a double-sided design for multiple student access.

Control Panel - Shall consist of a steel panel, painted and silk-screened with the following components. These components shall not be pre-wired to enable students to learn wiring skills:

- 1-Fused 3-phase safety switch
- 2-Padlocks
- 3-Safety tags
- 1-Pre-attached power cord (4 pole, 5 wire)
- 1-Lockout/Tagout mechanism
- 1-Nema 1 Control Cabinet, hinged, 42in L x 32in W x 8 in D
- 2-3-Phase Fuse Block with 3 fuses
- 2-2-Phase fuse block with 2 fuses
- 1-Ground Detection Indicators
- 1-Control Transformer
- 1-Reversing Motor Starter
- 1-Motor Starter
- 1-Set of raceways
- 1-Timer Relay, 4PST instantaneous, DPST timed (convertible N.O. or N.C.)
- 1-Control Relays, 4PST Convertible N.O. or N.C.
- 50-DIN rail terminal blocks

Electropneumatic Panel - Shall consist of a steel panel, painted and silk-screened with the following components. These components shall not be pre-wired to enable students to learn wiring skills. However, all pneumatic components shall be pre-plumbed.

- 1-Pneumatic Cylinder, 1.5 in bore x 4 in stroke
- 2-Cylinder foot mount
- 1-Cam Actuator
- 1-Nema Limit Switch DPST with adjustable arm
- 1-Flow Control Valve
- 1-Pressure Switch, SPDT
- 1-Filter/Regulator
- 2-Electrical Junction Box with terminal strip
- 1-Set of Flexible Conduit between junction box and other electrical components
- 1-Electropneumatic Valve, single solenoid 5/2, spring return
- 1-Set of assembled tubing and fittings to connect above components

Operator Station - all components shall be premounted but not wired

- 3-Black flush push button (1 N.O., 1N.C.)
- 1-Red mushroom push button (1 N.O., 1N.C.)
- 1-Three position selector switch (1 N.O., 1 N.C.)
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1-Red Indicator Lamp, push to test
1-Green Indicator Lamp, push to test
1-Amber Indicator Lamp, push to test
1-Set of Flexible Conduit connected to Control Panel
1-Set of Terminal Strips
1-Nema 1 Control Cabinet, hinged,

3 Phase Induction Motor – Qty (2) 1/3 HP, NEMA 56 Frame machine rated at 208-230/460 Volts, 3 phase. To include: 1- Motor Mounting plate, Single end shaft for safety

Student Curriculum - The student curriculum shall consist of learning activities for teaching industry level skills including reading prints, selecting wiring sizes, installing industrial wiring, wire splicing, wire bundling, wire labeling, layout, and basic wiring of motor control circuits, safety devices, switches, and other related components.

The student curriculum supplied shall be designed in a skills-based format that focuses on teaching industrially-relevant tasks. This curriculum shall be designed for use in a self-directed student learning environment. All learning materials needed shall be contained in the curriculum including text material, laboratory equipment activities, and multimedia directions. No external text sources shall be required. A combination of step-by-step enabling activities and creative, problem solving activities shall be provided. A self-review of five to ten questions shall be provided after each segment. All activities must correlate directly to the hardware supplied, with detailed illustrations and diagrams.

Teacher’s Assessment/ Portfolio Guides- A teacher’s guide shall be provided. It shall contain student data sheets, data sheet solutions, self-review answers, quizzes, quiz answers, student skill record sheets, and authentic assessment. The Instructor’s Package shall include directions for authentic skill assessment.

ITEM 13: PRINT-BASED CURRICULUM and TEACHER GUIDES LICENCES (if not included in the training module areas listed above) – QTY 1
Shall consist of a license and curriculum material preferably on CDROM for user reproduction of up to a minimum of fifty (50) copies for each of the:
CURRICULUM PRINT LICENSE – Industrial Electrical Wiring Trainer

ITEM 14: INTERACTIVE MULTIMEDIA (if not included in the training module areas listed above) – QTY 1
Interactive CDROM Curriculum – Industrial Electrical Wiring - to include interactive computer-based instruction in CDROM format with both theory and hands-on tutorials consisting of text, digital video, voice, online self-review tests, interactive simulations and color diagrams and photos.

The curriculum shall be designed in a skill-based format that focuses on teaching industrially-relevant tasks. This curriculum shall be designed for use in a self-directed student learning environment or an instructor lead learning environment. All learning materials needed shall be contained in the package including text material and hands-on tutorials. No external text sources shall be required. Each lab activity shall be identified by the industrial task taught. A self-review shall be provided after each segment. This software shall be provided as a one station license.

The student curriculum shall consist of learning activities for skills relating to industry tasks in industrial electrical wiring. The topics covered includes introduction to electrical control wiring and electrical control system wiring.
SECTION 4 - PROCESS CONTROL TRAINING MODULES

QUANTITY – 2 Complete training systems including all necessary items to meet the specified teaching objectives. Sample specifications are included for each item.

Each complete training system must include all necessary hands-on training equipment, accessories, printed student curriculum, and CD ROM based interactive training curriculum. The training system must include student curriculum and industrial quality equipment to teach a measurement and control of process variables including **level, pressure, and flow**. The topics shall include: introduction to process control, instrument tags, piping and instrumentation diagrams, loop controllers, final control elements, level measurement, liquid level control, methods of automatic control, basic flow measurement and control and control loop performance.

The individual component specifications may vary as long as the system meets these general specifications:

**ITEM 15: PROCESS CONTROL TRAINING MODULES**

These items may be bundled together or quoted individually to include all requested components.

15a - PROCESS CONTROL LEARNING SYSTEM

This system shall include a process control system, student curriculum, and a teacher’s assessment guide. These items shall meet the below minimum specifications.

Process Control System

The process control system shall consist of industrial quality components mounted and assembled on a heavy duty bench-top workstation with the capability to teach a variety of process control applications. The components of the system shall include the below components.

1) Workstation – Ideal specifications for workstation:
   - Welded steel tube construction with all components mounted and plumbed on two heavy-duty gauge steel panels which are painted and silkscreened

2) Centrifugal Pump
3) Electric Motor, single phase
4) Proportional Control Valve, pneumatically-operated
5) I/P Converter, 4-20ma input, 3-15 psia output
6) Pneumatic Regulator and Pressure Gage
7) Reservoir Tank, 10 gal, transparent with: Drain Valve, ball type
8) Process Tank, 5 gal, transparent with: 1-2-Compartment Baffle, 2-Drain Valve, ball type, 2-2-Way Valves, Solenoid Operated, 24 VDC, 1-Liquid Level Transducer, pressure-type, 4-20 ma output, 0-1psia range, 2-Float Switches, SPST
9) Piping Network with: 1-Pump flow control valve, ball type with V-notch, 1-Pump Valve, 2-Way Valve, Solenoid Operated, 24 VDC, 2-Control Mode Valves, ball type, 1-Flow Meter, rotameter type, 0-2.0 gpm water, 4-Pressure Gages, 0-30 psig, 2-1/2 inch, 1-Flow Transducer, Paddlewheel type, 4-20ma output
10) Control Panel with:
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- Process Meter with: 4-20ma input; (2) alarm relay outputs, SPDT; Scaleable Output Display; Digital Display, 3-1/2 digit; Programmable
- PLC I/O Interface with: Banana jack connection to process components; DB cable connection to PLC; (8) Discrete Inputs; (8) Discrete Outputs; (4) Analog Inputs; (4) Analog Outputs
- Power Supply, 24VDC, 2.4 Amp
- Relay Control Unit with banana jack connections with: Control Relays, DPDT, 24 VDC; (4) Selector Switch Inputs, 2-Position; (4) Output Indicators, 24VDC; (1) Pump Contactor Relay, 24 VDC; (3) Solenoid Valve Output interface
- 1-Ground Fault Circuit Interrupter Switch
- 1-Duplex Power Outlet
- 1-On/ Off Switch with circuit breaker, 15 Amp
- 1-Power On/ Indicator
- 1-Lockout/ Tagout Set
- 1-Alarm Output, 24 VDC

Student Curriculum
The student curriculum shall consist of learning activities in process control systems. The topics shall include: introduction to process control, instrument tags, piping and instrumentation diagrams, loop controllers, final control elements, level measurement, liquid level control, methods of automatic control, basic flow measurement and control and control loop performance. The curriculum must be capable of both self-directed study and instructor directed study.

The student curriculum supplied shall be designed in a skills-based format that focuses on teaching industrially-relevant tasks. This curriculum shall be designed for use in a self-directed student learning environment. All learning materials needed shall be contained in the curriculum including text material, laboratory equipment activities, and multimedia directions. No external text sources shall be required. A combination of step-by-step enabling activities and creative, problem solving activities shall be provided. A self-review of five to ten questions shall be provided after each segment. All activities must correlate directly to the hardware supplied, with detailed illustrations and diagrams.

Teacher’s Assessment/ Portfolio Guides
A teacher’s assessment guide shall be provided. It shall contain student data sheets, data sheet solutions, self-review answers, quizzes, quiz answers, student skill record sheets, and authentic assessment. A quiz shall be provided for each packet. A question shall be provided in each quiz for each cognitive objective taught. All tasks listed in the packet shall be listed on personalized student record sheets. The teacher’s assessment guide shall include directions for authentic skill assessment.

15b - PID CONTROL MODULE
This system shall include (1) PID Control unit meeting the below minimum specifications.

- Honeywell Brand
- Microprocessor Based
- LED Display
- Digital Programming
- (2) 4-20 mA Inputs
- (2) Discrete Inputs
- (1) 4-20 ma outputs
- Alarm Relay Output
- Banana Jack Interface
- Tuning Keypad
- Mounting Panel, silkscreened labels
The PID controller shall be fully compatible with Process Control System hardware and supported by the process control system’s curriculum. It shall have the capability to control the proportional controls on the system using both open loop and closed loop methods. All connections to output and input devices shall be via plug jacks. The mounting panel for the PID control unit shall allow the unit to mount directly to the process control system’s control panel.

15c - ULTRASONIC LIQUID LEVEL LEARNING SYSTEM
This system shall include (1) liquid level transducer meeting the below minimum specifications.

- Ultrasonic type
- Built-in transmitter, 4-20 ma
- 4-40 inch range adjustable

The transducer shall be fully compatible with Process Control System hardware and supported by the process control system’s curriculum. It shall have the capability to provide feedback of liquid level in a proportional control system closed loop liquid level control. All connections to output and input devices shall be via plug jacks. The unit shall mount to an adjustable slide mount on the process control system.

Student Curriculum
The student curriculum shall consist of learning activities with skills covering the following topics: ultrasonic level measurement, ultrasonic level sensor calibration and level control. The curriculum must be capable of both self-directed study and instructor directed study.

The student curriculum supplied shall be designed in a skills-based format that focuses on teaching industrially-relevant tasks. This curriculum shall be designed for use in a self-directed student learning environment. All learning materials needed shall be contained in the curriculum including text material, laboratory equipment activities, and multimedia directions. No external text sources shall be required. A combination of step-by-step enabling activities and creative, problem solving activities shall be provided. A self-review of five to ten questions shall be provided after each segment. All activities must correlate directly to the hardware supplied, with detailed illustrations and diagrams.

15d - SMART FLOW TRANSMITTER LEARNING SYSTEM
This transmitter shall be fully compatible with the Process Control System hardware and supported by the process control system’s curriculum. It shall have the capability to provide feedback of flow, level, and pressure from transducers that produce a differential pressure and output a 4-20ma signal in a proportional control closed loop system. The unit shall mount to the process control system and connect to at least 3 different types of transducers. It shall have the below specifications.

- 4-20ma output
- Capable of differential, and pressure measurement
- Stainless steel housing
- Calibrated range span, differential: 0.5 in-water to 25 in-water
- Integral coplanar manifold
- LCD meter with 5-digit display, diagnostic messages, digital output reading and meter cover
- Local span adjustment
- Zero adjustment
- Smart type with microprocessor
- Rosemount brand

Student Curriculum
The student curriculum shall consist of learning activities with skills covering the following topics: ultrasonic level measurement, ultrasonic level sensor calibration and level control, orifice plate flow sensors, differential pressure flow transmitters, common differential pressure flow sensors and flow
control using differential pressure flow measurement. The curriculum must be capable of both self-directed study and instructor directed study.

The student curriculum supplied shall be designed in a skills-based format that focuses on teaching industrially-relevant tasks. This curriculum shall be designed for use in a self-directed student learning environment. All learning materials needed shall be contained in the curriculum including text material, laboratory equipment activities, and multimedia directions. No external text sources shall be required. A combination of step-by-step enabling activities and creative, problem solving activities shall be provided. A self-review of five to ten questions shall be provided after each segment. All activities must correlate directly to the hardware supplied, with detailed illustrations and diagrams.

**15e - PITOT TUBE FLOW TRANSDUCER**
This system shall include (1) pilot tube flow transducer that is fully compatible with the Process Control System hardware and supported by the process control system’s curriculum. It shall have the capability to provide feedback of flow in a proportional control closed loop system. The unit shall mount to the process control system and include pipe unions on each end to enable it to be interchanged quickly with other types of flow transducers. The feedback signal shall be created by pressure taps located on transducer. These pressure taps shall include quick connect connections to attach to a separately supplied smart transmitter which senses differential pressure.

**15f - VENTURI FLOW TRANSDUCER**
This system shall include (1) venturi flow transducer that is fully compatible with the Process Control System hardware and supported by the process control system’s curriculum. It shall have the capability to provide feedback of flow in a proportional control closed loop system. The unit shall mount to the process control system and include pipe unions on each end to enable it to be interchanged quickly with other types of flow transducers. The feedback signal shall be created by pressure taps located on transducer. These pressure taps shall include quick connect connections to attach to a separately supplied smart transmitter which senses differential pressure.

**15g - ORIFICE PLATE FLOW TRANSDUCER**
This system shall include (1) orifice plate flow transducer that is fully compatible with the Process Control System hardware and supported by the process control system’s curriculum. It shall have the capability to provide feedback of flow in a proportional control closed loop system. The unit shall mount to the process control system and include pipe unions on each end to enable it to be interchanged quickly with other types of flow transducers. The feedback signal shall be created by two pressure taps located on either side of the orifice plate. These pressure taps shall include quick connect connections to attach to a separately supplied smart transmitter which senses differential pressure.

**ITEM 16: PRINT-BASED CURRICULUM and TEACHER GUIDES LICENCES (if not included in the training module areas listed above) – QTY 1**
Shall consist of a license and curriculum material preferably on CDROM for user reproduction of up to a minimum of fifty (50) copies for each of the:
CURRICULUM PRINT LICENSE – Process Control Trainer

**ITEM 17: INTERACTIVE MULTIMEDIA (if not included in the training module areas listed above) – QTY 2**
Interactive CDROM Curriculum – Process Control - to include interactive computer-based instruction in CDROM format with both theory and hands-on tutorials consisting of text, digital video, voice, online self-review tests, interactive simulations and color diagrams and photos.

The curriculum shall be designed in a skill-based format that focuses on teaching industrially-relevant tasks. This curriculum shall be designed for use in a self-directed student learning environment or an instructor lead learning environment. All learning materials needed shall be contained in the package.
including text material and hands-on tutorials. No external text sources shall be required. Each lab activity shall be identified by the industrial task taught. A self-review shall be provided after each segment. This software shall be provided as a one station license.

The student curriculum shall consist of learning activities with skills covering the following topics: **introduction to process control, instrument tags, piping and instrumentation diagrams, loop controllers, final control elements, level measurement, liquid level control, methods of automatic control, basic flow measurement and control and control loop performance, orifice plate flow sensors,** **differential pressure flow transmitters,** **common differential pressure flow sensors** and **flow control using differential pressure flow measurement.**

**SECTION 5 - CLASSROOM/TRAINING PROGRAM MANAGEMENT SOFTWARE SYSTEM**

**NOTE: THIS ITEM MAY NOT BE PURCHASED AT THIS TIME. THE COMBINED BID PRICE OF THE TRAINING EQUIPMENT WILL DETERMINE OUR ABILITY TO PURCHASE A CLASSROOM MANAGEMENT SYSTEM.**

**ITEM 35 - CLASS MANAGEMENT SYSTEM – QTY 1**
CLASS MANAGEMENT SYSTEM - to include appropriate instructor license(s) and at least 2 single-classroom multiple student software licenses. License must allow for multiple instructors to utilize the system in at least 2 separate classroom settings.

The system purchased must be compatible with training modules specified above in SECTIONS 1-4 while at the same time allowing the instructor to build their own customized assessment and tracking database for use with other independent courses, curriculum, and equipment.

Software – A Windows-Based software program shall be supplied to manage the functions of a multi-disciplinary classroom including:

- Automated Quiz Delivery [via database server]
- Class / Student Enrollment and Tracking
- Authentic Assessment enabled to support PDA Data Entry
- Automated Pre-Quizzes and Quizzes
- Class and Student Reports / Analysis
- Class Set-up
- Automated Grading
- Attendance

The system shall be able to run on a network and individual computer basis. Drag and drop capability shall be provided to enroll students into particular classes. The software shall be able to show what classes each student is enrolled in.

This software shall allow development of a set of competencies for each course. Templates shall be available for quick set-up of courses. Competencies shall be identified as either objectives (cognitive) or skills (manipulative). These competencies shall be directly correlated by the software to identify each activity in the course supporting each competency.

An automated delivery and tracking system shall be included that provides quizzes to each student on a computer via an ether network. Each question shall be correlated with a particular objective. Quizzes will correlated with each subunit. Each student’s score will automatically go into a grading database. Each
question shall be selected at random from a pool of questions for each objective so that quizzes change constantly. The teacher shall be able to add, modify, or delete the quiz databases. Graphics and text shall be displayed with questions. At the end of each quiz, students shall be able to see which questions were missed. Students shall also be able to see all of their quiz scores and other grades.

Quizzes are delivered via a database server. Animated graphics, video and audio can be delivered along with the questions. The teacher can specify the number of questions per objective with the default being one question per objective. Two types of quizzes are provided. One is an optional pre-quiz to enable starting point assessment. The second is an actual quiz for a grade. Grading shall be automatic. The software will display scores to show student progress.

The software shall include grading and assessment of students through live demonstration. The teacher shall be able to download the complete text of all skills for one or more subunits and assigned students. Assessment grading can be entered on the PDA or through any student PC workstation. The teacher can upload grading from the PDA for automatic grading. The software will show the student score for each competency.

The software shall include a project-grading module which permits the teachers to assess student performance on project-related activities that require criteria-based evaluation. The teacher shall have the capability to set up project criteria and weight each activity according to its contribution to the results of the project.

The grading shall be able to incorporate one or multiple topics in a course and multiple activities including: quizzes, authentic assessment, design projects, and research. Software shall weight the scores. The software shall have the ability to allow the teacher to weight each item and automatically calculate the final grade based on all results. The software shall allow the teacher to specify required subunits by student.

A powerful reporting capability shall be included to enable teachers to produce:

- End of term report
- Final grade
- Competency Profile with score for each skill
- Pre-Quiz and Quiz results
- Individual Quiz Results
- Student Progress Report
- Average results on any test for class
- List of competencies for each course

Requires customer supplied PDA with Microsoft’s PocketPC OS for PDA’s.