



# Board/Authority Authorised Course Construction Trades Sampler - Industrial Instrumentation Mechanic (IIM)

School District/Independent School Authority Name	Kamloops/Thompson
School District/Independent School Authority Number	#73
Developed by	Wendy Blaskovic
Date Developed	December 2013
School Name	NorKam Secondary
Principal's Name (District)	Sheryl Lindquist
Superintendent Approval Date (for School Districts only)	
Superintendent Signature (for School Districts only)	
Board/Authority Approval Date	
Board/Authority Chair Signature	
Course Name	Industrial Instrumentation Mechanic (IIM)
Grade Level of Course	11 and 12
Number of Course Credits	4
Number of Hours of Instruction	120
Prerequisite(s)	Completion of Grade 10



## Synopsis

This course has been developed to provide students with an opportunity to explore four common trades within the construction sector, in the following order –carpentry, plumbing, electrical (construction) and industrial instrumentation mechanic (IIM). The fourth trade taught within the Construction Sampler, IIM, will expose students to the foundation program offered at Thompson Rivers University (TRU) which follows sections of the ITA Level 1 curriculum. The ITA Level 1 curriculum has been utilized as a guide and framework for the content covered in the Sampler. In IIM (as with the three accompanying trades taught within the Construction Sampler), students will cover: Safe Work Practices (personal and shop), mathematical applications, tools and equipment, materials, cutting processes, and forming and joining processes. The approach supports safe workplace practices, student skill development and encourages meaningful methods of ideation, design, planning, production and evaluation of various construction sampler techniques and projects. To provide students with tangible skills and assist their understanding of the trade, all trades covered within the Construction Sampler will build skills sets towards a common project. For example, a bathroom or kitchen unit framed to scale by the carpentry trade with plumbing and electrical components installed over the course of the semester. Students will gain an understanding and appreciation for trades that are in their everyday lives.

## Rationale

This course will:

1. Provide students with an overview of the IIM Foundation Program .
2. Provide students with an introduction to safe work practices employed in a construction facility.
3. Provide students with an overview of the practices and skill sets needed for the IIM trade.
4. Provide students with theory and practical applications within a major project which is inclusive with the accompanying trades in the Construction Sampler.
5. Provide direct exposure to foundation training content, post-secondary and job ready expectations; therefore, providing students with the ability to make informed choices regarding which direction they choose to embark on during Senior Secondary School and/or after.
6. Provide students with 20% theory and 80% practical content. The 20-80 approach supports the purpose of the sampler – a hands-on experiential program to excite students, yet be realistic in the expectations of the trade and program.



Unit/Topic	Title	Time
Unit 1	APPLICATION OF OCCUPATIONAL SKILLS 1.1 Use trade-related schematics and drawings	15 hours
Unit 2	INSTALLS AND MAINTAINS MEASURING AND INDICATING DEVICES 2.1 Calibrate and service indicating and recording instruments 2.2 Measure pressure	15 hours
Unit 3	INSTALLS AND MAINTAINS PNEUMATIC AND HYDRAULIC SYSTEMS 3.1 Examine air supply systems 3.2 Install tubing and fittings 3.3 Install and service pneumatic instruments	30 hours
Unit 4	INSTALLS AND MAINTAINS FINAL CONTROL ELEMENTS 4.1 Service, size, and install control valves and actuators 4.2 Install and service valve positioners (includes advanced diagnostics)	30 hours
Unit 5	INSTALLS AND MAINTAINS MEASURING AND INDICATING DEVICES 5.1 Measure level 5.2 Measure flow (volumetric, mass flow)  *Final project will be in collaboration with Carpentry, Plumbing, and Electrical Samplers (For Example, Life-size, framed bathroom/kitchen with plumbing and electrical installations. Details in development stages).	30 hours
	Total Hours	120 hours

## Grading

Although 50% is a passing grade for high school credit, recommendation for TRU's ACE IT Program will require a minimum grade of 70% per course. Students in the Construction Sampler will be encouraged and supported to meet TRU's 70% standard, but not halted by it.

## Unit 1 – Application of Occupational Skills - 1.1 Use Trade-Related Schematics and Drawings

**Objective:** The student will be able to use schematics and drawings related to Level One Instrumentation:



## Prescribed Learning Outcomes

It is expected that students will:

1. Examine types of schematics and drawings.
  - P&ID, SAMA, isometric and orthographic drawings

### Achievement Criteria

1. Given a 10 question test on the symbols, conventions, drawings, and schematics used in Level One, the student must answer seven or more questions correctly.
2. The student's use of Level One drawings and schematics will be evaluated during lab activities, and the student must achieve a minimum grade of 70%.

## Unit 2 – Installs and Maintains Measuring and Indicating Devices – 2.1 Calibrate and Service Indicating and Recording Instruments

**Objectives:** To be competent in this area, students will be able to use schematics and drawings related to Level One Instrumentation:

## Prescribed Learning Outcomes

It is expected that students will:

1. Examine types of recording devices.
  - Chart recorders
2. Examine indicating devices.
  - Digital displays
  - Configurable
  - CRT
  - LCD
  - Plasma
3. Calibrate and service indicating devices using principles of zero, span and angularity adjustments as they relate to links and levers.
  - Gages
  - Dampening
  - Chemical seals
  - Bourdon tube
  - Bellow
  - Diaphragm capsule.
4. Service recording devices.
  - Identification of measuring element and input measurement scale.



### **Achievement Criteria**

- Given a 10-question test on the types of recording and indicating devices and their calibration and servicing the student must answer seven or more questions correctly.
- The student must also score 70% or higher on a lab assignment in which principles of links and levers (zero, span and angularity adjustments) are used to calibrate three gauges and four chart recorders.

## **Unit 2 – Installs and Maintains Measuring and Indicating Devices –**

### **2.2 Measure Pressure**

**Objectives:** To be competent in this area, students will be able to configure and calibrate pneumatic, electronic, and digital measuring devices to process requirements.

### **Prescribed Learning Outcomes**

It is expected that students will:

1. Examine types of pressure.
  - Absolute
  - Differential
  - Gage
  - Vacuum
  - Conversion tables
  - Pressure conversion formulas
  - Steam tables (relationship between temperature and pressure)
2. Examine types of pressure-measuring devices.
  - Pneumatic
3. Install pressure measuring devices.
  - Location of device
  - Isolation of device
  - Connection of device to process
  - Sealants and gaskets
4. Configure/calibrate pressure-measuring devices.
  - Manometer types
  - Dead weight testers

### **Achievement Criteria**

- Given a 10-question test on pressure measuring devices the student must answer seven or more questions correctly. The student's ability to configure and calibrate pressure-measuring devices will be evaluated during lab activities, and the student must achieve a minimum grade of 70%.



## **Unit 3 – Installs and Maintains Pneumatic and Hydraulic Systems -**

### **3.1 Examine air supply systems**

**Objectives:** To be competent in this area, students will be able to explain the purpose, operation, and servicing of air supply systems.

#### **Prescribed Learning Outcomes**

It is expected that students will:

1. Examine instrument air systems and equipment.
  - Need for clean, dry air.
  - Air compressors.
  - Air dryers.
  - Air receivers
2. Examine air distribution systems.
  - Mill air
  - Instrument air
3. Examine use of relative humidity to infer dew point
  - Sling psychrometer
4. Examine the servicing procedures for air supply systems.
  - Pre and post filters

#### **Achievement Criteria**

- Given a 10-question test on air supply systems, the student must answer seven or more questions correctly.
- The student's ability to service air supply systems will be evaluated during lab activities. The student must achieve a minimum grade of 70%.

## **Unit 3 – Installs and Maintains Pneumatic and Hydraulic Systems –**

### **3.2 Install Tubing and Fittings**

**Objectives:** To be competent in this area, students will be able to select, assemble, and install tubing and assorted fittings as per drawings provided.

#### **Prescribed Learning Outcomes**

It is expected that students will:

1. Examine types of tubing and installation procedures.
  - Plastic
  - Stainless steel
  - Copper



2. Examine types of fittings and installation procedures.
  - Types of fittings
  - Unions
  - Elbows
  - Tees
  - Couplings
  - Bushings
  - Reducers
  - Caps
  - Plugs
  - Bulkhead fittings
  - Others
  - Tube fittings
  - Compression

#### **Achievement Criteria**

The student's ability to (1) identify types of fittings and (2) bend tubing to a pre-determined pattern will be evaluated during lab activities, and the student must achieve a minimum grade of 70% for both of these tasks.

### **Unit 3– Installs and Maintains Pneumatic and Hydraulic Systems – 3.3 Install and Service Pneumatic Instruments**

**Objectives:** To be competent in this area, students will be able to calibrate pneumatic instruments to required specifications.

#### **Prescribed Learning Outcomes**

It is expected that students will:

1. Examine specification and hazards of pneumatic equipment.
  - Compressed air safety
  - Pneumatic signals (3-15 psi, 6-30 psi, 20-100 kPa)
2. Examine types of pneumatic equipment.
  - Transmitters
  - Converters
  - Positioners
  - Controllers
  - Relays
3. Examine operating principles of pneumatic equipment.
  - Force balance
  - Motion balance



#### **Achievement Criteria**

- The student's ability to calibrate pneumatic equipment will be evaluated during lab activities. The student must achieve a minimum grade of 70%.

### **Unit 4 – Installs and Maintains Final Control Elements –**

#### **4.1 Service, Size and Install Control Valves and Actuators**

**Objectives:** To be competent in this area, students will be able to install and service control valves and actuators.

#### **Prescribed Learning Outcomes**

It is expected that students will:

1. Examine actuators.
  - Types
  - Pneumatic
  - Hydraulic
  - Electric
  - Applications
2. Examine control valves.
  - Sliding stem
    - Globe
  - Rotary
    - Butterfly

#### **Achievement Criteria**

- Given a 10-question test on the operation of valves and actuators, the student must answer seven or more questions correctly.
- The student's ability to service regulators will be evaluated during lab activities, and the student must achieve a minimum grade of 70%.

### **Unit 4 – Installs and Maintains Final Control Elements –**

#### **4.2 Install and Serve Valve Positioners (includes advanced diagnostics)**

**Objectives:** To be competent in this area, the student will be able to serve and install valve positioners on final control elements.

#### **Prescribed Learning Outcomes**

It is expected that students will:

1. Examine valve positioners.
  - Types
  - Pneumatic





- Electronic
- Digital
- Electrohydraulic
- Electromechanical
- Boosters

#### **Achievement Criteria**

- Given a 10-question test on valve positioners, the student must answer seven or more questions correctly.
- The student's ability to install and service valve positioners will be evaluated during lab activities and the student must achieve a minimum grade of 70%.

## **Unit 5 – Installs and Maintains Measuring and Indicating Devices –**

### **5.1 Measure Level**

**Objectives:** To be competent in this area, the student will be able to install, calibrate, and service level-measuring devices.

### **Prescribed Learning Outcomes**

It is expected that students will:

1. Examine level measuring devices and their operation.
  - Point level
  - Capacitance
  - Float switches
  - Tuning fork
  - Indicator
  - Microwave
  - Ultrasonic
  - Nuclear
  - Continuous level
  - Hydrostatic head
  - Laser
  - Ultrasonic
  - Radar
  - Sight glass
  - Bubble pipe
  - Resistance tape
  - Magnetic float



- Load cell
  - Displacement
  - Drum level
2. Examine calibration instruments used on level-measuring devices.
    - Pressure calibrator
    - Laptop/software
    - Handheld programmer (configurator)
  3. Install, calibrate and service level-measuring devices.
    - Manufacturer's specifications
    - Selection/location of measuring device
    - Process application
    - Process medium
    - Price
    - Best practices
    - Verify operation
    - Device check/calibration
    - Interpretation of calibration results
    - Cause/effect of calibration error
    - Device adjustments
    - Repairing/replacing device components
    - Verification of operation
    - Returning device to service
    - Documenting calibration

#### **Achievement Criteria**

- Given a 10-question test on level measuring devices and their operation, calibration and servicing requirements, the student must answer seven or more questions correctly.
- The student's ability to calibrate and service level measuring devices will be evaluated during lab activities, and the student must achieve a minimum grade of 70%.

## **Unit 5 – Installs and Maintains Measuring and Indicating Devices – 5.2 Measure Flow (volumetric, mass flow)**

\*Note: Concept drawings for the final project follow the 'Achievement Criteria' for this unit.

**Objectives:** To be competent in this area, students will be able to install, calibrate, and service flow-measuring devices to process requirements.



## Prescribed Learning Outcomes

It is expected that students will:

1. Examine flow measuring devices and their operation.
  - Bernoulli's Theorem
  - Differential pressure
  - Orifice plate
  - Flumes/weirs
  - Annubar
  - Pitot tube
  - Target meter
  - Elbow meter
  - Venturi
  - Wedge
  - Flow nozzle
  - Multi-variable mass flow
  - Variable area flow meters
  - Velocity
  - Turbine
  - Vortex
  - Ultrasonic
  - Magnetic flow meter
  - Mass flow
  - Coriolis
  - Thermal
  - Positive displacement meter
  - Other flow measurement devices
2. Examine calibration instruments used on flow-measuring devices.
  - Pressure calibrators
  - Flow simulators
  - Temperature calibrator
  - Frequency generator
  - Laptop/software
  - Handheld programmer (configurator)
3. Install, calibrate, and service flow-measuring devices.
  - Manufacturer's specifications
  - Selection/location factors
  - Straight pipe requirements
  - Accuracy requirements
  - Process application



- Process medium
- Cost
- Best practices
- Verify operation
- Device check/calibration
- Interpretation of calibration results
- Cause/effect of calibration error
- Device adjustments
- Repair/replace device components
- Returning device to service
- Documenting calibration

#### **Achievement Criteria**

- Given a 10-question test on flow-measuring devices and their operation, calibration, and servicing requirements, the student must answer seven or more questions correctly.
- The student's ability to calibrate and service flow-measuring devices will be evaluated during lab activities, and the student must achieve a minimum grade of 70%.

#### **Instructional Component**

- Direct instruction
- Indirect instruction
- Interactive (peer) instruction
- Independent instruction
- Modeling
- Practical creativity
- Brainstorming
- Group work
- Analysis of own and classmates' project work
- Project-based learning

#### **Assessment Component**

- Twenty per cent (20%) of the grade will be based on safety tests, unit quizzes, skill-set evaluation through Units 1-3
- Eighty per cent (80%) of the grade will be based on demonstration of proper employability skills (proper industrial work habits ranging from the safe use of equipment to good "Housekeeping" techniques, project management), demonstration of skills related to practical activities.



## Learning Resources

- Teacher handouts
- Guest speakers from the community in related fields
- Visit/interview local trades people in related fields
- Resource Training Organization (RTO):  
<http://www.rto.bc.ca/Assets/RTO+Assets/About+RTO/ie+logbook.pdf>
- ITA Website: <http://www.itabc.ca/>
- ITA Essential Skills: <http://www.ita.essentialskillsgroup.com/>

## Instructor Resources

- Industry Learning Modules (ILM):  
[http://www.crownpub.bc.ca/Product/Details/7960003229\\_S#/?statesave=true](http://www.crownpub.bc.ca/Product/Details/7960003229_S#/?statesave=true)  
[http://www.crownpub.bc.ca/product/listing/13589\\_1st-Period#/?statesave=true](http://www.crownpub.bc.ca/product/listing/13589_1st-Period#/?statesave=true)
- ITA Level 1 Program Outline  
[http://www.itabc.ca/sites/default/files/program-information/carpenter-outline-august-2013\\_0.pdf](http://www.itabc.ca/sites/default/files/program-information/carpenter-outline-august-2013_0.pdf)

## In-Class Tools & Resources

For the IIM Sampler, it is strongly recommended:

- The Lab-Volt 'Process Control Training Systems 6090' be purchased for every two students in the IIM Sampler. The Lab-Volt 6090 contains all tools and resources required.
  - For details regarding the contents of the Lab-Volt Unit, refer to pages 16-18 or <https://www.labvolt.com/downloads/dsa6090.pdf>
    - The Lab-Volt Unit would take place of the ITA Program Guideline tool and resources listed.
    - Also, IIM would work with the tools used for the three previous samplers (Carpentry, Plumbing, and Electrical) alleviating the need to purchase additional tools.
- For specific ITA Program Guideline requirements for tools, resources, etc., refer to 'Training Provider Standards' in this package.

To supplement the Program, it is strongly recommended:

- Students visit Thompson Rivers University's Trades & Technology IIM Program, as well as:
- Complete site visits to Industry.

## Additional Information

FACILITY REQUIREMENTS (Based on ITA IIM Program Guidelines)

### Facilities Classroom Area

- Comfortable seating and tables suitable for training, teaching, lecturing, and drafting
- Compliance with all Local and National Fire Code and occupational safety requirements



- Lighting controls to allow easy visibility of projection screen while also allowing students to take notes
- Windows must have shades or blinds to adjust sunlight
- Heating/air condition for comfort all year round
- In-room temperature regulation to ensure comfortable room temperature
- In-room ventilation sufficient to control training room temperature
- Acoustics in the room must allow audibility of the instructor
- White-marking board with pens and eraser (optional: flipchart in similar size)
- Projection screen or projection area at front of classroom
- Overhead projector and/or multimedia projector

#### **Lab Area**

- Fully operational, representative process equipment with supporting instrumentation and control equipment, for example, distillation column, evaporator and power boiler, pulp stock digester, Brownstock washer
- Installed control system (e.g. Fisher Delta V)
- Stand alone controllers (e.g. F&P MC-5000)
- PC-based advanced control software (e.g., Brainwave)
- Programmable Logic Controllers (e.g. Rockwell's PLC-5s, Modicon Quantum PLCs, Rockwell PLCs, GE/Fanuc Series 90/30 PLCs with Genius I/O)
- Distributed Control Systems (e.g. Provox DCS, Honeywell TDC 3000 DCS, Foxboro IA DCS, Delta V DCS, BaileyNet90 DCS)
- Communication and Signal transition instrumentation and final control equipment
- Measurement recorders and indicators including motion, speed, vibration, position, mass flow, pH, temperature, pressure weight, level
- Test bed for interfacing multiple vendor equipment with ease
- Multiple computer stations and an array of interfacing options N.B.: the Lab Area of the Training Facility must provide learners with the resources to:
  - Create variety of complex control processes.
  - Feed analog and digital instrumentation into multiple DCS and PLC control platforms.
  - Adapt and modify control configuration easily.
  - Create custom equipment configurations with a minimum of difficulty.

#### **Student Facilities**

- Adequate lunch room as per WorkSafeBC requirements
- Adequate washroom facilities as per WorkSafeBC requirements
- Personal Storage lockers



## Tools and Equipment

(Based on ITA IIM Program Guidelines)

### Hand Tools

- Calipers (assorted) crowbar
- Diagonal cutter drill bits
- Easy-out (extractor) fixed vice
- Flaring tool flashlight fuse puller
- Gauge pointer puller gasket cutter grease
- Gun hammers (assorted)
- Hand files (assorted)
- Hex keys (Imperial/Metric) jackknife
- Knock out punch level
- Magnet measuring tape
- Micrometers (assorted) mirrors
- Pinch bar pipe threader
- Nut drivers (assorted) packing puller
- Pliers (assorted), punches (assorted), reamer
- Rubber mallet saws (assorted) screw starter
- Screwdrivers (assorted) scribe
- Sockets (Imperial/Metric) square
- Steel rule, strap wrench, tap and die set, torch
- Torque wrench, Torx wrench, tube benders, tube cutter, tweezers
- Wire brushes, wire crimpers, wire cutter, wire labeller, wire stripper
- Wrenches (assorted)

### Power Tools

- Air compressor
- Band saw
- Cut-off saw
- Drill press, grinders, hammer drill, heat gun
- High pressure grease gun, hydraulic press
- Impact wrench
- Jig saw
- Pipe threader, portable electric drill, portable generator
- Power-actuated tools (Hilti, Ramset, etc.)
- Pneumatic tools
- Pressure and vacuum pumps
- Reciprocating saw
- Sandblaster
- Soldering iron

### Electronic Tools and Test Equipment

- Amp probe, analog multimeter analyzers, barometer bridges
- Calibrated oven capacitance simulator, current calibrator data logger deadweight tester
- Decade resistance box deflectional-type strain indicator, dew point tester
- Digital multimeter dry block calibrator
- Eddy current tachometer, electromagnetic flowmeter, electrostatic voltmeter, frequency counter, frequency generator, gauge blocks
- Handheld programmer (configurator), handheld pyrometer
- Hydrometer infrared camera
- Infrared thermometer, lab scales



- Label maker, laptop computer
- Laser strength meter, logic testers
- Loop calibrator/simulator manometer
- Microscope
- Microwave leakage meter, millivoltmeter calibrator
- Mobile phone/pager/two-way radio modern
- Null balance strain indicator, optical pyrometer, oscilloscope
- Personal computer
- Personal digital assistant (PDA) pH simulator/buffers
- Pneumatic test stand, portable sound level meter, portable voltage tester, potentiometer
- Power supplies, pressure calibrator, printers
- Protocol analyzer, radiation meter regulator
- RPM tester/tachometer, RTD/thermocouple calibrator, signal generator
- Signal analyzer, sling psychrometer software, stroboscope
- Tachometer generator temperature bath
- Test gases
- Test gauges (pressure, vacuum), thermal meter
- Thermometer, vacuum pump variable transformer
- Vibration table (wobbulator) wireless signal strength tester
- Wrist ground strap

#### **Personal Protective Equipment (PPE AND Safety Equipment)**

- All PPE must comply with WorkSafeBC Regulations.
- Apron
- Cap lamp
- Coveralls (regular, disposable, and fire-proof)
- Ear protection (muffs and plugs)
- Eye wash bottle
- Face shield
- Fire extinguisher
- First aid kit
- Flame-retardant clothing
- Gloves
- Ground mat
- Hard hat
- Low-voltage gloves
- Mask
- Personal dosimeter
- Personal monitor (gas)
- Radiation survey meter
- Radiometer
- Respirators
- Rubber boots
- Rubber suits
- Safety boots
- Safety glasses
- Safety harnesses
- Safety lines
- Self-contained breathing apparatus
- Splash goggles
- Supplied air hood
- Winter gear