

*IIMM*

# Instrumentation

# Overview

- Concepts
  - Process Instrument
  - Instrument Component
  - Instrumentation Bubble
  - Control Requirement / Sensing Requirement / Acting Requirement
  - Control Function
  - Instrument Loop / Process Control Loop
  - Signal Line
  - Connection Point
- RDL Classes/Properties
- Examples

# Concepts : Process Instrument

RDL RDS934064 : “A physical object that detects an aspect of something; records, modifies and/or displays such an aspect or performs a combination of these activities”

A ‘Process Instrument’ on a P&ID is a ‘Functional Physical Object’ identifying an instrumentation function that acts on a process medium.

These are often referred to as inline items since they are connected to the process, even if an instrument is drawn as inline it may not be physically realized as an inline item. Any physical instrumentation item which is connected to or contained in a ‘Piping Network Segment’ is considered to be a Process Instrument

Within a P&ID it is difficult to identify whether instruments are ‘directly connected’ to the process fluid or connected indirectly via a coil, diaphragm etc. An instrument connected indirectly that is sensing or acting on process properties itself may be classified as a ‘Process Instrument’

# Concepts : Instrument Component

RDL ?? : “A physical object that is part of an Instrument that performs an instrumentation function such as sensing, recording, communicating, processing or decision making.”

An Instrument component may or may not be a ‘Process Instrument’.

Where an Instrument Component is not identified as a Process Instrument it is identified as an Instrument Component. On a P&ID is usually used to represent items such as transmitters and indicators that are not represented as having a direct connection to the process line. i.e. this includes all physical items that have no connection to a ‘PipingNetworkSegment’.

# Concepts : Composite Device

- TBD

# Concepts : Instrumentation Bubble

RDL ?? : “A circular representation of an aspect of instrumentation that includes an identifier and often classification of the instrumentation function”

On a P&ID an ‘Instrumentation Bubble’ is usually either the only representation of the identified function/object or a label associated with an instrumentation symbol such as a Flow element symbol.

If an Instrumentation Bubble is not a label then it may be classified to indicate the classification of the object being represented.

# Concepts : Control Requirement

RDL ?? : “A requirement for instrumentation and/or control structures”

This is used in functional instrumentation to identify the need for instrumentation and control entities without specifying their physical form.

A control requirement may contain sensing requirements and acting requirements, it may also indicate the location of the requirement within a process

# Concepts : Sensing Requirement

RDL ??? : A requirement to sense one or more properties of a process.



# Concepts : **Acting Requirement**

RDL ??? : A requirement to manage/alter the process such as altering flow.

# Concepts : Control Function

RDL RDS11566725 : “Activity that converts one or more input signals into one or more output signals in order to regulate a process.”

On a P&ID this is usually represented as hexagonal or rhombus shape symbol

The activity may be realised by a ‘Control Function Device’ (RDS324224)

# Concepts : Instrument Loop / Process Control Loop

RDL ?? : “The instrumentation and control components intended to perform an identified measurement, control, actuation, monitoring and/or safeguarding activity.”

This is a specialisation of Control Loop

Nb. Control Loop is currently wrongly defined as a sub class of electronic Circuit

# Concepts : Signal Line

RDL R-5ce86596-72e1-49eb-c794-c12f7244dad8 : “A representation that defines the graphical representation for connections between physical or functional plant objects”

In a P&ID this represents communication between 2 concepts and may not represent a physical connection.

Signal Line items may or may not be directed (From/To). The interpretation of the direction is not defined.

Nb term change to remove word ‘logical’

# Concepts : Connection Point

RDL RDS900680641 : “A functional object that identifies the purpose and location of a connection”

The location on a schematic where a symbol is connected to something else. The connection may be classified to describe the relationships between physical items though the connection doesn't represent a physical connection.

On a P&ID this may include connection properties such as 'Safety Critical', 'Alarm High' etc.

# Concepts : ProcessConnection

RDL RDS1442382761 : “A 'fluid connection point' where one device is connected to another object containing the process medium.”

Used in this set of examples to connect instrumentation to a PipingNetworkSegment without indicating the nature of the connection.

XMpLant 3.3.3 uses InstrumentConnection for this structure

# Concept classes

Class	In the RDL
Process Instrument	y
Instrument Component	n
Instrumentation Bubble	n
Control Requirement	n
Sensing Requirement	n
Acting Requirement	n
Control Function	y
Instrument Loop / Process Control Loop	n *
Signal Line	n * (dev endpoint)
Connection Point	y

\* Definition in RDL needs amending

# New Instrumentation classes

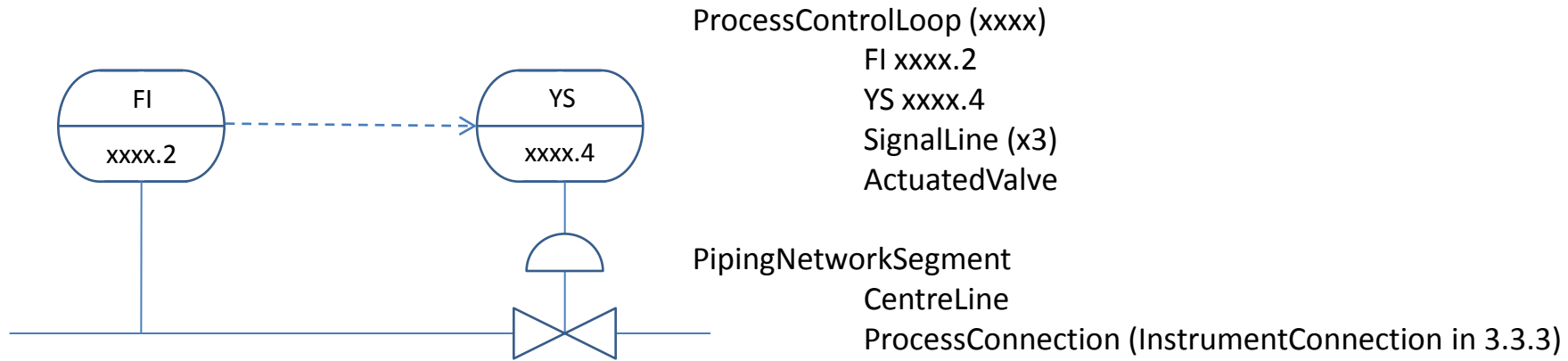
- Instrument Component
- Instrumentation Bubble
- Control Requirement
- Sensing Requirement
- Acting Requirement
- Instrument Loop / Process Control Loop
- Signal Line



# New Instrumentation Properties

# Examples

# Instrumentation Example (IEC example)



SensingRequirement (FI xxxx.2)

- ConnectionPoint (Signal to acting requirement)
- ConnectionPoint (Signal to ProcessConnection)

ActingRequirement (YS xxxx.4)

- ConnectionPoint (Signal from sensing requirement)
- ConnectionPoint (Signal to actuator)

SignalLine (FI xxxx.2 / ProcessConnection)

SignalLine (directed : from FI xxxx.2 to YS xxxx.4)

SignalLine (YS xxxx.4 / actuated valve or actuator)

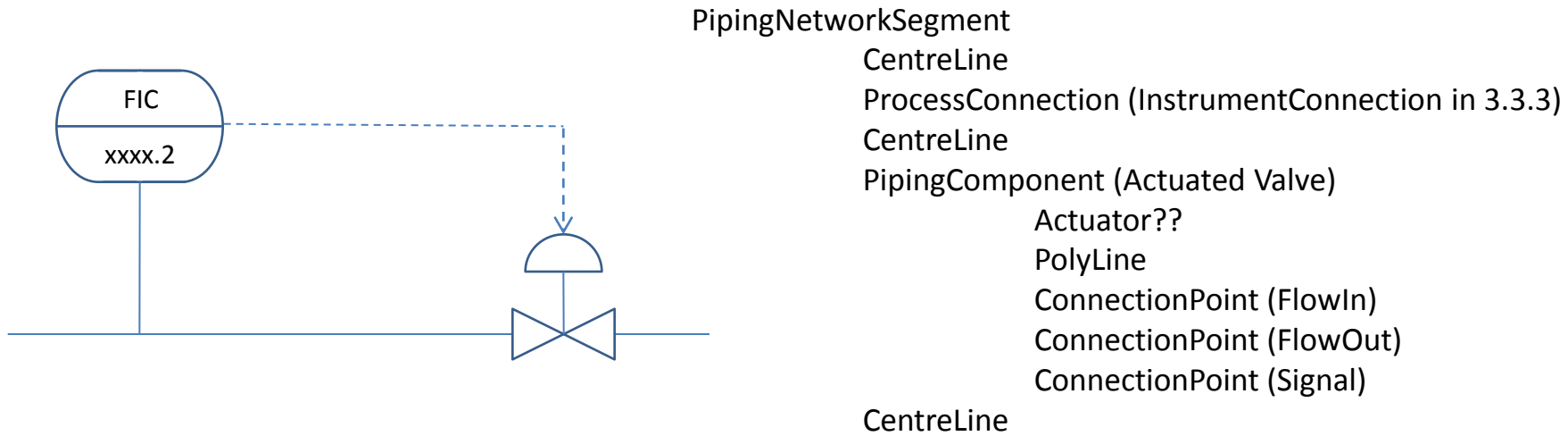
ProcessControlLoop (xxxx)

- FI xxxx.2
- YS xxxx.4
- SignalLine (x3)
- ActuatedValve

PipingNetworkSegment

- CentreLine
- ProcessConnection (InstrumentConnection in 3.3.3)
- CentreLine
- PipingComponent (Actuated Valve)
- Actuator??
- PolyLine
- ConnectionPoint (FlowIn)
- ConnectionPoint (FlowOut)
- ConnectionPoint (Signal)
- CentreLine

## Instrumentation Example (non, IEC example)



ControlRequirement (FIC xxxx.2)

ConnectionPoint (Signal to ActuatedValve/Actuator)

ConnectionPoint (Signal to process connection)

SignalLine (directed : from FIC xxxx.2 to actuated valve or actuator)

SignalLine (FIC xxxx.2 / process connection)

ProcessControlLoop (xxxx)

FIC xxxx.2

SignalLine (x2)

ActuatedValve

# Instrumentation Example (IEC Example)

SensingRequirement (TI xxxx.1)

ConnectionPoint (SHH)

ConnectionPoint (AH)

ConnectionPoint (Signal to ProcessConnection)

ControlFunction (US xxxx.3)

ConnectionPoint (from FI xxxx.2)

ConnectionPoint (from TI xxxx.1)

ConnectionPoint (to YS xxxx.4)

SensingRequirement (FI xxxx.2)

ConnectionPoint (SHH)

ConnectionPoint (AH)

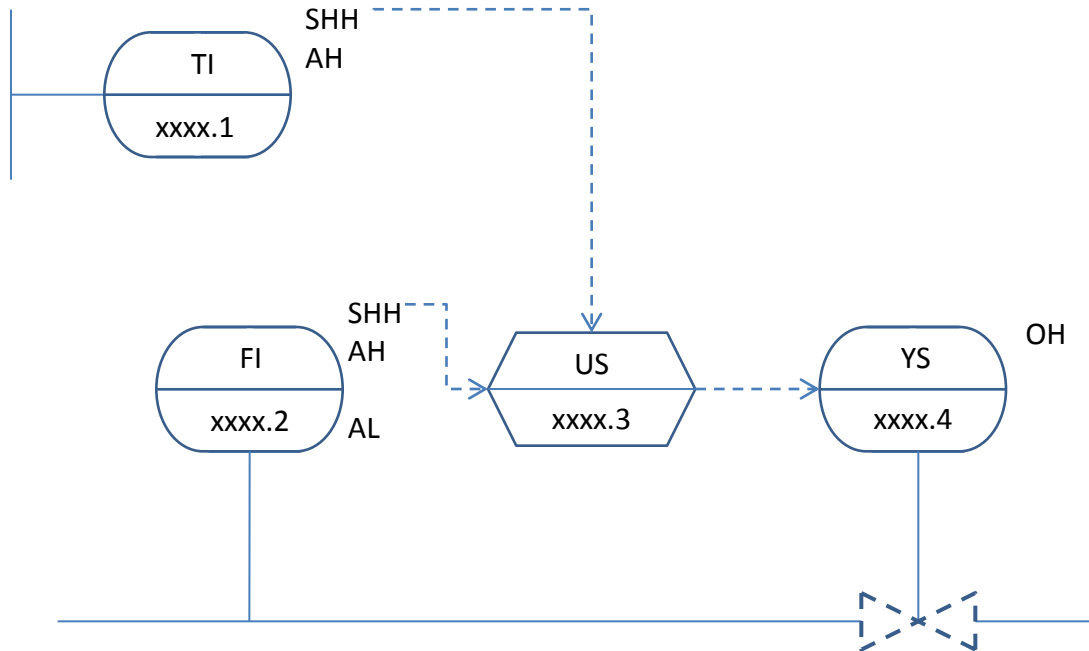
ConnectionPoint (AL)

ConnectionPoint (Signal to ProcessConnection)

ActingRequirement (YS xxxx.4)

ConnectionPoint (from US xxxx.3)

ConnectionPoint (Signal to Valve)



# Instrumentation Example (IEC Example)...continued

PipingNetworkSegment

CentreLine

ProcessConnection

CentreLine

PipingNetworkSegment

CentreLine

ProcessConnection

CentreLine

PipingComponent (Valve)

ConnectionPoint (Signal)

ConnectionPoint (FlowIn)

ConnectionPoint (FlowOut)

CentreLine

ProcessControlLoop (xxxx)

SensingRequirement (TI xxxx.1)

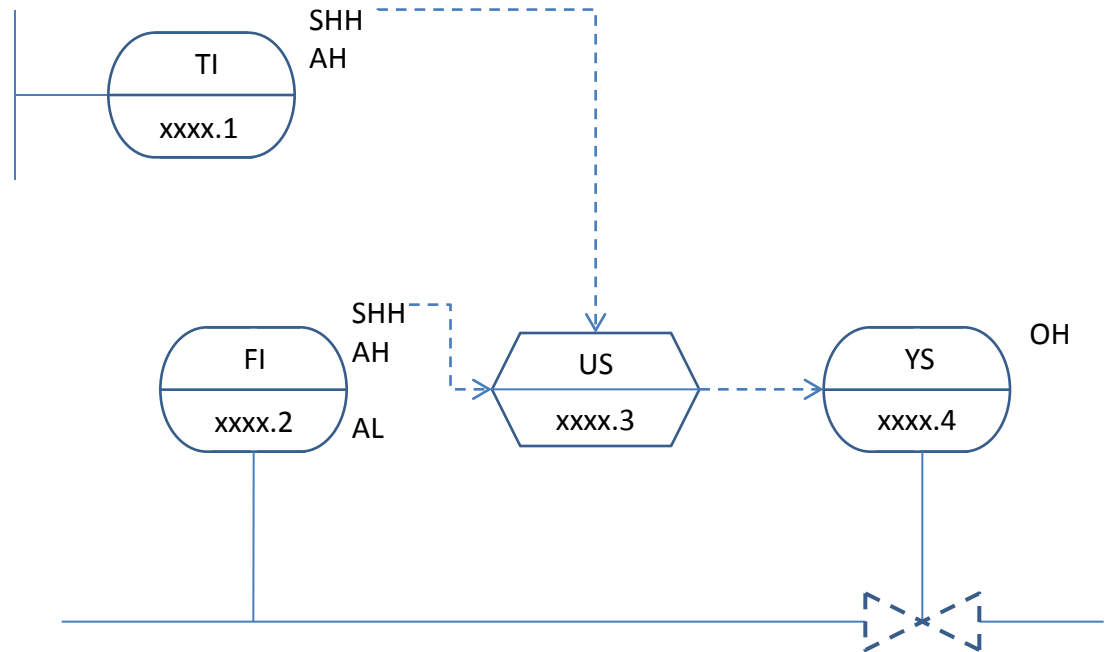
SensingRequirement (FI xxxx.2)

ControlFunction (US xxxx.3)

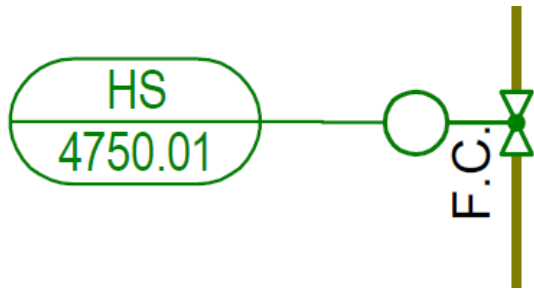
ActingRequirement (YS xxxx.4)

SignalLine (x3 undirected)

SignalLine (x3 directed)



## Instrumentation Example (DEXPI Example)



PipingNetworkSegment

CentreLine

Piping Component (Actuated Valve)

Label : F.C.

Actuator??

ConnectionPoint (FlowIn)

ConnectionPoint (FlowOut)

ConnectionPoint (Signal)

CentreLine

ActingRequirement (HS 4750.01)

ConnectionPoint ( to ActuatedValve)

ProcessControlLoop (4750)

ActingRequirement (HS 4750.01)

SignalLine

ActuatedValve

SignalLine ( HS 4750.01 / ActuatedValve or actuator)

# Instrumentation Example (DEXPI Example)

Equipment

Nozzle (N7)

ConnectionPoint (Signal TICSA 475.03)

ControlRequirement : (TICSA 4750.03)

ConnectionPoint (to ProcessConnection)

ConnectionPoint (to Actuated Valve)

ProcessControlLoop : 4750

ControlRequirement (TICSA 4750.03)

PipingComponent : TV4750.03

SignalLine ( Directed : From TICSA, To TV )

SignalLine ( TICSA / N7 )

PipingNetworkSegment

CentreLine

PipingComponent (Actuated Valve) TV 4750.03

Label : F.O.

Label : TV 4750.03

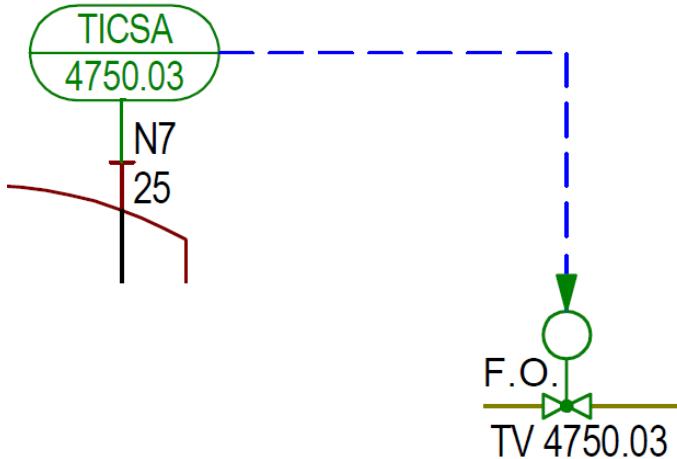
Actuator??

ConnectionPoint (FlowIn)

ConnectionPoint (FlowOut)

ConnectionPoint (Signal)

CentreLine





# Instrumentation Example (DEXPI Example)

PipingNetworkSegment

CentreLine

PipingComponent (Actuated Valve)

Label : PV4712.02

Label : F.C.

Actuator??

ConnectionPoint (FlowIn)

ConnectionPoint (FlowOut)

ConnectionPoint (Signal)

CentreLine

PipingNetworkSegment (From ??, To Flange)

CenterLine

PipingComponent (Valve)

CenterLine

Flange

ConnectionPoint (Signal)

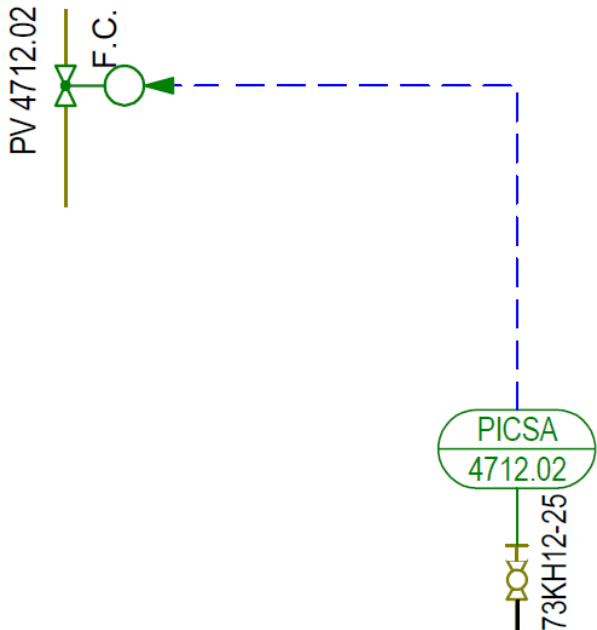
ControlRequirement (PICSA 4712.02)

ConnectionPoint ( to ActuatedValve)

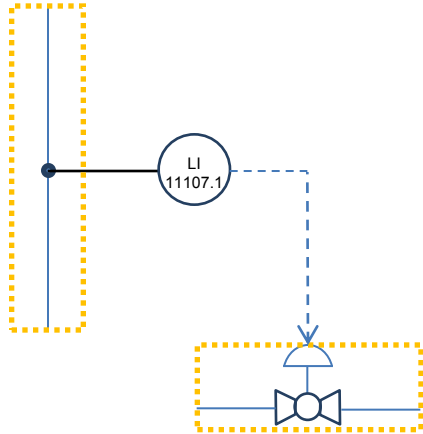
ConnectionPoint ( to Flange)

SignalLine (Directed : From ControlRequirement, To ActuatedValve)

SignalLine (Flange/ Control Requirement)



## Instrumentation Example (Physical Modelling)



PipingNetworkSegment

CentreLine

ProcessConnection

ConnectionPoint (Signal)

CentreLine

ProcessInstrument (LI11107.1)

ConnectionPoint (to processConnection)

ConnectionPoint (to ActuatedValve)

SignalLine (Directed : From LI 11107.1 To ControlValve)

SignalLine ( LI 1107.1 / ProcessConnection)

InstrumentLoop (11107)

ProcessInstrument (LI 11107.1)

ProcessInstrument (ControlValve)

SignalLine (x2)

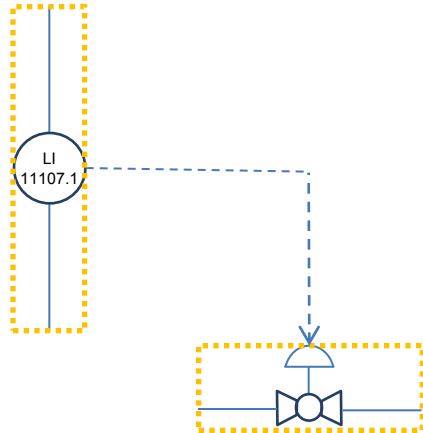
PipingNetworkSegment

CentreLine

ProcessInstrument (ControlValve)

CentreLine

## Instrumentation Example (Physical Modelling)



PipingNetworkSegment

CentreLine

ProcessInstrument (LI11107.1)

ConnectionPoint (FlowIn)

ConnectionPoint (FlowOut)

ConnectionPoint (to ActuatedValve)

CentreLine

SignalLine (Directed : From LI 11107.1 To ControlValve)

InstrumentLoop (11107)

ProcessInstrument (LI 11107.1)

ProcessInstrument (ControlValve)

SignalLine

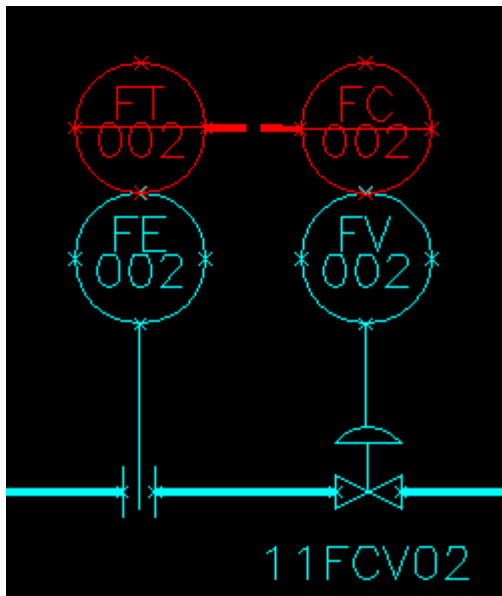
PipingNetworkSegment

CentreLine

ProcessInstrument (ControlValve)

CentreLine

## Instrumentation Example (Physical Modelling)



PipingNetworkSegment

CentreLine

PipingComponent (Flow Element) FE 002

InstrumentationBubble

CentreLine

ProcessInstrument (Control Valve) FV 002

InstrumentationBubble

Label (11FCV02)

CentreLine

InstrumentComponent (FT 002)

InstrumentationBubble

InstrumentComponent (FC 002)

InstrumentationBubble

SignalLine (From FE 002, To FT 002) – no graphics

SignalLine (From FT 002, To FC 002)

SignalLine (From FC 002, To FV 002) – no graphics