Fieldbus 401

Project engineering standards

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Overview

How is project engineering different with fieldbus?

Engineering standards help ensure everyone does things not just the same way, but the best way for project success. That's especially important when using new technologies, like FOUNDATION fieldbus, that not everyone is familiar with.

Even if your project timeline doesn't allow for formal adoption of new standards, you should review your existing standards, determine what needs to be changed, and then document and communicate those changes before the project begins. The time you invest will reduce the risk of costly errors, rework, and "one-off" solutions.

Fortunately, engineering a fieldbus project isn't any harder than using traditional technology — and in many areas it's substantially easier. The basics are generally the same, from environmental specifications to hazardous area considerations to wiring types. What will change most are standards related to field devices, which are now capable of far more than their analog ancestors.

This course outlines how various aspects of project engineering are affected by FOUNDATION fieldbus technology.

Hint: As you go through the topics in this course, watch for answers to these questions:

- *Which project engineering standards will change as a result of adding fieldbus?*
- *What new information will be required on instrument specification sheets?*
- *What should be added to a P&ID to accommodate fieldbus?*

Field device specifications

Because of the added functionality in fieldbus devices, their specifications are more comprehensive than for analog devices. Spec sheets for fieldbus devices should incorporate new fields for input and output, control, and diagnostic capabilities that didn't exist previously. For example:

Input and output

- Function blocks, such as integrators for flow devices and characterizers for analytical devices
- Multivariable input blocks — for example, allowing a flow device to also provide temperature, density, and viscosity inputs
- Output blocks that include both the output value and the actual valve position
- Additional information used in diagnostics, such as temperature of the electronics.

Control

- Standard control function blocks in a device, such as PID
- Multiple function blocks in the same device, such as two PIDs for a cascade loop
- Link Active Scheduler/Backup LAS to maintain loop control without a host
- Configurable loop execution times.

Diagnostics

- Basic status information, such as sensor failure
- Health monitoring to detect problems such as impulse leg plugging, glass breakage, or probe fouling
- Wear monitoring indicators such as valve cycles and total valve travel, and performance diagnostics such as valve signature

- Statistical process monitoring
- Loop diagnostics.

In addition to function-block, control, and diagnostic requirements, other items to include in fieldbus device specifications include

- Working voltage
- Maximum current draw from bus
- Block execution speeds
- Interoperability testing (ITK 4.1 or higher)
- Polarity sensitivity (if required by device)
- Capacity for instantiable function blocks

Segment design practices

In a fieldbus project, segment design replaces and greatly simplifies the traditional I/O assignment task. Segment design standards set the segment-loading rules for your plant.

- Instead of assigning every signal to a specific I/O at the host and splitting inputs and outputs to separate places, you design segments and bring all the devices, regardless of input or output, into a single point for I/O assignment.

- The bus nature of fieldbus also gives you much more flexibility in adding to and modifying device counts and types. As devices are added and changed during design, in many cases I/O assignment is either unchanged or changed only to a very limited extent.

- Finally, the need to marshall I/O points -- so different signal types and inputs and outputs can be properly routed to a dedicated termination point -- is significantly reduced.

The documents you will need for segment design include

- P&IDs
- Instrument plans
- Host-system documentation showing configuration rules or restrictions.

Segment design standards set the segment-loading rules for your plant. Devices should be grouped according to these rules and, of course, your specific process.

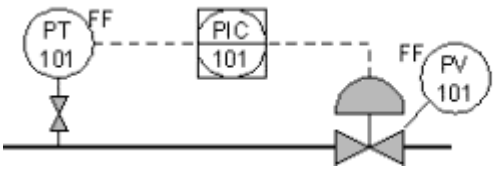
Both fieldbus and host-system constraints should be considered. As you are engineering a project, an automated segment design tool can check fieldbus-related items such as number of devices, power, and overall segment length. Vendor-specific segment design tools may also cover host-system issues such as the maximum number and type of parameters.

Piping and Instrumentation Diagrams

There's currently no industry standard for showing fieldbus capabilities in P&IDs, although ISA is working on one. In the meantime, your best option is to develop a company or plant standard.

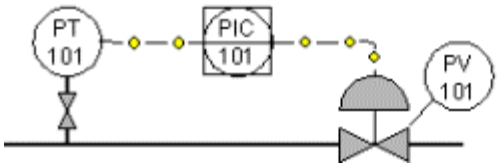
This doesn't have to be a major effort. With the few simple changes to your existing standards, your P&IDs can reflect both conventional and fieldbus devices.

Label all fieldbus devices. This can be done by simply placing a small "FF" beside each fieldbus device.



Identifying fieldbus devices

You can also use a different line style for the connection between fieldbus devices.



Fieldbus I/O line designator

Indicate where control resides, especially if it's in a field device. You can do this by placing a small "FF" next to the PID or other function block. Then, to indicate where the control block resides, place the function block symbol next to the field device that will execute control.

Showing location of PID Control

Label the Link Active Scheduler (LAS). If a specific loop requires a backup LAS, this should also be indicated.

Label the loop execution time. Show the execution time (such as 250 ms or 500 ms) so devices with appropriate control performance can be specified.

Loop sheets

Fieldbus changes what's shown on loop sheets — or can even eliminate the need for them. It depends on what you choose to document on loop sheets.

For example, because point-to-point wiring is replaced by fieldbus segments, a loop sheet that shows only point-to-point wiring can be replaced by a segment drawing. One segment drawing typically shows four to six loops (as well as additional devices), substantially reducing drawing time and costs.

If you've traditionally used loop sheets to document device ranging for analog signals, you no longer need them to show that information. Fieldbus uses only digital signals.

If, on the other hand, you typically use loop sheets to show process diagrams or logic drawings, you may want to retain a very simplified form of loop sheet that includes this information.

And with the added diagnostic capabilities of FOUNDATION fieldbus, you may also decide to add loop-specific diagnostics to the loop sheet.

Segment design drawings

Use segment design drawings to document the **topology, electrical characteristics,** and **control properties** of each segment:

1. Segment topology

- Segment and spur length
- Wire types (and pinouts on any pre-manufactured connectors)
- Locations and types of
  - Junction boxes and connectors
  - Power supplies and conditioners
  - Barriers and terminators
  - Guest devices like configuration tools and bus analyzers
- Additional segment physical capacity for connecting new devices or extending the segment

2. Segment electrical characteristics

- Voltage and current draw, both per device (including guest devices) and for the overall segment. This is especially important for long segments or those with intrinsic safety requirements.
- Device polarity — or polarity insensitivity for devices that offer this feature.

3. Control properties

- Loop execution requirements and times are used to determine overall segment communications loading.

Cable schedules

Your standards for cable schedules should address **types of cables** and **cable numbering conventions.**

The **type of cable** used will depend on the planned segment length and, of course, plant practices.

Single shielded, twisted pair wires inside an instrument cable, or small multi-conductor cables, are often used for fieldbus wiring. You can use existing wire unless it's old or in poor condition.

Cable and wire **numbering and labeling conventions** will need to be changed in order to differentiate between traditional point-to-point, single-device wire pairs, and a multi-drop digital bus.

For example, in a traditional analog installation, a single wire pair has a single device tag. In the fieldbus environment, that same wire pair acts as a digital bus connecting multiple devices, so it should be labeled with a segment number or segment description.

Installation practices

As with so many other aspects of fieldbus projects, installation isn't any harder than with traditional technologies. In fact, it's usually easier. But some things are different — and those differences should be reflected in your standard installation practices.

Here are few examples:

Optimize your wiring. To reduce costs and labor, wire the home-run cable to a field junction box close to the field devices. Then connect the devices using either of the following methods:

- Continue running individual wire pairs — through conduit if you want — from the trunk to the individual devices
- Run quick-connect cables from the junction box to the individual devices. Quick-connect cables cost more than twisted pair, but they install faster, produce fewer wiring errors, and provide some short circuit protection.

Select time-saving devices. Devices with vendor-installed, quick-disconnect wire connectors are faster and easier to connect and can reduce wiring errors.

More on installation practices

Observe device polarity. Because most fieldbus devices are polarity sensitive, crossing the positive and the negative anywhere on a segment may cause individual devices or parts of the segment to malfunction.

Although this won't happen with polarity-insensitive devices, observing the polarity of all devices will reduce electrical installation problems.

The PlantWeb advantage

All fieldbus devices from Emerson are polarity insensitive. They will function regardless of the polarity of the wiring. This reduces design, installation, commissioning, and troubleshooting by eliminating polarity considerations.

Anticipate device and segment changes. Define standard methods of attaching and removing individual devices without shorting out the segment. For example, you might use quick-disconnect cables, removable terminal blocks, and short-circuit-protected junction boxes.

Standard wiring practices can also help technicians avoid mistakes in connecting (or disconnecting) devices and cables. For example, always have the segment enter a junction box on terminals 1 and 2 and exit on terminals 3 and 4. If the segment doesn't continue beyond the junction box, put the terminator on the same terminals where the segment would have left the box.

Document everything. To ensure consistent installation and streamline maintenance later, immediately update your standards and project records to reflect any changes made during engineering and installation. The time and headaches you save may be your own.

Project schedules

With fieldbus you may spend more time doing up-front planning but less on installation, checkout, and commissioning. In general, **fieldbus will shorten your overall project schedule and allow your plant to start up earlier**. The profit from incremental production enabled by an earlier startup can easily exceed the total project cost reduction..

The biggest schedule change is that field devices are specified earlier in the project.

That's because they're no longer single-function components at the end of individual 4-20 mA wires. They're intelligent devices that provide new capabilities and work together on a digital network.

For example, in a traditional project I/O assignment and instrument specification could proceed in parallel. But with fieldbus, device attributes such as power, diagnostic requirements, and multivariable capability can affect segment design -- which means you'll need to specify the devices that go on a segment before segment design can be completed.

Similarly, on traditional projects with all control in the host system, instrument specification can wait until system configuration is complete. If your fieldbus project includes control in the field,

instrument selection must be done much sooner to ensure they have the needed control functionality.

One of the longest-duration tasks in a typical project is host configuration of control strategies, operating displays, data historians, etc. How a vendor implements fieldbus in their host can have a huge impact on both schedule and functionality.

The PlantWeb advantage

With well over 1000 FOUNDATION fieldbus PlantWeb projects, in every industry and every world area, Emerson has more FOUNDATION fieldbus experience than anyone else.

This experience translates into bottom-line benefits for you. For example, we've consistently implemented FOUNDATION fieldbus projects with shorter project schedules and lower total installed costs than conventional analog projects.

The savings are so consistent and so real, we'll even guarantee them.