Installation – Issues and Solutions

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Fieldbus is in use since 1998\textsuperscript{1}, yet still new for many customers today.

This presentation will look at the installation issues and the “lessons learned”, so that you can benefits from their experience.

Introduction

- The pictures you will see are collected from “real” projects; they are neither simulated nor “demo”.

- We will look at
  - Control room: cabinet design and wiring
  - Field: Wiring, field junction boxes, field device installation.

- Processes typically involve explosion protection methods “intrinsic safety” (I.S. / Ex i; energy limitation by a ‘barrier’) or “explosion proof” (Ex d; protection by explosionproof enclosure).
Many examples use “IS” as this is a key product of my company and that is where I get involved.
Disclaimer

All products shown serve as EXAMPLE only. In particular, problems shown in conjunction with a product serve as example only.

The brand/make/model of the product serving as example is IRRELEVANT.

Problems highlighted serve as example only, are do in no way express problems with a particular product, model or brand.
The conventional system
Control room – Conventional wiring

2nd level
junction box

1st level

Marshalling
and barrier

Control system
Control room – Conventional wiring

Marshalling: to group AI / AO / DI / DO / etc
Control room – Conventional wiring
Control room – Conventional wiring

- Long wires, standard length
- Allows pre-fabrication of wire (ferrules, mounting)
- Conventional signals (4-20mA, RTD, thermocouple, 0-5V/10V/24V) – slow, hardware filtered, length less important
Field – Conventional wiring

- Quality (material)
- Safety
- Location / access
- Weight/size, …
Fieldbus versus conventional
Control room – DCS wiring EXAMPLES

Fieldbus

Conventional
Installations do not have to look messy. They can be very nice, too.

Conventional

Fieldbus
Successful Implementation & Improved Operation

Control room – DCS wiring EXAMPLES

Fieldbus

Conventional
Control room – DCS wiring EXAMPLES
Important: do not use individual wires to wire cabinet. Use fieldbus cable and shield properly.

Why?

Higher signal frequency – protect them against disturbances. Individual wires will cause crosstalk from one wire to another – communication faults can occur.
Fieldbus Cable

Recommended:
Type A cable: Shielded twisted pair

Other cable is possible, but there are limitations in terms of achievable cable distance and electromagnetic compatibility (EMC).

Fieldbus is a digital “high speed” (31kBit/s) communication, a current modulated signal superimposed on the DC power.
Successful Implementation & Improved Operation

Fieldbus Cable

- Shielded pair principle
- Foil shield
- Foil plus braided shield
- Multi-pair (multi-trunk)
- SWA Multi-pair
Successful Implementation & Improved Operation

Please note this way

Images obscured – Brand is irrelevant.
Control room – DCS wiring
Fieldbus system – Field wiring

- Parallel wiring (terminals)
- Special wiring blocks
- (daisy chaining)
Fieldbus system – Field junction boxes

Principle of wiring distribution in junction box: all devices are in parallel
Fieldbus system – Field junction boxes

Please not this way
Fieldbus system – Field junction boxes

Use dedicated wiring blocks with built-in electronic short circuit protection.

LEDs: - built-in s/c protection
Good Wiring Practices

- Test segment wiring before connecting components
- Avoid damaging the wire when removing insulation
- Ground the cable shield only at one point (at the control room end)
- Insulate the ungrounded end of the cable shield (at the instrument)
- Ground armor on both sides (potential equalization)
- Use crimp ferrules
  - Ferrule diameter must fit wire
  - Crimp tool must fit ferrule
  - Ferrule must fit terminals
- Maintain polarity and associated color codes throughout the segment
Good Wiring Practices

- Lessons learned:
  - Torque screwdriver
  - Wire end ferrules
  - Right (!) wire strippers
  - Fieldbus tester

Choose right size

Harms wire strands
Fieldbus Design Tools (Examples)
Project Procedure

Best practice:
- Bench test
  Functional tests and interoperability test
- FAT
- SAT
Installation Guidelines

- Cable Tests
  - Experience has shown that new cable irregularities are so infrequent that it is more efficient to check cable after installation
- Cable Installation
  - Verify that cable is properly installed, bypassing impact from wiring components
- Segment Checkout
  - Check of proper wiring of wiring components
- Device installation
  - Check of proper device installation
- Loop checkout
  - Functional test
Installation tools

Portable fieldbus diagnostic test equipment (Handhelds)

- Measures relevant fieldbus parameters
- Establish baseline after commissioning
Handheld diagnostic tools

Connect at respective location to obtain accurate measurement.
To measure at fieldbus barrier/IS segments, Handheld needs to be Ex i approved. Important since the galvanic isolation of fieldbus barrier impacts on measurement.
Earthing/Grounding

- Grounding in the control room
- One point grounding only
- Continuous shield from control room to the field
- Shield not connected at the field instrument

- Connect cable armor at both ends (potential equalization)
Earthing/Grounding

Successful Implementation & Improved Operation

Host Computer

H1 Interface

24VDC

FF Power Supply & Conditioner & Terminator

Wiring Block & Terminator

Device 1

Device 2

Device 3
Earthing/Grounding

Successful Implementation & Improved Operation
Local field junction box for 4 instruments. Rust prevented proper grounding, so that separate ground connection was required.
Field – Fieldbus wiring

Green: fieldbus
Red: Power (Motors, etc)

For easy maintenance
Troubleshooting
Daisy chaining – not recommended
Electrical welding can generate significant surges.
Bend radius too tight, Upward facing gland risks water ingress

Two cables into one gland prevents sealing of gland
Water ingress caused corrosion of wire and terminals
Troubleshooting

Cable jacket stripped back too far
Troubleshooting

Earth stud not connected – internal surge protectors not working
Troubleshooting

Ground not connected
Troubleshooting

Poor cable (shield) quality
Troubleshooting

Grounding concept failure-prone
Troubleshooting

Water marks, fungus inside junction box
Wire squeezed by enclosure lid – water ingress
Valves drop every 2 weeks

The problem we are experiencing right now is that we lose communications with the valve about every 2 to 3 weeks. The first thing that happens is that we find that every instrument in the segment won't show readings. When I look what instruments are present in the segment with the 375 communicator the only one that I can't find is the valve, but every other instrument is present. The way to fix it is that we only unplug the valve and every instrument in the segment starts reading right away. After we do this we can plug the valve back in and everything starts to work.

I don't believe that the positioner is bad because it happens on every segment that has a Flowserv valve. They can't all be bad. It doesn't happen on any segment that does not have a Flowserv valve. We have other valve manufacturers and we don't see this behavior. We got Fisher, Metso, and Mesonellian. What I am looking for is that if there is a parameter or setting that may be wrong and perhaps that is why the valve locks up. It can't be noise because it happens only on segments with Flowserv valves.

The other thing that we found is that this valves come set up from the factory as link masters. We changed that setting to basic to see if this will help. Could this be the problem?

I am sure the valve checked ok on your end because it usually works for weeks.

I bought a FBT-6 to check the media. I am attaching the report of one of the segments. Right now it seems like is operating properly, but the only error I get is retransmits from the devices listed below. My control system is not picking up on this, which from what I read is what happens.

I am not getting any download errors when I download the schedule.

Address 14h is an Rosemount analytical xmt-c/t
Address 1Ah is a Flowserv positioner PMV D3
Address 24h is a Rosemount 848T

This was done at the power conditioner.

We ended up checking everything in detail. We opened every junction box and instrument to look for signs of anything that might be an issue. We found two segments with shorts between the (+) and the shield.
We also found some instruments were the shield was landed on the chassis ground. This are the major ones we found. I haven't heard of any issues for a couple of weeks.
Conclusion

- Fieldbus is robust if the installation is adjusted to the requirements of a digital communication line
- Do not simply copy 4-20 methods
- Use fieldbus smartly (e.g. eliminate marshalling)
- Good wiring practices are more important than on 4-20 due to bus structure
- Train your installers on fieldbus practices
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