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American National Standard

Instrument Loop Diagrams

ISA-S5.4 — Instrument Loop Diagrams

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Preface

The information contained in the Preface and Forward is for information only and is not a part of the standard.

This standard is prepared as part of the service of ISA toward a goal of uniformity in the field of instrumentation. To be of real value, this document should not be static, but must be subject to periodic review. Toward this end, the Society welcomes all comments and criticisms, and request that they be addressed to the Secretary, Standards and Practices Board, ISA, 67 Alexander Drive, P. O. Box 12277, Research Triangle Park, NC 27709. Telephone (919) 549-8411, e-mail: standards@isa.org.

The ISA Standards and Practices Department is aware of the growing need for attention to the metric system of units in general and the International System of Units (SI) in particular, in the preparation of instrumentation standards. The Department is further aware of the benefits to U.S.A. users of ISA standards of incorporating suitable references to the SI (and the metric system) in their business and professional dealings with other countries. Toward this end, this Department will try to introduce SI-acceptable metric units in all new and revised standards to the greatest extent possible. *The Metric Practice Guide*, published by the Institute of Electrical and Electronics Engineers as ANSI/IEEE Std. 268-1982, and future revisions will be the reference guide for definitions, symbols, abbreviations, and conversion factors.

It is the policy of ISA to encourage and welcome the participation of all concerned individuals and interests in the development of ISA standards. Participation in the ISA standards-making process by an individual in no way constitutes endorsement by the employers of the individual, of the ISA, or of any of the standards that ISA develops.

At the time it approved this standard revision, the ISA-S5.4 Committee had the following members:

NAME	COMPANY
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Gerald V. Barta	Dow Corning Corporation
William H. Cleary	Stone & Webster
Richard L. Emerson	Bechtel Power Corporation
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Raymond Robertson	PPG
Robert P. Larkin	Ford, Bacon & Davis
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John Lorenz	Leeds & Northrup
Richard E. Terhune	Consultant
Mike Wiley	Lummus Crest
Thomas C. McAvinew	Metropolitan Denver Sewage Disposal District

*One vote

This recommended practice was approved for publication by the ISA Standards and Practices Board in 1989.

Foreword

Instrument loop diagrams are suitable for general use throughout industry. It is important to consider their value for design, construction, checkout, start-up, operation, maintenance, rearrangement, and reconstruction. Benefits can include reduction in engineering costs, improved loop integrity and purchasing accuracy, and easier maintenance troubleshooting.

An instrument loop diagram can be effective on any size project from one or two loops up to large and complex installations. It can present on one sheet all the information or references to the information needed for installation, checkout, start-up and maintenance. Without the use of an instrument loop diagram, that information is spread among many other documents and is not readily available. Updating this single diagram to "as built" status is more easily achieved than updating the variety of other documents.

This standard does not mandate the style and content of instrument loop diagrams, but rather it is a consensus concerning their generation. As such, it has the same strengths and weaknesses as other consensus standards. Its primary strength is that the format and content guidelines apply to the majority of instrumentation applications. Its weakness is that it is not specific enough to satisfy the special requirements of particular interest groups.

The ISA Standards Committee on Instrument Loop Diagrams operates within the ISA Standards and Practices Department. This committee is appreciative of the work of previous SP5.4 committees and has tried to treat their work with respect. This committee would like to acknowledge the work of the SP5.1 committee in developing ISA-S5.1, Instrumentation Symbols and Identification. One of our major goals has been to have the S5.4 standard conform to the revised S5.1 standard.

Contents

1 Purpose

1.1 Provide guidelines. This standard will provide guidelines for the preparation and use of instrument loop diagrams in the design, construction, start-up, operation, maintenance, and modification of instrumentation systems.

1.2 Assist understanding. This standard will assist the understanding of instrument loop diagrams and improve communications among technical, non-technical, management, design, construction, operating, and maintenance personnel.

2 Scope

2.1 Additional information for individual loop. This standard establishes minimum required information and identifies additional optional information for a loop diagram for an individual instrumentation loop. This loop is typically part of a process depicted on the class of engineering drawings referred to as Piping and Instrument Drawings (P&IDs).

2.2 Suitability. This standard is suitable for use in the chemical, petroleum, power generation, air conditioning, metal refining, and many other industries.

2.3 Specialty fields. Certain fields, such as astronomy, navigation, and medicine, use very specialized instruments that are different from the conventional industrial process instruments. No specific effort to have this standard meet the requirements of those fields has been made. However, this standard is flexible enough to meet many of the needs of specialty fields.

3 Applications

3.1 Serve many purposes. Loop diagrams serve many purposes. Several of these stated below are in the chronology of project development.

3.2 Design

1) Illustrate control philosophy and confirm the completeness of submitted data

2) An extension of P&IDS, which show the components and accessories of the instrument loop, connections between devices, and identification of component action

3) The specification of instrument hardware items and a means of communicating requirements to vendors

3.3 Construction

1) Panel instrumentation interconnections and checkout diagram

2) Instrumentation installation references and special requirements

3) Instrumentation interconnections

4) Instrumentation loop checkout

5) Inspection and documentation

3.4 Start-up

1) Pre-start-up commissioning and calibration

2) Training tool and aid

3.5 Operation

1) Communication medium between operations, maintenance, and engineering personnel

2) Training device for operations

3.6 Maintenance

1) Troubleshooting

2) Routine calibration

3) Preventative and corrective maintenance tool

3.7 Modification

1) Rearrangement

2) Reconstruction

3) Enhancement

4 Definitions

This standard is an extension of the communications defined by ISA-S5.1, “Instrumentation Symbols and Identification”, and the definitions of that standard therefore apply. The guidelines of this standard cover the content of a loop diagram drawing, and it does not produce any new definitions for that presentation process.

5 Content

5.1 General. The instrument loop diagram is a composite representation of instrument loop information. It contains all associated electrical and piping connections and should contain all of the information needed to accommodate the intended uses. Classified below are minimum requirements and some established options that can be used to match the desired uses.

5.2 Minimum content requirements. As a minimum, an instrument loop diagram shall contain the information covered below.

1) Identification of the loop and loop components shown on the P&IDS. Other principal components of the loop to be shown and identified under ISA-S5.1, "Instrumentation Symbols and Identification".

2) Word description of loop functions within the title. If not adequate, use a supplemental note. Identify any special features or functions of shutdown and safety circuits.

3) Indication of the interrelation to other instrumentation loops, including overrides, interlocks, cascaded set points, shutdowns and safety circuits.

4) All point-to-point interconnections with identifying numbers or colors of electrical cables, conductors, pneumatic multitubes, and individual pneumatic and hydraulic tubing. This identification of interconnections includes junction boxes, terminals, bulkheads, ports, and grounding connections.

5) General location of devices such as field, panel, auxiliary equipment, rack, termination cabinet, cable spreading room, I/0 cabinet, etc.

6) Energy sources of devices, such as electrical power, air supply, and hydraulic fluid supply. Identify voltage, pressure, and other applicable requirements. For electrical sources, identify circuit or disconnect numbers.

7) Process lines and equipment sufficient to describe the process side of the loop and provide clarity of control action. Include what is being measured and what is being controlled.

8) Actions or fail-safe positions (electronic, pneumatic, or both) of control devices such as controllers, switches, control valves, solenoid valves, and transmitters (if reverse-acting). These are to be identified in accordance with ISA-S5.1, "Instrumentation Symbols and Identification".

5.3 Optional content information. Additional information needs to be considered for its effectiveness in accommodating the intended uses. Stated below are typical examples of items for inclusion at the user's discretion.

1) Process equipment, lines, and their identification numbers, source, designation, or flow direction.

2) Reference to supplementary records and drawings, such as installation details, P&IDs, location drawings, wiring diagrams or drawings, and instrument specifications.

3) Specific location of each device, such as elevation, area, panel subdivision, rack or cabinet number and location, I/O location, etc.

4) Cross reference between loops that share a common discrete component, such as multipen recorders, dual indicators, etc.

5) References to equipment descriptions, manufacturers, model numbers, hardware types, specifications or data sheets, purchase order numbers, etc.

6) Signal ranges and calibration information, including setpoint values for switches, and alarm and shutdown devices.

7) Software reference numbers, such as I/O addresses, control block types and names, network interfaces, point names, etc.

8) Engraving or legend information that helps identify the instrument or accessory.

9) Accessories, tagged or otherwise identified, such as regulators, filters, purge meters, manifold valves, root valves, etc.

10) References to manufacturer's documentation such as schematics, connection details, operating instructions, etc.

11) Color code identification for conductors or tubes that use numbers for differentiation.

6 Format

6.1 Consistency for ease of use. The following format conventions should be consistently employed for improved communications and ease of use.

6.2 Size of drawing. The minimum size for the original drawing should be 11 inches X 17 inches. Attention to the proper size of text and symbols will keep them legible on reduced copies. (For convenience in printing and binding, this standard uses reduced size example figures.)

6.3 Drawing content. An instrument loop diagram should typically contain only one loop. Avoid showing a loop on multiple pages or sheets where practical. Use judgment to accommodate the individual situations where loops that share common components can be adequately and completely communicated on a single diagram. Prevent overcrowding and provide space for future additions and loop data.

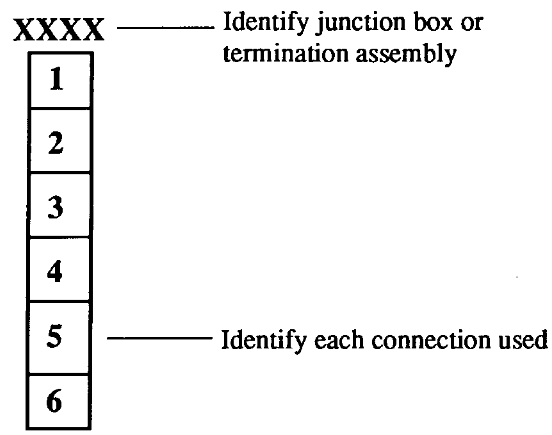
6.4 General layout. Maintain a consistent layout (horizontal or vertical) throughout a project. A suggested layout is to divide the drawing into sections for relative locations of devices.

7 Symbols

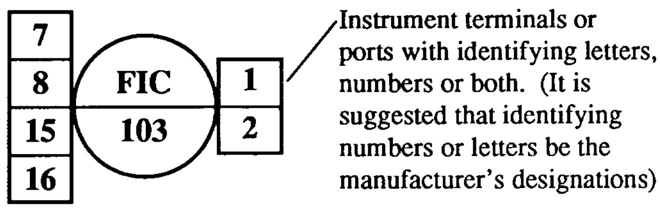
7.1 Instrument connection and action information. The symbols in ISA-S5.1 apply for instrument loop diagrams. However, expansion of those symbols to include connection points, energy source (electrical, air, hydraulic), and instrument action is necessary to provide the information required on instrument loop diagrams.

NOTE: The terminals or ports shown are not to be pictorial.

7.2 General terminal or bulkhead symbol

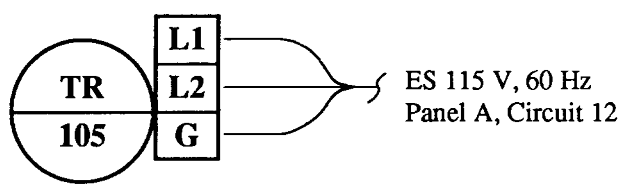


7.3 Instrument terminals or ports

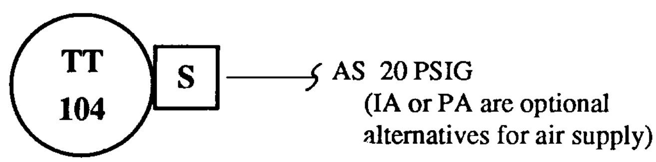


7.4 Instrument system energy supply

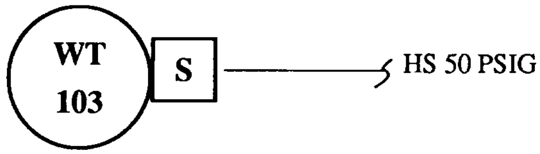
7.4.1 Electrical power supply. Identify electrical power supply followed by the appropriate supply level identification and circuit number or disconnect identification.



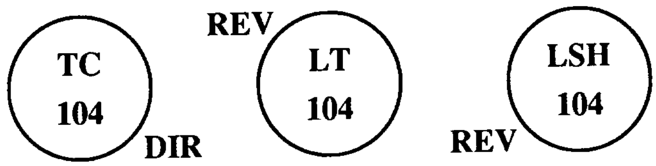
7.4.2 Air supply. Identify air supply followed by air supply pressure.



7.4.3 Hydraulic fluid supply. Identify hydraulic fluid followed by the fluid supply pressure.



7.5 Identification of instrument action. Show the direction of the instrument signal by placing appropriate letters close to the instrument bubble. Identify an instrument in which the value of the output signal increases or changes to its maximum value, as input (measured variable) increases by the letters "DIR." Identify an instrument in which the value of the output signal decreases or changes to its minimum value, as the value, of the input (measured variable) increases by the letters "REV." However, since most transmitters are direct-acting, the designation DIR is optional for them.



8 Examples

8.1 Typical symbols for various control hardware. The example figures illustrate this standard's symbols and identifications that are typical for the various instrument hardware types. This usage does not imply, however, that the applications or designations of the symbols or identifications are restricted in any way. No inference is to be drawn from the choice of any of the information depicted as being a recommendation for the illustrated control method.

8.2 Examples of minimum required items. Sample instrument loop diagrams illustrate the use of the symbols for various relatively simple feedback flow control loops. Figures 1, 2, and 3 show the minimum required items on those loop diagrams.

8.3 Examples of minimum plus optional items. Figures 4 through 6 show the minimum required items, plus examples of optional items presented in various alternate formats.

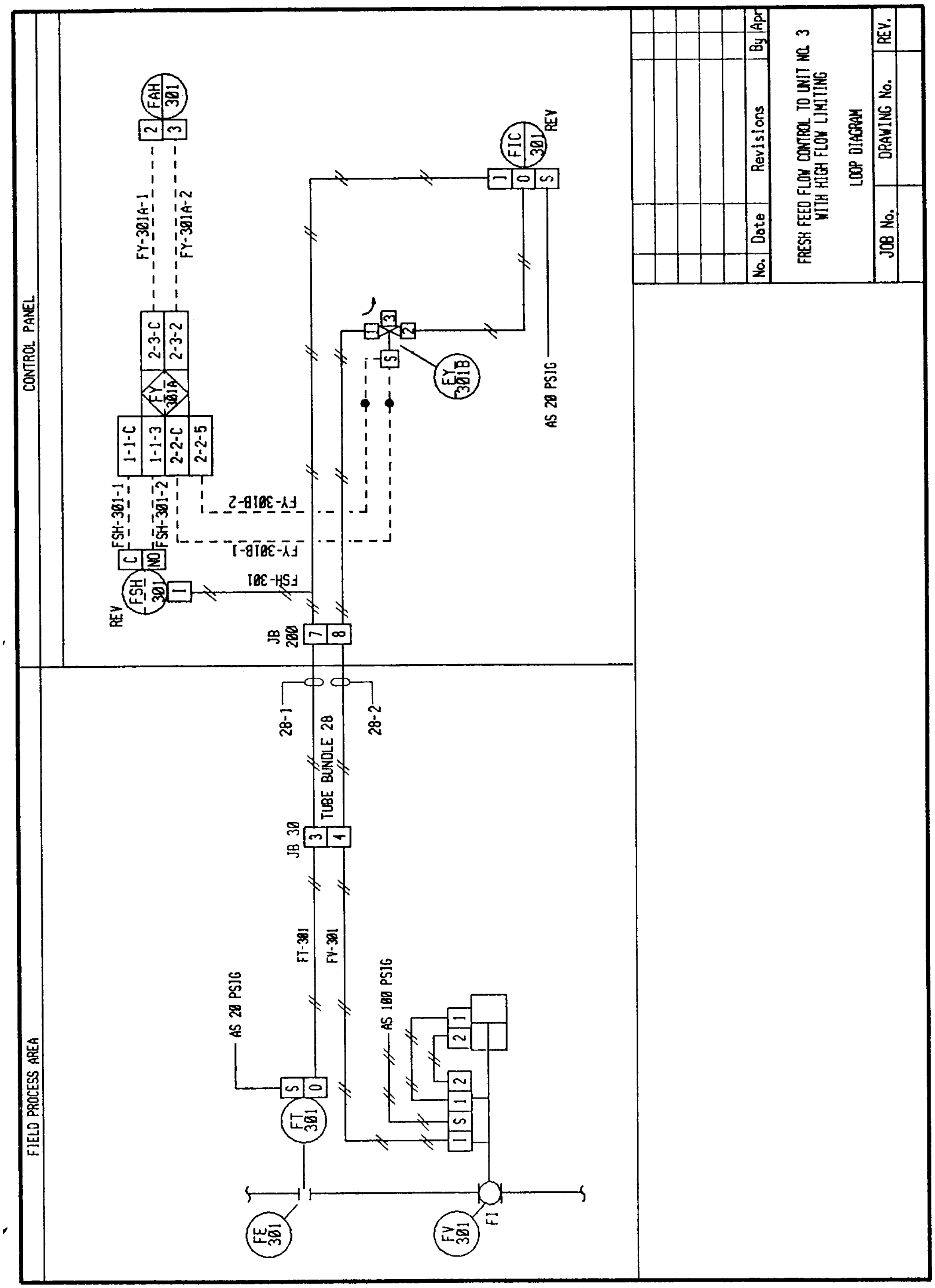


Figure 1 — Loop diagram, pneumatic control, minimum required items.

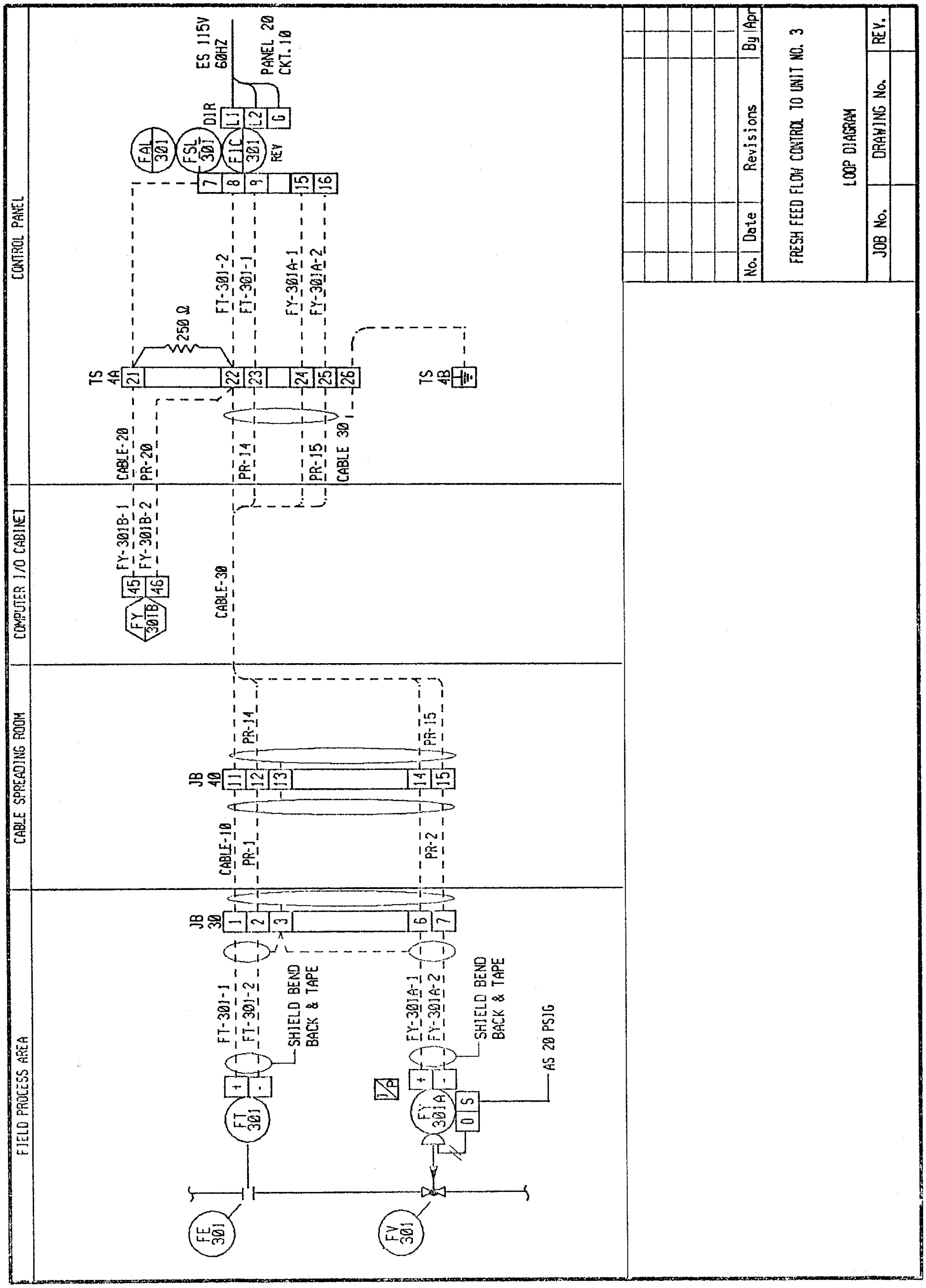


Figure 2 — Loop diagram, electronic control, minimum required items.

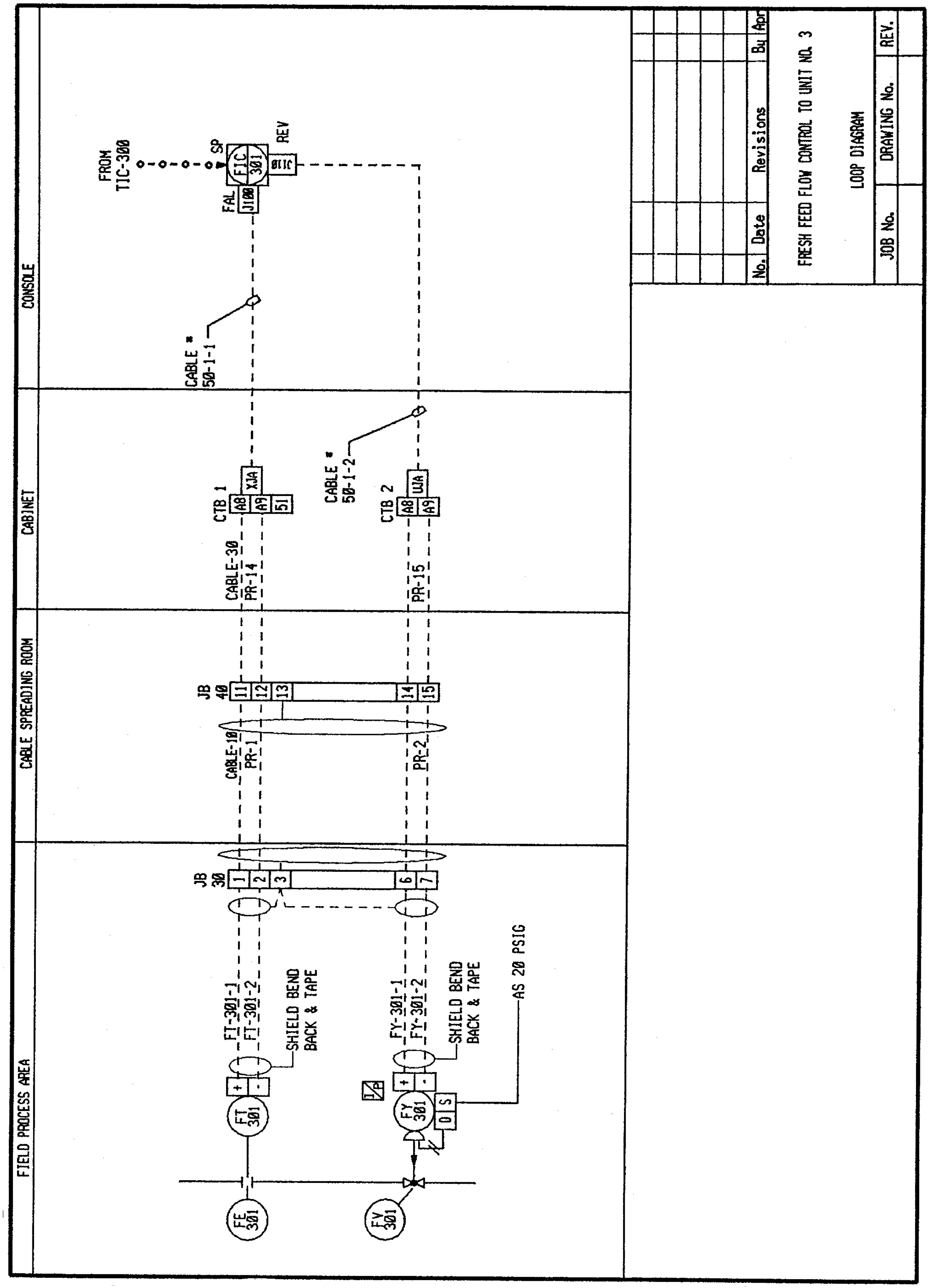


Figure 3 — Loop diagram, shared display and control, minimum required items.

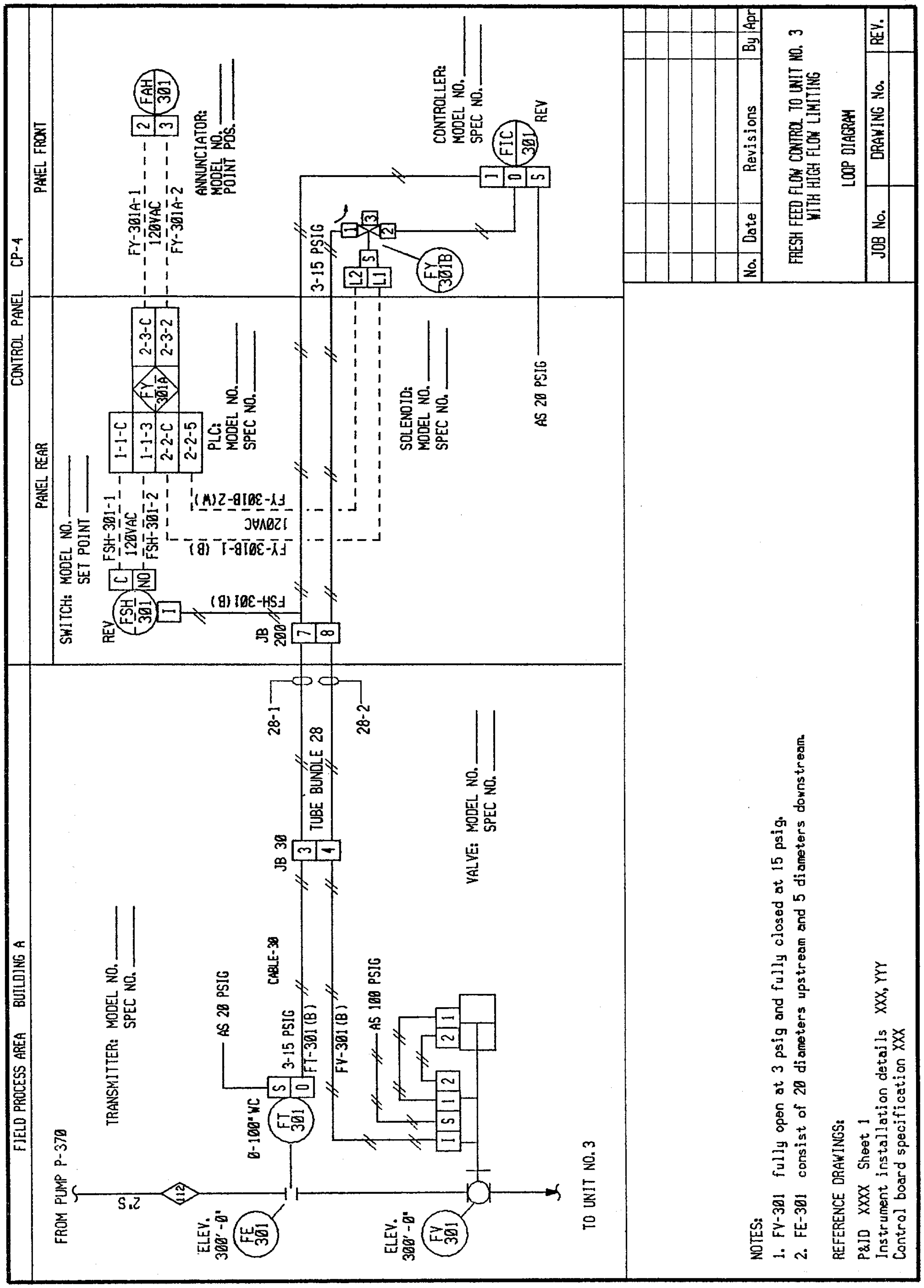


Figure 4 — Loop diagram, pneumatic control, minimum required items plus optional items.

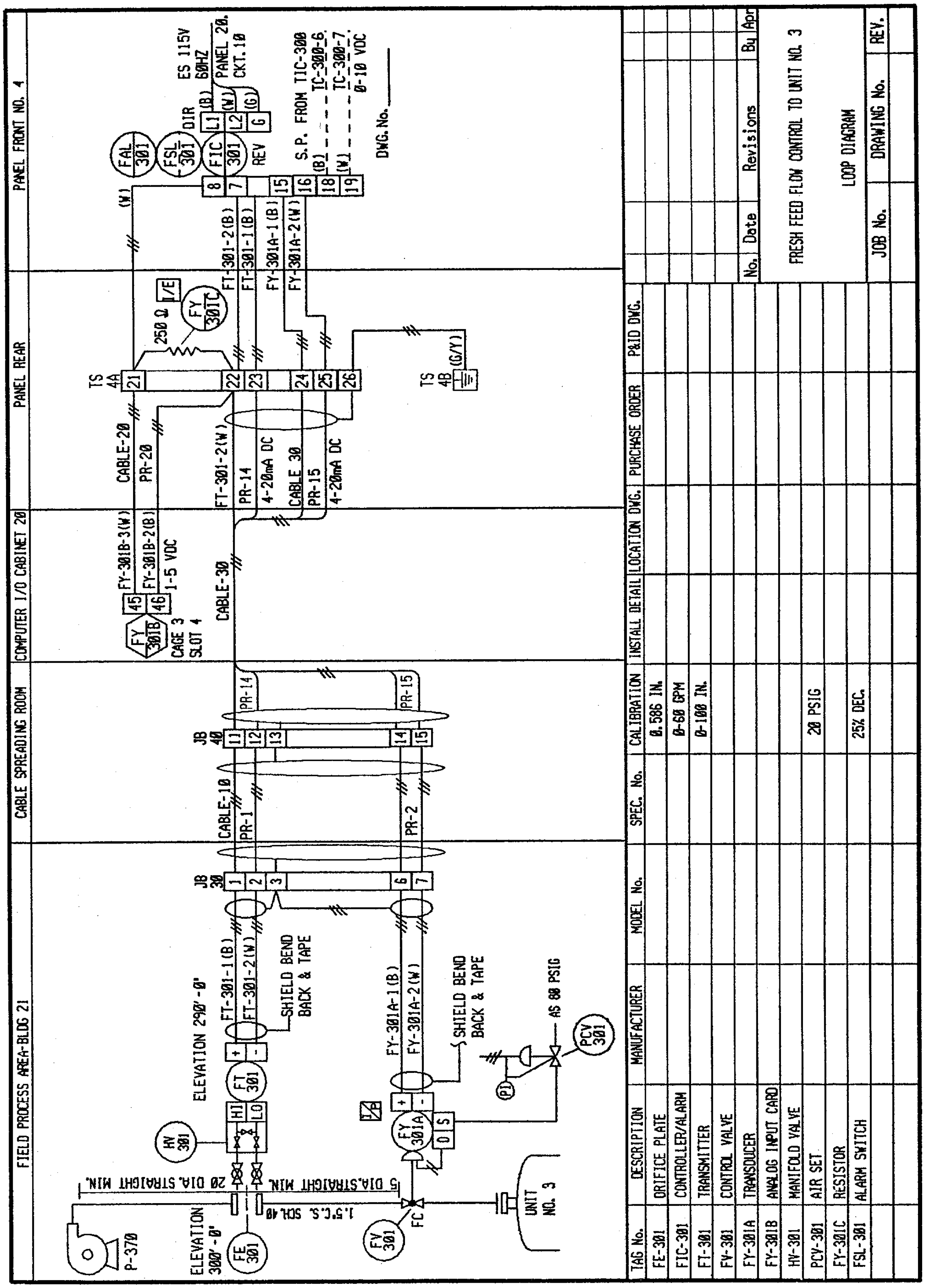


Figure 5 — Loop diagram, electronic control, minimum required items plus optional items.

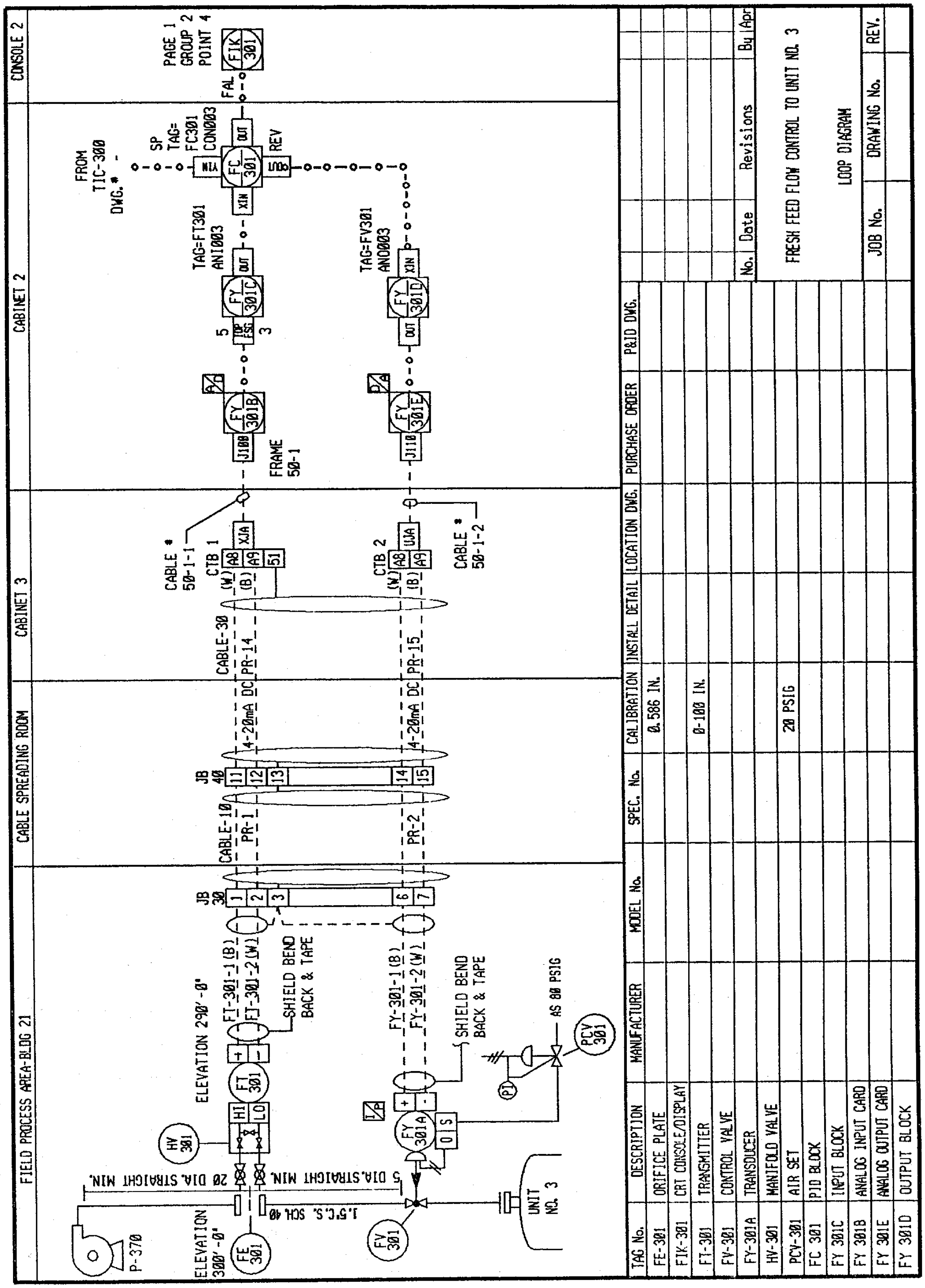


Figure 6 — Loop diagram, shared display and control, minimum required items plus optional items.

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