

THE TOOLS OF COMMUNICATION

■ INTRODUCTION: SYMBOLS AND IDENTIFICATION

This chapter establishes a philosophical and practical basis for symbolism and for identification methods. No graphic examples are given—deliberately. Sound understanding, by necessity, precedes rational application

The What and the Why

In control engineering and design work, symbols and identifiers are used as graphical representations of concepts, ideas about things (devices), or functions (actions performed by devices). These symbols and identifiers are used for two fundamental purposes:

1. To help in the conceptualizing process
2. To help with the communication of information

Conception and communication are the two major categories of the study of symbols and identification; other categories are all subsets of these two. For instance, recording information for future use is nothing more than postponed communication. Indeed, it could be argued that conceptualization is a form of self-communication and that, therefore, there is only one category—communication. However, there tends to be a quantum difference in the detail used in sketches that are intended to help the conceptualization process and drawings that are used for purposes of formal communication, so there is a practical basis for considering two major categories.

Why use symbols? Symbols are a shorthand representation of a great deal of detail that otherwise would require pages of description. They do not stand alone. They appear on various drawings such as flowsheets, loop diagrams, and installation details; and they are supported, necessarily, by other docu-

ments such as instrument indexes and data sheets. They serve a particular purpose; to convey the idea that a device or function exists and that it has definite physical and functional relationships with other devices and functions and with the process being measured or controlled.

In a sense, symbols and identification methods may be likened to a language, a higher (in the computer science use of the word) language, but one that is not so structured as FORTRAN or BASIC.

The Who

When writing a book or preparing a speech, the author must keep the audience clearly in mind for the book or speech to be effectively communicated. Similarly, when an engineering document is created, along with its symbols and identification, the end users must be kept clearly in mind at all times. Learning what the end user requires to help do the job facilitates the design process. An agreed to scope of work that not only tells what is to be done but what is not to be done is most critical.

The end users of instrumentation symbols and identification are quite varied. Examples are process engineers, control systems engineers and designers; piping, electrical, and mechanical engineers; purchasing, expediting, and inspection personnel; vendor and fabricator personnel; installers, and calibration and checkout people, maintenance personnel; safety engineers; and programmers.

It is not always necessary to create a different document for each of the above categories of interested people; but it is wise to analyze which among them are likely to be users of a particular document before work is begun on it. The communication will be much more effective.

The How

It is also wise to remember that *concepts* are being communicated—not pictures. A Circle with a line across it with FIC 100 inscribed in the circle immediately indicates a discrete, panel-mounted flow controller. The fact that the device is not circular at all does not matter. The same applies to drawing a single signal line symbol to represent a signal that is transmitted on two wires. The primary concern is that information in the form of a signal is being transmitted, not that it requires two wires. Later, when it is necessary to know what terminal numbers are used, two wires will be drawn (but on a specific document and only at the terminations).

The best symbol to use is the simplest one that will get the concept across to the intended audience without leaving a sense of uneasiness that something is missing or different. At the other extreme, the reader may be left with a sense of annoyance that there is too much detail, too much clutter involved in the use of symbols. Discomfort in the minds of the audience will impede transmission of the message.

As with all methods of communication, it is first necessary to have something to say and then someone to say it to. In other words, first one must have a purpose for communication something, then the needs of the intended audience must be considered. These two factors usually will decide the type of document to be used and the degree of detail necessary to convey the message. The choice of specific symbols usually comes down to application of the correct standard. The overall impact depends largely on experience and on a sense of aesthetics.

■ SYMBOLS, IDENTIFICATION, AND DOCUMENTATION

Both symbols and identifiers can represent hardware (a discrete, uniquely identifiable device) and the functions performed by such a device. The degree of detail involved in this representation depends on the end use of the symbols and identification. It can range from extremely simple representations to very complicated ones. For instance, a process flow diagram might indicate only that a variable is to be controlled, while the associated loop diagram would show all the devices in the control loop, their interconnections, and their locations.

Since symbols and identifiers are graphical tools, they are always found on a surface that is capable of supporting a graphic image. This surface is usually paper, but it is often a hard surface such as a blackboard. More and more frequently it is an electronic medium, for instance, a video display unit. In a broad sense, these media may all be classified as documents, since they are used to convey information.

As a document is designed, with the end user (the audience) in mind, the type of symbols and identification and the degree of detail to be used on a given document must also be chosen with the end user in mind. At times it is difficult to decide how much detail to put on a particular document. Most will err on the side of excessive detail, but this can be avoided. One golden rule is not to put the same piece of data in more than one document (or database), especially if the document is likely to be revised.

Continuity of Concept

In engineering and design work, it is normal to proceed from the general to the specific: a general concept, sketches, more detailed flowsheets, narrative specifications, individual data sheets, and so on. A continuity of concept exists throughout the various stages of the design process. The scaffolding must be erected before the building can be built.

This continuity is evident in degrees of detail: the same concept, the same device or function, but at different levels of immediate concern. The different degrees of detail are usually represented by different documents: process flow diagrams, piping and instrument diagrams, loop diagrams, installation details, etc. When going from one level or document to another, it is best not to change a symbol for the same concept radically, as doing so will cause unnecessary discomfort in the minds of most users and will inhibit communication and understanding.

For instance, going from a circular symbol to a square one for the same device simply because it is being depicted on a loop diagram instead of a flow diagram is an unnecessary abrupt transition. It forces memorization of more than one symbol for the same object. The use of a basic symbol and the addition of a terminal strip makes use of continuity of concept and is much more comforting to the thought process; or, at least, it does not cause the irritation that inhibits acceptance of the concepts being portrayed.

Communication Requires a Common Language

Common standard symbols and identifiers are not necessarily required for the conceptualizing process or for recording information for personal use. Any individual may try to live in a vacuum if he or she so chooses. However, a common means of communication is required if one wishes to exchange information with others. Communication is not possible without a common language.

The communication function takes precedence over the conceptualizing function in deciding what symbols and identifiers should be used in a particular situation. The communication function, by its nature, requires a common system. Furthermore, since we wish to communicate our ideas clearly to others and we wish not to be misunderstood, nor to misunderstand, it is inadvisable to invent our own symbols and identifiers when commonly accepted ones are readily available.

The goals of a good communications system should be simplicity, clarity, consistency, completeness, flexibility, and compactness. Judgment is involved since some of these goals may be in apparent conflict.

ISA Standards as the Prime Source

The sources of these commonly accepted symbols and identification methods are usually some form of standard: company, institutional, national, or international. Most of these standards are based, even if somewhat loosely, on the ISA 5 series of standards—even the international ones. The popularity of ISA methods may be attributed, at least in part, to the manner in which ISA standards are developed. Committees, whose members are representative of the users of the standard, develop draft standards that are subjected to public review and comment. These draft standards are revised in light of the comments and recycled until a consensus (substantial agreement) is achieved. They then are subjected to a review by ISA's Standards and Practices Board to ensure that correct procedures have been followed and that the committees that developed the drafts were indeed representative and unbiased. These methods ensure that an ISA standard will have reasonable acceptance among users. They also ensure that the "language" used will be a common one.

Symbols and Identification for Equipment and Piping

This book follows ISA standards as closely as possible. It does add many symbols and identification methods that are not usually thought of as being in the domain of instrumentation, for example, process equipment and piping symbols and identification.

However, instrument people cannot perform their work in isolation from the processes and equipment they are attempting to control, and this fact alone justifies the inclusion of symbols and identifiers for other than what is commonly recognized as being in the field of instrumentation.

Symbols, Identifiers, and Words

Although this is a book about symbols and identification methods, the judicious use of words must not be neglected. The combination of a symbol, an identifier, and a well-chosen word or two can often result in a simpler, more readily understood depiction of a complex scheme than words alone or symbols and identifiers alone. The symbol and its associated identifiers supply the general category to which the device belongs; the words supply the qualifier that specifies the device.

■ SUMMARY

In control systems work, symbols and identifiers are basically tools of communication that graphically represent devices, functions, and their interconnections. In addition to being tools of direct communication, they help in conceptualizing and recording information about instrument systems.

These tools of communication are of interest to a wide variety of technically oriented people. The end use to which these people wish to put the graphical representations of concepts must be kept clearly in mind if the communication is to be successful. Concepts, not images, are the subject of the communication process; and concepts, not images, are the base of the most successful (most accepted) standards. Simplicity helps.

It is necessary to know what one wishes to communicate and to whom. The choice of document, the degree of detail, and the standard symbols and identification to be used then follow, usually as a matter of course.

Symbols and identifiers may represent both hardware and software functions. The degree of detail used to represent these functions depends on the purpose of the communicator and on the needs of the intended audience.

The choice of documentation follows and can range from very simple conceptual sketches to highly detailed systems diagrams and loop diagrams. Moving from one type of document to another should entail a modification of the symbols and identifiers used, not a radical change in them.

Since the principal use of symbols and identifiers is found in communication with others, common standards are needed. ISA standards, in general, have earned their place as the prime international source of symbols and identification methods.

This is primarily a book about the application of instrumentation symbols and identification. For completeness, however, related piping, electrical, and equipment symbols are included.

Finally, the use of a few well-chosen words on a drawing should not be neglected. The combination of a symbol, an identifier, and one or two judiciously selected words can communicate a concept more explicitly and more clearly than symbols, identifiers, or words alone.