

**Automatic Control Terminology — 1970 Annual Survey of U.S. Standards Activities**

This 1970 U.S. compilation of control standards updating the 1969 U.S. compilation which appeared in IFAC Bulletin No. 59, gives terms, definitions, letter symbols, graphical symbols, abbreviations, and stylized codes for broad classes of hardware and software. It also includes work at the international level, stressing the evolution of and the growing need for co-operation in the development of worldwide standards. — IFAC is indebted to the magazine „Control Engineering“ for the permission to reproduce the survey which originally appeared in „Control Engineering“, June 1971 issue, vol. 18. No. 6, pp. 62, 63, 64.

ANSI American National Standards
Institute
1430 Broadway
New York 10018

ANSI Subcommittee X3L2 (formerly X3.2), Character Codes, has forwarded to X3 a proposed standard for the graphic representations of the control characters of ASCII (American Standard Code for Information Interchange). Control characters are not printed in most applications. They are those characters used to control communications and formats, and to separate information elements. However, in certain situations it is desirable to display graphically all the characters in a given bit string. Also, standard symbols are needed for key tops on devices having keyboards with the control characters. The proposed standard provides for two alternative sets of representations—pictorials (symbols) and alphanumerics (letters and numbers).

Committee X3T9, which has responsibility for input and output standards, has received and is considering two industry proposals for interface standardization at the channel level. It hopes to recommend a draft standard this spring, after which the committee would immediately begin the development of standards needed at the device level.

Committee C85, dealing with *Terminology for Automatic Controls*, plans to extend the scope of its C85.1-1963 publication to cover control systems in the chemical, petroleum, metallurgical, power, food, textile, paper and transportation industries. Chairman D. H. Smith of Bell Labs expects inputs from SAMA, ISA, and IEEE.

W. L. Hewetson is chairman of Committee Y32/SC5—*Graphic Symbols for Process and Engineering Flow Sheets*, and J. R. Couper, University of Arkansas, is secretary.

IEC International Electrotechnical
Commission
1, rue de Varembe
Geneva, Switzerland

Technical Committee 25 of Working Group 1, Letter Symbols for Electrical Engineering, is considering symbols for *Singularity Functions (Distributions)*—unit step, ramp, Debye function, etc. C. H. Page of NBS is the secretary.

TC25/WG4, Letter Symbols for Automatic Control, has been working toward a consensus on 15 signal variables.

Technical Committee 65, Process Control Systems, met under the chairmanship of Kurt Stahl of Germany during the IEC annual meeting in Washington. Representatives of Canada, Denmark, France, Germany, Italy, Japan, The Netherlands, the United Kingdom, the U.S., and the International Federation of Automatic Control attended. The United States delegation consisted of W.E. Hickes, W.H. Howe, H.H. Koppel, D.G. Muster, R.G. Shaw, D.H. Smith, H.L. Mason and V.V. Tivy. With the help of R. Kay, IEC central office, other IEC committees were advised of the interest of TC/65 in their work.

TC65/WG1, Terms and Definitions, met, in Paris last May and has restructured IEV Group 37 into five chapters titled *General, Variables, The Functional Block Diagram, Performance Characteristics, and Modes of Operation*, and is working on definitions. D.H. Smith of Bell Labs is providing the U.S. input at this year's meeting.

TC65/WG2, Service Conditions, met in New York last May and has established classes of climatic, mechanical, power supply, electrostatic and electromagnetic conditions. W.H. Howe of SAMA, secretary, represents the U.S. at a forthcoming meeting in Soest, The Netherlands.

TC65/WG3, System Safety, has es-

tablished 12 classes of faults which impair continued effective functioning of a system and endanger the safety of a process and its environment. H.H. Koppel of Bailey Meter supports the U.S. effort to include questions of reliability and maintainability.

TC65/WG4, Interface Characteristics, recommends the range 4-20 milliamps for dc signals and 3-15 psi or 0.2-1.0 kgf/cm² for pneumatic signals. V.V. Tivy of Rosemount Engineering has presented the U.S. position that supply voltage, load impedance, grounding, ripple, and signal isolation are major influences; digital interfaces remain to be discussed.

IEEE Institute of Electrical and
Electronics Engineers
345 East 47th St.
New York 10017

Symbols and definitions for the automatic control field are included in the revised IEEE 315, *Graphic Symbols for Electrical and Electronics Diagrams*, just published, and in the revised *IEEE Dictionary*, to be published in the fall. The latter includes a number of terms related to state variable techniques and types of stability, as developed by the Group on Automatic Control.

IPC The Institute of Printed Circuits
1717 Howard St.
Evanston, Ill. 60202

R.E. Pritchard reports that a new loose-leaf *Printed Wiring Design Guide* is now available for rigid and flexible interconnection structures using printed wiring. It contains a comprehensive compilation of data pertinent to the problems encountered in the application of printed

wiring design principles. Another publication, a *Technical Manual*, contains 17 standards issued by IPC, from standard tolerances to procedures for design, assembly, and testing.

ISA Instrument Society of America
400 Stanwix St.,
Pittsburgh, Pa. 15222

In 1970, ISA published the third edition of *Standards and Practices for Instrumentation*. This book contains three sections: the full texts of 32 current standards and recommended practices developed by ISA; information on 800 related instrumentation standards featuring 650 abstracts (25-50 words) of standards developed by 52 U.S. standards organizations and 150 titles of standards published by the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), and the Pan-American Standards Commission (COPANT); and a new key-word index to help quickly locate related standards by subject area.

ISA also published S7.4, *Air Pressures for Pneumatic Controllers and Transmission Systems*, an adoption of SAMA Standard RC2-5-1967. This standard establishes standard operating pressure ranges for pneumatic intelligence transmission systems, and also establishes air supply pressures for operation of both pneumatic controllers and pneumatic intelligence transmission systems.

ISA Committee SP5.1, Instrumentation Symbols and Identification, chaired by George Platt of the Bechtel Corp., has offered its work to ANSI Y32, where it is still under consideration. SP5.2, Binary Control Logic Diagrams, is reported by Chairman Platt to be developing a draft standard to be ready for public review by the end of 1971. SP5.3, Instrument/Computer Intertie Symbols, under Louis Costea of Hunt-Wesson Foods, is aiming at a draft by 1973. SP56, Valve Connection Designations, under Herbert Gilbert, began an industry survey to be completed this year.

T. S. Imsland of Fisher Controls, who chairs SP51 on Instrumentation Terminology, reports the committee's endorsement of SAMA PMC20, and support of its use in the proposed revision of ANSI C85.1. In addition to measurement and control terms, hardware terms and terms relating to environmental influences as they affect instrument performance should be included. SP51 will meet three times in 1971.

ISA has organized four new standards committees. These are SP57, Measuring Instruments for Nuclear Radiation—chairman John E. Meyers Jr. of Combustion Engineering; SP58, Instrument Connection Designations, authorized to initiate an industry survey; SP59, Environmental Noise Measuring Instruments—chairman Terrence J. Molloy of Grove Valve and Regulator; and SP61, Instrumentation Loop Diagrams, approved for formation as a survey committee—chairman L. A. Spence of Union Carbide.

ISO International Standards
Organization
1, rue de Varembe
Geneva, Switzerland

The International Standards Organization's new Technical Committee 131, Fluid Power Systems and Components, has established two control-related subcommittees. Subcommittee 5, Control Components, is formed to standardize hydraulic, pneumatic, and fluidic control components. France has been assigned the subcommittee secretariat duties for SC 5. Subcommittee 9, Installations and Systems, will supervise the international standardization of control systems. The United Kingdom has the secretariat.

Technical Committee 37 has approved DR 1951, *Lexicographical Symbols*, for submission to the council. Supplements are being prepared for the *Vocabulary of Terminology* R 1087, *Lexicographical Symbols* DR 1951, *Layout of Multilingual Classified Vocabularies* R 1149, and *Symbols for Languages, Countries and Authorities* R 639. Austria holds the secretariat for TC37, Terminology (Principles and Coordination).

ISO/TC10/SC3, Graphical Symbols for Instrumentation, completed a draft of a system of symbols for basic instrumentation at a meeting in West Berlin in January 1970 (CE, June '70, p. 88); the draft is still under discussion by SC3. The U.S. Advisory Committee was represented by George Platt, Bechtel Corp., and Louis Costea, Hunt-Wesson Foods. SC3 will take over the work of TC124/WG7 on *Graphical Symbols for Control Instruments*.

Frank L. LaQue, long active in ANSI and International Nickel Co., took office as president of ISO in June 1970.

The secretariat for ISO/TC97, Computers and Information Processing, is held by the Business Equipment Manufacturers' Assn., which works closely with the European Computer Manufac-

turers Assn. TC97/SC1, Vocabulary, has completed Section 01 on *Fundamental Terms* as a draft recommendation. TC97/SC2, Character Sets and Coding, is at work on extension procedures, block spanning techniques, decimal numerals in packed numeric form, and parallel data transmissions.

TC97/SC4, Input/Output, will shortly discuss physical characteristics of magnetic six-disc packs for magnetic interchange, and physical properties of unrecorded magnetic tape for instrumentation applications. WG1 of SC4 has drafted proposals on magnetic-tape cassettes, magnetic-tape vocabulary, and conditions of storage and transportation. WG5 of SC4 has completed work on DR1858, *Instrumentation Tape*, and is studying a vocabulary, modes of recording, and reels of varying sizes.

TC97/SC5 has completed work on FORTRAN (DR 1539) and ALGOL (DR 1538), is voting on numerical control processor outputs, and will initiate a formal working group on programming languages for numerical control, asking close U.S. participation.

TC97/SC6, dealing with digital data transmission, has asked the cooperation of CCITT on new networks, pen allocation, signal quality, terminology, residual errors, control procedures, system performance, interfaces and modems, prefixes and DLE sequences, compilation of national regulations, conversational message transfer, block and control sequence numbering, two-way transmission control, and go-ahead sequences with interrupt.

TC97/SC8 which is concerned with the numerical control of machines, is asking accelerated ISO procedures on vocabulary and on formats for contouring. It is also considering revision of R1056, asks information on computerized control, direct numerical control, and adaptive control, and is weighing standardization of sensors and interfaces.

The U.S. Advisory Committee to IEC has long advocated the transfer to IEC/TC65 of the standardization work of ISO/TC124, Process Control Instruments, and this action has now been approved. TC124/WG1, Terminology, will probably be merged with its TC65 counterpart. WG2, Temperature Sensors, is standardizing the dimensions of bulbs and wells to provide adequate strength for exposure to high-temperature and high-velocity fluids. J. W. Murdock of ASME and R. D. Thompson of ASTM represent the U.S.

TC124/WG3, Test Procedures, has dealt with the performance evaluation of

process controllers using continuous (analog) signals. C. E. Ryker of Cummins Engine Co., who has represented U.S., believes WG3 has overemphasized static tests for dynamic operation.

TC124/WG4, Instrument Scales, is concerned with the readability of digits and graduation marks. J. W. Murdock has represented U.S.

TC124/WG5, Dimensions for Panel Mounting, has examined German and other national standards and finds them based on switchboard types of electrical instruments. P. F. Pagerey of Taylor-Sybron emphasizes the grid-pattern approach of the U.S. Position Document 2.3.1.2.—U.S., for providing maximum packing density of process-control instruments with minimum restriction on flexibility of panel design.

NEMA National Electrical Manufacturers Assn.
155 East 44th St.
New York 10017

The Industrial Control and Systems Section chaired by K.M. Nelson of Cutler-Hammer has published ICS-1970, which has a complete section on terms and definitions used in industrial control work. In addition, there are sections on diagrams, device designations and symbols, graphic symbols for logic diagrams, statistic switching control devices, service conditions, tests, enclosures, spacings and ratings, applications and manufacturing. There are detailed standards covering manual and magnetic controllers, control relays, resistors and rheostats, and such devices as push-button stations, control centers, and automatic transfer panels. These standards are continuously being updated.

NFPA National Fluid Power Assn.
P.O. Box 49
Thienville, Wisc. 53092

The following three NFPA recommended standards are past the ANSI/B93 voting stage and are undergoing final review by ANSI: NFPA/T3.7.70.3—*Method of Rating Performance of Fluidic Devices*, NFPA/T3.12.70.3—*Fluid Power Industrial-Type Air-Line Pressure Regulators*, and NFPA/T2.70.1—*Glossary of Terms for Fluid Power*.

Significant progress is being made in the cleanliness of both control and fluidic-power systems, in cooperation with Oklahoma State University. The defini-

tion of the term "fluidics" is being reexamined, and there are projects on measuring the response time of a fluidic to a pneumatic or hydraulic interface device, and on standardizing tubing sizes for fluidic interconnections.

For pneumatic control systems, NFPA is completing work on standards for air-line filters and lubricators. For electrohydraulic servovalves, it is updating a glossary of terms and preparing a standard method of rating performance of the valves and dimension in their subbases. For compressed air dryers, a committee has completed a glossary, and is working on standard test and rating methods.

Project T3.21.2 is a proposed 180-page standard establishing norms for both attached and detached diagramming methods. This is expected to have a major impact on hydraulic, pneumatic, and fluidic control areas.

SAMA Scientific Apparatus Makers Assn.
1140 Connecticut Ave. N.W.
Washington, D.C. 20036

SAMA presented an industry position paper as part of the U.S. National Metric Study. The association also plans to continue to assist the instrument industry in defining costs and procedures for metrication. This process involves not only expanded use of SI units, but also SI-based engineering standards.

The secretariat for two ANSI Committees—C39, Electrical Measuring Instruments, and C100, Electrical Reference Instruments—is provided by SAMA. Existing standards for direct-acting recorders (C39.2), indirect-acting recorders (C39.4), and electrical instrument safety (C39.5) have been reaffirmed. IEC recommendations are being reviewed as a basis for inputs to a new edition of the safety standard.

ANSI C100.1, on transformer-type voltage dividers, and C100.2, on precision laboratory potentiometers, are under revision. C100.3, covering reference standard resistors, was published in 1970. Draft standards for voltage and current reference devices and dc null detectors are under development.

SAMA sponsored a delegate to IEC TC31 (Intrinsic Safety) in Basel in September and two of the U.S. delegates to the meetings of TC13 (Electrical Switchboard Instruments) in Budapest in October 1970. Further support for such travel will likely be continued in 1971. SAMA also co-sponsors (with ISA) the

U.S. Advisory Committee for Process Control Instrumentation. This group, chaired by W.H. Howe, advises the U.S. National Committee to the IEC. It is expected that during 1971 it will also coordinate domestic interest in this subject.

U.S. efforts have helped consolidate international standards work for process control instruments in one IEC committee, TC65, where it previously had been split between IEC/TC65 and ISO/TC124. The U.S. Advisory Committee is promoting use of a distinctive dimensional matrix for panel-mounted process control instruments. Based on the work of a U.S. delegate, IEC class indexes for electrical reference instruments probably will be based on stability rather than accuracy.

SAMA Standards for Instrument Case Locks & Keys, Mechanical Chart Drives, and Panel Cut-Out Dimensions have been withdrawn. Earlier dimensional standards for industrial thermometers, bulbs, and wells are being updated to include metric dimensions. SAMA Standard PMC 20-2, on Process Measurement and Control Terminology, together with a group of state variable definitions developed by IEEE/PGAC, have been proposed as a basis for revising AN Standard C85.1. A new standard method for hydrostatic testing of control valves will be published this year.

SAMA draft standards on Test Procedures for Glass pH and Reference Electrodes, and Safety Guidelines and Performance Specifications for Atomic Absorption Spectrophotometers are in trial use by manufacturers. User review of these documents is invited.

VRCI Variable Resistive Components Institute
1717 Howard St.
Evanston, Ill. 60202

A standards document on *Precision Potentiometers* includes *Terms and Definitions* (VRCI-P-100) and *Inspection and Test Procedures* (VRCI-P-200). A similar document on *Trimming Potentiometers* was published in July 1970, and includes VRCI-T-110 and VRCI-T-215.

Acknowledgement

C.M. Doolittle, President, AACC, and H.L. Mason, Chairman, AACC Terminology Committee, wish to thank the organizations whose responses made this report possible. The compilation was assisted by L.N. Combs, E.A. Capelle, J.E. French, W.H. Howe, H.H. Koppel, E.J. Mastascusa, J.I. Morgan, G.L. Platt, R.E. Pritchard, and D.W. Smith.

IFAC Journal Automatica

„Automatica“, the official organ of IFAC, makes the most significant papers from IFAC symposia, conferences, and congresses readily available to control engineers. The subjects of the papers cover the application and theory of all areas of automatic control and, thus, the Journal provides communication between various spheres of interest in the automatic control field.

In addition to papers presented at IFAC meetings, others from independent sources are published, if they are judged to be of sufficiently high quality.

It should be noticed that the Journal does not replace any existing control journal; it supplements the existing literature and provides a broad perspective of control theory and practice throughout the world through the existing structure of meetings and the corresponding exchange of information.

In an effort to publish the most significant papers available, a number of associate editors assist the editor *G.S. Axelby* in selecting IFAC papers, worthy of possible publication, from formal reviews on which they make recommendations to the editor for possible publication, revision, or rejection. The reviewing is done by a large number of referees all over the world who are normally selected by the associate editors. A referee is an outstanding authority on the special area of interest.

The Journal is published bimonthly.

The *July issue 1971* showed a wide variety of subjects, from control of respiratory systems to power distribution and process control systems with other papers on optimum control, optimum estimation, non-linear system stability, and multivariable decoupling.

The *September issue* contained papers on space vehicles including a concise, but thorough description of the Saturn Launch Vehicle controls. There are also papers on modelling and bias errors in state estimation, singular control theory, self-organizing systems, and stability.

The forthcoming *November issue* will include several papers on systems with time delays with respect to smoothing and optimization. Also there will be papers on suboptimal control, the estimation of the order of linear systems, digital integrator design, computer-aided system design, and optimization of sampled data systems.

In the *January issue* of the year of 1972, practical and theoretical papers will include the control of satellite attitude, inertial aircraft flight, and cement kilns. In addition, a comparison of available process control structures will be presented as well as discussions of optimal control problems, organizational and learning systems, feedback invariants of multivariable systems, and fuzzy automata.

A description of some of the material to appear in the forthcoming *November issue* as given by the editor may round up the picture of what „Automatica“ offers its readers.

The first paper by *S. Chirarattananon* and *B. Anderson* describes a fixed lag smoother algorithm which provides

a state estimates with lower error variance than a Kalman filter, and it overcomes the usual difficulties of computational instability and physical un-realizability.

Whereas the first paper considered a fixed time lag in an optimal estimator, the second paper by *K. Inoue*, *K. Ogino*, *H. Akashi*, and *Y. Sawaragi* considers a time lag in an optimal controller where two different sensitivity approaches are used to synthesize optimal and sub-optimal control systems with decreased computational effort but without decreased performance.

The next paper by *M. Soliman* and *W. Ray* also concerns the optimal control of systems with time delays but it includes non-linear multivariable systems, and a neighboring optimal feedback control scheme is developed and illustrated on a third order non-linear model of a continuous stirred tank chemical reactor.

The discussion of optimum multivariable systems is continued by *A. Niederlinski* who considers design and implementation methods, based on heuristics, to select control configurations proven to be stable with satisfactory disturbance attenuation.

Another suboptimal design method is presented by *Y. Nishikawa*, *N. Sannomiya*, and *H. Itakura* for non-linear feedback systems where the non-linearity is interpreted as a disturbance in a power series which produces the usual Riccati equation for the linear terms and higher order equations for higher order terms, but the latter are transformed into conventional linear equations using an extended Liapunov equation as illustrated by three examples.

An iterative computational method for the dynamic optimization of non-linear control systems, described by *Lekkerkerker* and *T. Oerlemans*, uses a difference technique in state space to determine partial derivatives of the Hamiltonian and a quadratic approximation to the minimum surface which facilitates application of optimal control to complicated process control problems as illustrated by an example of optimizing the temperature profile of a chemical reactor.

The difficult, but very important problem of estimating the order of linear systems when modelling and estimating parameters is considered by *C. Woodside* who compares three approaches and determines that one of the methods successfully determines the order of a system even with 30% white noise in the measured input and output data.

Another important but rather specialized problem, solved by *R. Bywater*, concerns a digital differential analyser (DDA) used in process control, and it is shown that a scaled digital integrator reduces costs and solution errors by reducing the number of machine elements and delays.

The Journal is published by

PERGAMON PRESS

Headington Hill Hall
Oxford OX3 0BW,
England

Maxwell House,
Fairview Park,
Elmsford, N.Y. 10523, USA

Annual subscription rate: £ 16 (US \$ 40.00). Reduced annual subscription rate for private individuals whose departmental libraries subscribe or who are attached to a member organization of IFAC: £ 3.50 (US \$ 9.00).