Chapter 20

STANDARDIZATION OF OIL-FIELD EQUIPMENT

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INTRODUCTION

The American Petroleum Institute program for standardization of oil-field equipment and materials is essentially an engineering achievement. Since their first issuance in 1924, API standards have been accorded wide acceptance in the domestic industry. By the latter part of the 1940's these standards had become an integral part of world-wide commerce in oil-field equipment. This steady progression to international pre-eminence is strong testimony to the engineering knowledge and perception through which these standards have been conceived and formulated.

The standardization program has given to the petroleum engineer no less than it required from him. The discussions and exchanges prerequisite to the preparation of standards have constituted a major technical forum from which all participants have gained knowledge and understanding not immediately available from intracompany sources. With the growing acceptance of standards, engineers have been freed from routine technicalities of design and purchase in order that they might better concentrate on the unknown and the unusual.

The API standardization program has been a concerted, continuous development by the petroleum industry and its suppliers of standard specifications which define minimum properties and dimensional limits for various items of equipment and material. This process has often required the establishment of grade, type, and size classifications to improve quality and to provide interchangeability. When adequate and generally accepted methods of testing to determine minimum properties or performance qualities have not been available, these too have been developed by the Institute's standardization committees — often through highly original applications of engineering knowledge. Another important function of the program has been the development of recommendations as to methods of handling, storing, installing, and maintaining equipment and material. Publications of this type were originally called "Codes of Care and Use" and more lately referred to as "Recommended Practices". The term "standard" is used herein to describe both specifications and recommended practices.

INCEPTION OF OIL-FIELD STANDARDS

Material shortages brought about by World War I gave impetus to standardization in several industries. Herbert Hoover, then United States Secretary of Commerce, and other prominent industrialists urgently advocated intra- and inter-industry action to reduce the useless multi-
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Plicoplicity of sizes and types that was draining raw materials and thwarting industrial efficiency.

The oil industry was growing at a furious pace and the oil-field equipment situation was particularly chaotic. Few of the many manufacturers of pipe, for example, made their product in the same sizes, or with the same thread. Drilling operations were subject to expensive shutdowns in order to search for pipe and other items that could be used with those on hand. Costs mounted; purchasing became a frenzied pursuit of the unobtainable; and crude, dangerous, and expensive operational practices were resorted to. E. W. Clark, president of the Institute in 1927, described the situation up until 1925 as "... a wilderness of individual effort."

The need for standardization was recognized by many even prior to the organization of the Institute. At the first Institute meeting in 1919, a conference on standardization was held by R. L. Welch, API secretary; John Glover, Oil Well Supply Company; H. J. Lockhart, Parkersburg Rig and Reel Company; and C. A. Young, Lucey Manufacturing Corporation. This conference led to the presentation at a 1922 meeting of a session devoted to standardization and simplification of oil-field equipment.* Thomas A. O'Donnell, API president, and W. S. Farish, president of Humble Oil & Refining Company, presided over this session. Quoting the former: "The petroleum industry cannot expect the manufacturer to meet its requirements ... unless there is a great demand from the industry itself to get some kind of standardization. Today there is the purchase of drill pipe ... that never has been or never will be strong enough to stand the strains put on it. Sometimes it won't stand its own weight. We frequently get into trouble with the drill stand (sic) and the tool joints, not knowing ourselves what the different combinations of carbon and steel should be in order that the different joints make up together. We find that we have a lot of fishing jobs ... . The tool joint maker says, 'It is not my joint; it is the casing.' ... The casing people say that it is not their casing; it is the tool joint. If any of you have ever been able to find a manufacturer who sold you the wrong kind of stuff you have done better than I have."

At the conclusion of this session a resolution was passed which called upon the Board of Directors to appoint such committees as were necessary to promote simplification and standardization. This resolution has further historical significance because of its mention of the organized standardization activities then in existence, viz.:

*At this session papers were presented by F. B. Trough, and F. B. Foley, U. S. Bureau of Mines; Frank N. Spiller, National Tube Co.; F. B. McIntosh, Carnegie Institute of Technology; Wm. A. Durgin, U. S. Dept. of Commerce; A. B. Steen, The Texas Co.; O. V. Borden, Purchasing Agents Association of Tulsa; J. Edgar Pew, Sun Oil Co.; S. A. Guiberson, Jr., Guiberson Corp.; and Grant Hedley, Oil Well Supply Co. These papers described in detail the penalties the industry was paying for lack of standardized equipment. They are printed in full in API Bulletin, III (42) December 30 (1922).

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Committee on Casing and Rotary Drill Pipe of the Mid-Continent Oil and Gas Association (J. Edgar Pew, Chairman).

Committee Conference on Cable Tools, held in 1922 under API auspices (Louis C. Sands, Oil Well Supply Company, Chairman).

Voluntary Committee of Rig Iron Manufacturers (H. J. Lockhart, Chairman). This group was sponsored jointly by the API and the Purchasing Agents Association of Tulsa.*

Also acknowledged were the efforts of S. A. Guiberson, Jr. who had been cooperating with various agencies to bring about standardization of tool joints.

While standardization had the active and articulate support of numerous industry leaders from its first mention in Institute circles, and although proposals gained rapidly in clarity and momentum from 1924 to 1929, support was far from being universal. Some oil-company representatives were fearful that standardization would stifle initiative and innovation. Many manufacturers were concerned about the loss of competitive advantage and the expense of plant and process modifications which standardization would require. These fears continued to be expressed from this direction and that until the 1940's, but with diminishing force and mostly by organizations newly touched by the constantly increasing scope of the Institute program.

In December 1923, the API Board authorized the formation of a Division of Standardization. This authority was implemented almost immediately by the organization of several standardization committees. From 1924 onward the Institute was regarded as the authoritative source of oil-field equipment standards, although other associations — notably the Western Oil & Gas Association — maintained standardization committees with an advisory function for several years thereafter.

DYNAMIC LEADERSHIP

Among the thousands of industry representatives who have taken part, two individuals — J. Edgar Pew and John R. Suman — are the acknowledged paterfamilias. Pew, a vice-president of Sun Oil Company, was the leader in oil-field standardization from its inception until his retirement in 1946. His strong personality and ability to win the confidence and cooperation of able men was instrumental in the rapid success of the program. He served as the first chairman of the standardization committee on casing of the Mid-Continent Oil and Gas Association, and successively as chairman of the General Committee of the Division.*

*From records available, it appears that the first direct attempt to achieve standardization in petroleum equipment was made in 1919 by the Purchasing Agents Association of Tulsa through formation of a committee on rig irons headed by J. R. Stockton.
of Standardization (1923-1924), chairman of the Committee on Standard-
ization of Oil-country Tubular Goods (1923-1929), and chairman of the
Central Committee on Standardization of Oil-field Equipment
(1924-1945). He was active in all of these assignments, even during
the period of his presidency of the Institute. His contributions to stand-
ardization were acknowledged in the first presentation of the Anthony
F. Lucas Medal by the American Institute of Mining and Metallurgical
Engineers.

John R. Suman's first contribution to standardization was as a mem-
er of the Committee on Standardization of Beltling (1925), representing
the Rio Bravo Oil Company. In 1929 he became chairman of the im-
portant Committee on Standardization of Oil-country Tubular Goods,
relinquishing this office in 1947 to become chairman of the Central
Committee on Standardization of Oil-field Equipment. In the meantime
he had become successively a vice-president of Humble Oil & Refining
Company and of Standard Oil Company (New Jersey). Suman, also an
AIME Lucas Medalist, provided an invaluable continuation of the in-
spiring leadership and keen perception of J. Edgar Pew.

On retirement in 1955, Suman was succeeded as Central Committee
chairman by H. W. Ladd, Stanolind Oil and Gas Company. Ladd —
who had 23 years of prior experience in standardization, including the
chairmanship of the Committee on Standardization of Tubular Goods
— was exceptionally qualified to guide this extensive and complex
activity until completion of his tenure at Jan. 1, 1960, when he was suc-
cceeded by R. E. Foss, senior vice-president of Sunray Mid-Continent
Oil Company.

COMMITTEE ORGANIZATION

Although it has had little effect on the fundamental organization
and procedures of standardization, it should be noted that the Division
of Standardization was merged in 1927 with the Division of Develop-
ment and Production Engineering to form the Division of Production.
This merger continued — without disturbance — the Central Committee
on Standardization,* which had carried from the beginning the ultimate
responsibility for the formulation of standards and the immediate re-
sponsibility for definition of standardization policies and procedures.
Created by and reporting to the Central Committee there were other
committees, each with an immediate responsibility for standards within
a limited field — as, for example, the "Committee on Standardization of
Rotary Drilling Equipment". These committees sponsored subcommit-
tees and task groups according to need, with a typical committee con-
taining a permanent User Subcommittee and a permanent Manufacturer

Subcommittee in addition to several subordinate groups of a temporary
nature and with limited functions. User and Manufacturer Subcom-
mittees considered the same proposals and problems — first separately,
then jointly — in an effort to obtain a coincidence of views which
could be ratified by letter ballot of the entire committee. Where recon-
ciliation was impossible, the matter was continued until agreement was
obtained or seemed to be impossible of attainment. This parallel flow
of proposals through user and manufacturer groups, ending in recon-
ciliation by joint discussion and final action by the committee as a whole,
has been the fundamental method of operation from the beginning to the
present.

SCOPE OF OIL-FIELD STANDARDIZATION

Standardization committees have been created as the need became
apparent, and have been dissolved as changes in industry practice have
indicated. Following are the major areas that have been subject to API
standardization, in chronological order, and with mention of the cli-
mactic points in the development of standards.

Oil-field Tubular Goods

This committee was organized in 1923, with J. Edgar Pew as its first
chairman. Within a year the committee achieved a standardization of
sizes and threads on casing and tubing. The original specification (1924)
established 2 classes of lap-welded and 3 grades of seamless casing and

tubing, the strongest of which had a minimum yield strength of 45,000 psi.
In addition, there were included wrought-iron and open-hearth pipe.
In 1929, a higher grade of seamless steel pipe having a specified minimum
yield strength of 55,000 psi, designated D-grade and later redesignated
J-55, was adopted as standard. In 1939, a still higher grade of seamless steel
casing and tubing having a specified minimum yield strength of 80,000
psi (N-80) became standard. The N-80 grade did not long satisfy the
industry's requirements and intensive studies of processes adaptable to
the production of a higher grade were undertaken. In 1955, a 110,000-
psi minimum yield casing (P-110) and 105,000 psi minimum yield tub-
ing (P-105) were made standard. It was soon found that the "P" grades

could be made more economically and satisfactorily by quench-and-tem-
eral thermal treatment, rather than by the customary normalization. This
innovation opened the way for production of grades of even higher
strength.

As seamless and resistance-welded casing and tubing became avail-
able in higher-strength grades than could be attained in lap-welded pipe,
the committee undertook a study of the mechanism of collapse, with
manufacturers taking the leading role. After a number of years,
and on the basis of a large number of tests, this study resulted in the

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*Redesignated in 1919 as the Executive Committee on Standardization of Oil-field Equipment and
Materials.
adoption in 1940 of formulas for the calculation of ultimate collapse strengths involving plastic and elastic types of failure. The minimum collapse values calculated by means of these formulas, for all API sizes, weights, and grades of casing, are the present basis of design for most tubing and casing strings.

In 1939, the committee took an important step in changing the form of thread for casing, tubing, and drill pipe from the truncated V (as for line pipe) to a form with greater truncation and rounded crests and roots. The 3/4 in. per foot of thread taper was also changed to 3/4 in. per foot. Primary advantages achieved were greater accuracy of thread finish and greater resistance to leakage. Other advantages of the round thread were a lower concentration of stress at the thread roots and less injury to the threads in handling, transportation, and stabbing. This API thread form has since become generally accepted as standard in all countries.

For the N-80 grade of casing in some applications, and for the "P" grades, the API threaded-and-coupled connection proved less popular than certain patented designs. Much of the committee's activity in 1956-58 was devoted to the quest for a high-strength joint design that was amenable to standardization. Late in 1959 it appeared that this problem would be solved by transfer of patents on proved design to the public domain, thus permitting their adoption by the Institute.

With deeper drilling, higher pressures became commonplace. By 1948, several instances of casing and tubing failure caused by elevated pressures were documented, with these failures being caused both by thread leakage and body defects. The committee moved effectively in two directions by establishment of a research project on thread compounds at Mellon Institute and by adoption of a requirement that N-80 and higher grades of casing and tubing be mill-tested at hydrostatic pressures equivalent to 80 percent of specified minimum yield strength. The thread-compound project resulted in two formulations which soon after dedication to public use were produced commercially in a quantity in excess of one million pounds annually. The hydrostatic-test requirement went far toward satisfying the requirement for a reliable non-destructive method of test. By 1957 the committee had under consideration further non-destructive tests, with a view to eventual elimination of all field failures resulting from mill defects.

The first draft of an API specification for line pipe was developed in 1926 in cooperation with a committee of the American Gas Association. In 1947, in answer to the requirements of long-distance transmission lines—particularly natural-gas lines—the API committee developed Std 5LX, which specified pipe of high yield strength and eventually provided for hydrostatic mill tests of from 75 to 90 percent of the specified yield strength. This standard was also subjected to regular revision, the seventh edition being current in 1958. The maintenance of Std 5LX was a service of great magnitude to the pipeline industry during the 1947-1957 period of record expansion. Hal H. Anderson, vice-president of Shell Pipe Line Company, and his successor as vice-chairman of the Committee on Standardization of Oil-field Tubular Goods, R. G. Strong, Natural Gas Pipeline Company of America, made outstanding contributions to the development of API line-pipe standards.

Chairmen of the Committee on Standardization of Oil-field Tubular Goods following J. Edgar Pew were Charles Fitzgerald, Sinclair Pipe Line Company (1928-29); John R. Suman (1929-45); H. W. Ladd, (1945-55); C. A. Dunlop, Humble Oil & Refining Company (1955-59), and C. W. Dawson, Standard Oil Co. of California (1959-).

Rig Irons

This committee was organized in 1923 with H. J. Lockhart, of Parkersburg Rig and Reel Company, serving as its chairman from organization until 1935, when he was succeeded by Wm. Schwemlein of Parkersburg. The committee was dissolved in 1936 and rig-iron specifications were made the responsibility of the Committee on Standardization of Standard Rigs and Derricks. API efforts on rig irons benefited from and were given impetus by standardization initiated in 1919 by the Purchasing Agents Association of Tulsa.

Cable Tools

This committee was organized in 1924, with Louis C. Sands, Oil Well Supply Company, as its first chairman. The confused multiplicity of sizes and types was then as pronounced in the cable-tool drilling equipment as it was in tubular goods. One large manufacturer reported the need for 306 gages in order to supply the connections for the cable tools that were then being marketed. In the first edition of Std 3 (1924), the committee reduced this confusion to 11 standard connections; and these, with 3 later added, have since met all of the industry's requirements. In 1928, the committee compiled a recommended-practice publication on care and use of cable drilling and fishing tools that was so adequate it was reissued 14 years later without change. The cable-tool standard was published in 11 editions from 1924 through 1955. Because of reduced activity and lack of evolution in cable tools, the standard was declared obsolescent in 1957 and the committee was dissolved. Chairmen of the committee following Sands were Grant Hubley (1924), John T. Kirby (1924-25), and Thomas Fleming, Jr. (1925-29), all of Oil Well Supply Company; E. H. Williams, National Supply Company (1926-46); and F. J. Spang, Spang & Company (1946-57).
Boilers

This committee was organized in 1924, with A. B. Steen, of The Texas Company, as its first chairman. The early work of this committee was simplified by the existence of the ASME Boiler Code. Most boilers of the locomotive — or fire-box — type were manufactured in accordance with this code. However, there was no recognized standard on measurement of boiler horsepower, nor on the location or size of boiler openings and related fittings and connections. In the first edition of Std 2, 10 sq ft of heating surface per boiler horsepower was adopted as the basis for rating, and 4 sizes — 30, 50, 65, and 85 hp — were made standard for oil-field usage. Ten editions of the standard were issued, with the tenth being current from 1949 through 1958. In 1957, because of the marked decline in steam drilling, the standard was declared obsolescent and the committee was dissolved. Chairman of the committee following Steen were S. J. Dickey, General Petroleum Corporation (1927-32); L. W. Voorhees, Union Oil Co. of California (1932-37); and Chase Sutton, The Pure Oil Company (1937-57).

Production Equipment

This committee, which for many years was called “Committee on Standardization of Pumping Equipment and Engines,” was organized in 1924 under A. V. Hoenig, of The Carter Oil Company. Hoenig was succeeded in 1926 by W. L. McLaine, General Petroleum Corporation, who was in turn succeeded in 1927 by Theodore E. Swigart, Shell Oil Company, who served for 17 years.

Because of the number and variety of equipment items under the jurisdiction of this committee, its work involved a great amount of engineering detail. First efforts were toward recommending standard tubing joints to the tubular-goods committee. At the same time the committee, recognizing certain advantages of several manufacturers’ sucker-rod joints, ended up by designing a new API standard joint (Std 11B). Perhaps its greatest achievement — at least from the point of view of volume of detail — was in connection with oil-well pumps (Std 11A). This standard presented standard diameters for working barrels and a series of thread standards covering pump parts from 1½ to 4 in. in diameter, including thread tolerances and gage dimensions and tolerances. In 1928, standards were adopted for polished rods, pull rods, countershafs, pumping-unit reduction gears, and wellhead taps and fittings. The first standard for pumping units was issued in 1936. Chairman of the committee succeeding Swigart were H. N. Marsh, General Petroleum Corporation (1944-55); J. H. Field, Sohio Petroleum Company (1955-60); and T. S. Mitchel, Shell Oil Company (1960-).

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Beltng

This committee was organized in 1925 with A. H. Riney, Phillips Petroleum Company, as its first chairman. The first edition of Std 7 (1926) covered leather, cotton-fabric, woven-hair, balata, and rubber flat belting. Tests for elongation, ultimate tensile strength, fatigue, and function made up the bulk of this standard. In 1937, the standard was extended to include V belts and V-belt sheaves. Committee chairman subsequent to Riney were D. L. Trax, Gulf Oil Corporation (1951-53); J. E. Orrell, Shell Oil Company (1953-57); and Max Halderson, Phillips Petroleum Company (1957-).

Wire Rope

This committee was organized in 1925 with the author as its first chairman. The first edition of Std 9 — issued in 1926 — established 6 grades of steel appropriate to wire rope intended for use as drilling line, sucker-rod and tubing line, sand line, pumping line, guy line, power pull line, torpedo line, and bailing line. Properties of wire and methods of test were prescribed. Standard sizes for each of the ordinary types of wire-rope construction were specified. New editions were issued at an average interval of 2 years, with the 14th edition being current in 1958. A recommended procedure for care and handling of wire rope was included in the second and several subsequent editions, and was later published separately. A signal contribution in this connection were the tone-mile formulas for wire-rope evaluation derived by H. H. Anderson. Chairmen of the committee succeeding the author were K. N. Saatjian, The Texas Company (1938-41); J. E. Toussaint (1941-49) and C. W. Dawson (1949-53), of Standard Oil Co. of California; H. S. Kelly, Phillips Petroleum Company (1953-57); and R. B. Anderson, Columbian Carbon Company (1958-).

Storage Tanks

This committee was organized in 1925 with G. M. Vandaveer, Midwest Refining Company, as its chairman. The first standard, covering storage tanks with riveted shells, was issued in 1927. Additional standards issued, with date of first edition, were: bolted tanks (1929); welded oil-storage tanks (1930); large welded production tanks (1935); wooden production tanks (1943); small welded production tanks (1954); and aluminum-alloy welded storage tanks (1957). API tank standards proved so effective that numerous state and local code authorities adopted them as the only approved basis for construction. API standard tanks soon became commonplace in numerous other industries, such as the chemical and food processing. The standards became exceptionally valuable during World War II as the basis for standardized military tanks.
Chairmen of the committee following Vandaveer were Ralph J. Reed, Union Oil Co. of California (1927-31); R. W. Howe, Atlantic Pipe Line Company (1931-36); W. M. Giffen, Shell Oil Company (1936-37); C. C. Ashley, Shell Oil Company (1937-53); and C. V. Lynn, Sinclair Refining Company (1953-58). At least half of the tank standardization effort from 1927 to 1958 was put forth by representatives of the refining branch of the industry, with a sizeable assist from transportation personnel. In 1958, because of the narrowing community of interest between large tanks of the refinery type and the smaller lease vessels, the committee was dissolved and responsibility for standards on riveted and welded storage tanks, including the aluminum-alloy type, was transferred to the API Division of Refining. Maintenance of standards on bolted, welded, and wooden production tanks was assigned to a new Committee on Standardization of Lease Production Vessels, the first chairman of which was C. F. McLaren, Jr., Humble Oil & Refining Company, who served until 1961 and was succeeded by F. S. Goddard, Sunray Mid-Continent Oil Co.

**Rotary Drilling Equipment**

This committee was organized in 1926 with Capt. J. F. Lucey, founder of the Lucey Manufacturing Corporation, as its first chairman. The situation in rotary tool joints was much the same as in cable tools, i.e., complete confusion; and it was on tapered tool joints that early efforts were concentrated. API standardization soon reduced the number of joints from over 200 to 7. The full-hole type of connection was adopted in 1934, and the internal-flush in 1946. In 1955, the whole range of requirements was spanned by 17 standard connections applicable to swivels, kellys, tool joints, subs, drill collars, and drill bits. The rotary-drilling equipment series was then progressively expanded to cover sheaves and hoisting blocks, drilling hooks, rotary hose, brake blocks, slush pumps, rotary table, transmission components, and rating of internal-combustion engines. Committee chairman succeeding Lucey were E. J. Nicklos, Nicklos Drilling Company (1928-49); G. B. Kitchel, Kerr-McGee Oil Industries, Inc. (1949-57), and John M. Payne, Shell Oil Company (1958-).

**Derricks and Masts**

This committee was organized in 1927, as the Committee on Standard Rigs and Derricks, with Walter W. Fondren, a vice-president of Humble Oil & Refining Company, as its first chairman. The first edition of Std 4, adopted in 1928, achieved a reduction in number of derrick heights and base sizes from 200 to 6, and introduced engineering and consistency into the dimensioning of important structural members. Subsequent editions of Std 4 presented methods of calculation of safe loading and extended dimensional specifications to all important parts of the derrick and substructure. Effective with the 1952 (14th) edition, steel derrick and wooden derrick specifications were published as separate standards. From 1938 until 1957, when it was declared obsolescent, the committee maintained the rig-iron standard.

Increasing popularity of portable masts prompted the renaming of the Committee in 1951 to Committee on Standardization of Derricks and Masts and the issuance in 1952 of a covering standard. Since then the committee's main effort has been on guyed and free-standing masts. An original contribution of great value in mast standardization was made by Henry Schaefer, Stanolind Oil and Gas Company, in derivation of a method for calculating the design stresses in welded-end compression members.

Chairmen of the committee succeeding Fondren were W. H. Meier, The Atlantic Refining Company (1933-38); C. A. Dunlop, Humble Oil & Refining Company (1939-55); L. A. Ogden, The Pure Oil Company (1955-57), and Geo. B. Kitchel, Kerr-McGee Oil Industries, Inc. (1958-).

**Valves and Fittings**

This committee was organized in 1946, with W. S. Crake, Shell Oil Company, as its first chairman. Previously all API valve standardization work had been carried on, beginning in 1936, by the Committee on Standardization of Tubular Goods. The new committee issued revisions of the ring joint, thread, pipeline valve, and gate and plug valve (drilling and production service) standards. In 1949 and 1958, respectively, new standards were published covering wellhead equipment and ring-joint flanges for extreme pressures.

In 1956 C. H. Taylor, Shell Oil Company, succeeded Crake as chairman of the committee, and was succeeded in 1961 by T. V. Miller, Humble Oil & Refining Company.

**Cements**

This committee was organized in 1951, with C. W. Dawson, Standard Oil Co. of California, as its first chairman. The committee revised the standard procedures for cement testing (API Code 32, later designated RP 10B), to afford an adequate basis for the first API cement specification, which was issued in 1953. This specification, as later expanded, covered chemical and physical requirements, sampling, test methods, packaging, storing, and marking requirements for six classes of portland cement spanning the range of oil-field requirements.

Walter F. Rogers, Gulf Oil Corporation, succeeded Dawson as chairman of the committee in 1955, and was succeeded in 1961 by George Howard, Pan American Petroleum Corp.
Hoisting Equipment

The committee was organized in 1956, with John O. Hills, General Petroleum Corporation, as its first chairman. The committee assumed responsibility for the rating specifications on drilling and production hoisting equipment which had theretofore been a joint charge of the Committees on Standardization of Production Equipment and Rotary Drilling Equipment. C. H. Griffin, of the R. L. Manning Company, succeeded to the chairmanship in 1961.

Drilling-fluids Materials

This committee was organized in late 1959 with H. W. Perkins, Sun Oil Company, as its chairman. Its objective is the formulation of specifications for the more common components of drilling fluids and the maintenance of API RP 29 on the testing of drilling fluids.

API GAGES AND GAGING PRACTICE

One of the earliest problems of great magnitude confronting the standardization effort was that of obtaining interchangeability between similar parts or items of different manufacturers. This problem was particularly acute with respect to threaded parts. In the 1920’s few manufacturers had complete gaging equipment and those that did own gages did not pursue a consistent or uniform gaging practice nor entertain the same ideas as to reasonable tolerances. The mere writing of standard specifications in order to establish dimensional limits would obviously be insufficient to assure interchangeability unless all plants manufacturing the standard product used the same types of gages with the same frequency, and in the same manner. It was recognized that provision must also be made for periodic checks of plant working gages against reference master gages, and checks of reference master gages against regional or grand master gages.

Thus, among the earliest and most important requirements of API standards were those which concerned the manufacturer’s possession, use, and periodic testing of gages. The number, sizes, and types of gages required varied widely as between standards. For those products such as pipe and tool joints that required numerous and relatively complex gages, the manufacturer was required to possess plant working gages (with which actual product inspection was performed) and reference master gages. Plant gages were required to be checked frequently against reference masters, and reference masters were required to be checked at intervals against regional master gages in the possession of independent testing agencies, or against grand master gages in possession of the National Bureau of Standards. It was further required that all reference gages be registered with the Institute, as the basis for a system of reporting which assured compliance by manufacturers with the gage-testing requirements of the standards.

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Major credit for the conception of the API gage and gaging practice program belongs to the Committee on Gages and Gaging Practice, which was organized in 1926 under the chairmanship of A. B. Steen, of The Texas Company. This committee, working in direct collaboration with all standardization committees, specified the dimensional limits and accuracy of all API gages, and formulated the approved gaging procedures. Many of the specified gages have been adapted from those in common industrial use—the design of others has been entirely original with the committee. Invaluable assistance has been rendered since 1922 by the National Bureau of Standards, both in an advisory capacity and as a certificant on gage tests.

Chairmen of the committee following Steen were H. W. Fletcher, Hughes Tool Company (1928-42); J. J. Dunn, National Tube Company (1942-48); and W. O. Clinedinst, National Tube Division, U. S. Steel Corporation (1948-).

The unique API gage and gaging practice system has been so effective in achieving interchangeability of mating parts that drilling and production equipment components can be purchased from literally hundreds of different manufacturers and assembled without regard to origin and without difficulty.

COOPERATING ASSOCIATIONS

Since its inception the standardization program has been characterized by wide and intensive cooperation with other associations and societies in and out of the petroleum industry. In frequent instances API standardization has been expedited by the existence of adequate standards or methods of test developed by other bodies. In other cases research or investigation by other groups has given direction and impetus to API standards. To identify the contributions of each of these groups would require excessive space. It can only be mentioned that the associations, societies, and agencies listed in Appendix A have made continuous contributions to the standardization of oil-field equipment.

CONTRIBUTION OF THE MANUFACTURERS

Since the chairmanship of API standardization committees has almost invariably been reserved to oil-company or drilling-contractor representatives, i. e., the "users," the listing of these chairmen, past and present, might convey the erroneous impression that virtually all leadership and effort in the standardization program has been put forth by those directly employed by the industry. This is far from true. Manufacturer personnel, which throughout the history of the program has been as strong numerically as user representation, has played a vital part. Manufacturers generally were as eager for the inauguration of the program as were the oil companies. Without the manufacturer’s zeal in
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surmounting early obstacles, his continuous counsel, and his willingness to occasionally subordinate immediate competitive advantage to the broader requirements of the industry, the standardization program would have been a confused and probably futile gesture on the part of the users. Manufacturers’ representatives on each committee — usually concentrated in the Manufacturers Subcommittees thereof — have been with few exceptions either holders of engineering or scientific degrees or men who had achieved an engineering perspective, through long and intensive exposure to the science of materials and methods of fabrication. Many manufacturers’ representatives have been mechanical engineers, many others have been metallurgists and there has at all times been a leavening of chemical, civil and electrical engineers, physicists, and mathematicians.

From its first presentation in 1948, through 1959, 43 API Certificates of Appreciation were awarded in recognition of outstanding service to the standardization program. The following 16 manufacturers’ representatives were so honored. Unfortunately this listing gives no indication of the many manufacturers’ representatives who served conspicuously over the years 1924-48, but were deceased or became inactive before a formal recognition of their services became possible.

C. R. Athy, IdecO, Inc.
F. E. Bernsen, Lucey Products Corp.
W. O. Clinedinst, National Tube Div., U. S. Steel Corp.
D. R. Dale, S. M. Jones Co.
J. J. Dunn, National Tube Co.
H. O. Hill, Bethlehem Steel Co.
J. R. Mahan, The National Supply Co.

A. J. Morgan, John A. Roebling Sons Corp.
S. S. Parker, National Tank Co.
Gwynne Raymond, Union Tank & Supply Co.
J. C. Siegle, Youngstown Sheet & Tube Co.
J. C. Slonneger, Continental Supply Co.
F. J. Spang, Spang & Co.
Thos. G. Stitt, Pittsburgh Steel Corp.
C. R. Weiss, Link Belt Co.

THE ADMINISTRATION OF STANDARDIZATION

Adherence by any manufacturer to the provisions of any API standard is a purely voluntary act on the part of that manufacturer. Just as voluntary is the act of a purchaser in specifying that the equipment he desires be made in accordance with an API standard. With this fundamental premise for the entire program, it would have been theoretically possible for the Institute to follow the practice of other standards-making bodies by paying no attention, unless forced to do so, to any events sub-

sequent to the issuance of a standard. There were, however, certain compelling reasons for the adoption of a distinctive and permanent mark to be applied to equipment made to a standard. Because of the gage requirements, and to insure as far as possible the significance and integrity of this identifying mark, it was also deemed advisable to formally license manufacturers under each standard.

The identifying mark adopted was the API monogram — Ф. Manufacturers, in order to obtain the right to apply this mark to their products — and as the only consideration in obtaining a license — were required to furnish evidence of competence and stability, and to certify that the monogram would be applied only to products conforming completely with the applicable standard. In order that the petroleum industry may have the economic advantage of numerous and widely scattered sources of standard equipment, the licensing policy has been a liberal one. From commencement of the program through 1959 over 1,350 manufacturers have been licensed. In 1959, nearly 900 active licensees were on the rolls, with over one-third of these being foreign concerns. There have been very few instances of wilful abuse of monogram privileges. These have been countered by cancellation of license.

The API monogram has fully served its purpose as an identifying symbol manifesting the manufacturer’s warranty that the product conforms to specifications. Its significance is recognized in every oil field of the world. With the possible exception of the conventional derrick, it has become the symbol most identified with the American oil industry.

The administrative aspects of standardization, in distinction to the responsibility for formulating standards, have been responsibility of the Institute’s Dallas office. In addition to licensing of manufacturers and monogram administration, these functions include the publication and distribution of standards and the processing of committee appointments, agenda, and reports. In December 1923, when authorizing the formation of the Division of Standardization, the API Board made provision for a full-time divisional secretary. This position was filled in 1924 by C. A. Young, who in succeeding titles and despite frequently broadened responsibilities continued to supervise staff services to the standardization program for the first 29 years of its existence. His faith in and devotion to the advantages of standardization, and particularly to the Institute’s accomplishments in this field, was a strong force in the development of the program. Other key staff members with major responsibilities in the administrative phases of the program were standardization engineers J. E. Stillwell (1926-1948), Edwin Joyce (1946-1957), J. E. Ubben (1956- ), and S. G. Creagh (1957- ). Wm. H. Strang succeeded Young as Director of the Division of Production upon Young’s retirement in 1953.
20. STANDARDIZATION OF OIL-FIELD EQUIPMENT

as the savings that accrue to standardization, and this figure will, it is believed, put the savings at between 50 and 100 million dollars annually."

An additional and less measurable but highly significant economy achieved through standardization has been the improvement in quality and serviceability of equipment. This upgrading, which was stimulated by the continually increasing stringency of standard methods of test and rating, has promoted economy in all operations and opened the way to deeper drilling and safer manipulation of high pressures.

One measure of these advantages is given in an article by E. DeGolyer in Science of Petroleum, published by Oxford University Press in 1938. He said:

"The greatest and possibly the most important improvement in drilling technique from the standpoint of the prospectors has been the constantly improving ability to achieve increasingly greater depths. We are finding important oil pools today at depths of 7,000 ft. to 10,000 ft. which would not have been reached by the drill under the best practices of ten years ago. Oklahoma City and Kettleman Hills have already been cited as examples of pools, previously drilled, which remained undiscovered until we had achieved ability to drill to necessary depths. A consideration of well depth and some acquaintance with the technique of drilling suggests that increasing depth has come about as a result of better material equipment, and greater power rather than from any fundamental change in design. In the opinion of the writer, the standardization program of the American Petroleum Institute’s Division of Production has been one of the greatest single factors in contributing to this condition."

Most observers would agree that the same statement if made today, with reference to attained depths of over 25,000 ft., would be no less appropriate.

The worldwide currency of the API monogram as the hallmark of thoroughly engineered oil-field equipment is a tribute to the faith of the petroleum engineer in standardization and to his proficiency in analysis and solution of the countless technical problems involved.

APPENDIX A

Associations, Societies, and Agencies Which Have by Direct Participation or the Free Exchange of Expert Knowledge Rendered Major Services to the Standardization of Oil-field Equipment

American Association of Oilwell Drilling Contractors
American Gas Association
American Gear Manufacturers Association