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The value of standards to society

Most people have taken very little time, if any, to reflect upon the general topic of standards. Yet standards are among the most vital and basic instruments of a modern technological society. Engineers will immediately identify with this concept, since they use standards of various types regularly in their daily activities. But before addressing those standards specifically relating to building systems technology, it may be of some interest to reflect upon more fundamental issues.

Without standards, civilized societies could not exist and function in the way we know them. Probably the most fundamental standards relating to commerce are the monetary standards. These, by necessity, are established by the national government of a society, and the affect of their establishment is to raise our commerce above the primitive level of bartering.

One step removed from the monetary standards are those governmental standards deemed necessary for effective communication within either the national or international community. In the United States, within the Department of Commerce is the Bureau of Standards. The Bureau's fundamental role is to establish the basic standards of communication. The most elementary of these, almost as necessary as the monetary standards, are the standards of weights and measures. Scientifically, these include many more units than weights and measures and are sometimes referred to as dimensional standards. Even the least technical of us relates to these standards, such as the length of an inch, foot, or mile, the weight of a pound, the heat sensation of 90 F, and so on. In the engineering and scientific community, practitioners become familiar

with other less well-known units of measurement, relating to astronomical distances, radiation emission, energy, power, etc.

The vast majority of the standard units in the English (FPS) system used in the United States were initiated in a much less technical era and, in addition to being valid from the standpoint of standards, have the benefits of relating to physical experience—i.e., the foot was the length of the king's foot, the inch is approximately the distance between the first knuckle and the tip of the thumb, etc.—and of being oriented to ease of communication. As an example, if energy is being considered for heating a room, this energy is referred to as *Btu*; but if energy is being removed from a room to prevent overheating, it is referred to as *ton-hours* of cooling. Thus, when the unit *ton* is used, it not only implies a quantity of heat but also a process, and from the standpoint of thermodynamics, there is a significant difference between the addition of heat, usually a first law process, and the removal of heat, usually a second law process.

Metric units coming slowly

The comfort and convenience of such national standards has been found to be an ever-growing burden in this world of increasing international activity. To address this problem, following years of effort, a new system of dimensional standards, the *Système International d'Unités*, has been adopted, to which the United States, along with most other industrialized nations, is currently attempting to convert. Because of the total dependence of commerce upon dimensional standards, the conversions will be extremely difficult. As a result of its impact on institutions and indi-

viduals, it will be resisted. A change in the manner of thinking, to the man on the street, is only the tip of the iceberg. Relating to temperature in degrees Celsius instead of Fahrenheit, to distances in kilometers instead of miles, and to milk cartons in liters rather than quarts, will generate resistance that can be overcome with little difficulty. If nothing else time will solve the problem as new generations grow up with the new systems.

The engineering practitioners, manufacturers, mechanics, and others in technical disciplines will represent less volume of resistance, but more substance. The mechanic will need a second set of tools for a time, a problem that will be overcome with time. With the influx of foreign products in the past decade, many mechanics and homeowners have already solved this problem. The manufacturer will, in some cases, find it necessary to retool. This is an extremely costly burden that will ultimately be borne by the consumer, either in the product cost or as a federal tax. In many cases, United States industry will benefit, since much of the heavy industry in this country is currently outpriced on the world market by foreign manufacturers with more modern, efficient production machinery. Thus, as one steps back and observes the impact upon the mechanic and manufacturer, the inconvenience and adverse economic impact appear painful but temporary and definitely advantageous in the long run. Now, the mechanic, because of the presence of foreign products, already needs two sets of tools; whereas, following the total conversion to SI, he will need only one. Now, the manufacturer is competing, with archaic production machinery, in foreign markets that use other standards of measurement; whereas, following complete conversion to SI, he will be in a much more competitive position.

Thinking metric more complex

The impact on engineering practitioners and the physical relationships with which they work is much more complex. The simple problem of *thinking* in terms of meters rather than feet, watt seconds rather than British thermal units, and pascals rather than pounds

per square inch is analogous to the problem of the man on the street, albeit more difficult. This will be simply a dimensional change in his thinking, which can be considered the first-order problem.

The second-order problem will be his relationship to *constants* and *evaluation functions*. All engineers in the HVAC disciplines relate to such constants as 1.08 and 500 in the heat capacity equations; most know the flow rate capacity of various sizes of pipe; some have the steam tables fairly well in mind. With the change of dimensional standards, not only will the education of change be required, but the efficiency of production will suffer significantly (a cost problem analogous to the manufacturers') and the more serious problem of increased error will be manifest. One hopes that society will accept this last problem and that the practitioners will not be destroyed as individuals or as an industry during the conversion period.

SI units are inadequate

The third-order problem for the engineering community relates to the use of the new dimensional standards in engineering technology. The new SI system is seriously lacking in the units it defines. For example, the system does not include units for fluid head (energy per unit weight) or heat removal (cooling) energy. This lack is in some cases one of simple adjustment and subsequent acceptance of the inconvenience of the communication mechanism, such as with the lack of an equivalent for tons of cooling. In other cases, however, such as with the absence of a fluid head term, adequate time must be allowed for the practitioners in the arena of their engineering societies to resolve the problem. If, indeed, a fallacy exists in the proposed system, it must be corrected. On the other hand, the purely scientific approach to the new system may prove to update the current concepts and practices of the related engineering disciplines. Before the new system is finalized, it will, it is hoped, be subjected to the mature, unemotional scrutiny of the engineering community, and they in turn should address the change objectively.

Consensus standards are helpful

Another type of standard, to which John Q. Public relates much less than to these first two, is the consensus standard. Although there is this lack of recognition on the part of the public, consensus standards have done more to help and protect the consumer than all the consumer advocates, consumer-oriented federal laws, and consumer protection bureaus combined.

Consensus standards are one of the best available examples of voluntary efforts working for the common good. These standards are adopted by organized groups such as trade associations and technical societies for the purpose of standardizing dimensions, testing methods, safety regulations, etc.

At first glance, it might appear that if a trade association adopts a consensus standard, it follows that that standard would be to the benefit of the members of the trade group but *not* in the best interest of the consumer. Upon further consideration, however, it becomes evident that the "good guys and bad guys" syndrome of the typical consumer advocate movement is not valid where consensus standards are concerned. Consider some typical classes of consensus standards.

- *Dimensional standards:* If the lumber industry had not adopted dimensional standards, the dimensions of lumber would vary. For example, a two-by-four might range in dimension from 1½ in. by 3½ in. to 2½ in. by 4½ in., with ill-defined tolerances. If this situation existed, each lumber dealer would have to try to effectively market his size two-by-four. We might have "Brand X is bigger . . .," or "Brand Y two-by-four takes up less room and is lighter. . . ." All of which would simply add to the cost of the two-by-four regardless of the dimensions! This situation would render the lumber industry unstable, to say the least.

From the consumer's standpoint, the increased cost from the lumber mill would be only the beginning of the problem. The retailer would have to stock several different sizes of two-by-four, further increasing the cost. The lack of standard dimensions would make

construction extremely difficult, whether it be for new projects, remodeling, or repairing. Anyone who has ever done any retrofit on an old frame structure can identify with this problem.

The two-by-four is an overly simplistic example. Dimensional standards extend to all classes of materials used in machinery and construction, such as pipe dimensions, metal thicknesses, wire dimensions, bolt threads, and structural steel sections. They enable us to design and construct machinery, systems, and buildings at the least possible cost to the consumer, and most repairs can be done by the consumer with *standard parts* purchased from a hardware store.

- *Safety standards:* Safety standards apply in such diverse areas as manufacturing processes, materials (composition and fabrication methods), devices, and buildings. From the standpoint of the manufacturing interests, these standards assist in the design development of safe products and protect the reputable manufacturer from unfair competition from less scrupulous manufacturers who would market a less safe product at a lower price. It is self-evident that such safety standards serve to protect the consumer from unsafe products. Over the years, consensus safety standards have done more to protect the public than the Occupational Safety and Health Regulations (OSHA) ever will and at an immeasurably small fraction of the cost.

- *Standards for testing and rating:* In a bit more subtle manner, these consensus standards are among the most effective consumer protection devices in existence. Before the advent of the standards for testing and rating, the capacity of a machine or device was simply that claimed by the maker of that device. The purchaser had no assurance, other than the reputation of the manufacturer, that it would produce the capacity claimed. Although this may not seem like a significant protection to many consumers, except in the case of a few consumer products like residential air conditioners and furnaces, all of the components parts that go to make up such things as central air conditioning systems can only achieve the results intended if they *each* produce the

capacity intended by the systems designer. Where standards are not available, the designer inevitably relies upon safety factors for insurance, which results in higher investment costs to the consumer and higher operating costs.

Consumers have effective input

In the process of adopting consensus standards, the consumer and others affected by the proposed standard have more effective input than they have in any other process, including the democratic lawmaking process. Most organizations that draft and adopt consensus standards function under the rigorous guidelines developed and monitored by the American National Standards Institute. To adopt a consensus standard requires a consensus, not a simple majority as in the democratic process of lawmaking; the text of the proposed standard must be made available to anyone who wishes to review it, and all such reviewers are eligible to submit comments. All constructive comments must be considered by the adopting agency, which must either incorporate them into the final document or show technical cause for their exclusion. The "write your Congressman" approach of simply being for or against with no substantial reason is not

part of this procedure. Perhaps this is a singular reason why consensus standards have historically proved more beneficial to the consumer than so-called consumer protection laws! In the adoption of consensus standards, there are no lobbyist activities or voting blocs to cloud the true issues.

In a few cases, there has been evidence of misuse of the consensus process. Some reaction to this abuse has been activity on Capitol Hill, and more recently in the executive branch, to essentially destroy the voluntary consensus standards process through such diverse approaches as weakening it through withdrawing the participation of government employees or by replacing the entire process with standards mandated by law and drafted by federal bureaus. In either situation, the voluntary consensus process would collapse, to be replaced by either the purely political process or the uncontrollable bureaucratic process. Or both!

If, indeed, there is or has been misuse of the voluntary consensus process of adopting standards, these abuses can and should be eliminated by the adopting agencies themselves, if these standards are to survive and provide the service to both the manufacturer and consumer that they have in the past.