

Can the Highway Community Be Ready for Metric By 1996?

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Recent actions by Congress and the President are redirecting the United States transportation industry to design and construct metric highways in 1996. All federal lands highway and federal-aid construction projects advertised for bids after September 30, 1996, will be in metric units. The reasons for making metric conversions, the federal timetable for conversion, and a general conversion plan that can be used by highway agencies of all sizes are described. It is recommended that readers obtain a copy of the AASHTO *Guide to Metric Conversion*, which was published in 1993. A public awareness campaign by all levels of government is advocated to ensure that a public backlash to metrication does not occur.

Recent actions by Congress and the President are redirecting the U.S. transportation industry to design and construct metric highways in 1996. All federal lands highway and federal-aid construction projects advertised for bid after September 30, 1996, will be in metric units. Highway agencies presumably will wish to avoid the confusion of working in two separate systems, so it is assumed that by that date almost all highway projects will be designed and constructed in metric units. This paper will describe the reasons for making the metric conversion, the timetable for conversion, and the general plan that AASHTO and FHWA urge highway agencies to use in their conversion processes.

NCHRP and AASHTO are aware of the confusion that may be generated by the metric conversion announcement. Those organizations worked on the AASHTO *Guide to Metric Conversion*, which was published in 1993. The guide contains background information, conversion tables, a conversion plan that can be followed by highway agencies of any size, case studies, and cost estimates for important conversion steps.

CAN IT BE DONE?

Great Britain, Canada, South Africa, Australia, and New Zealand all converted to the metric system in the 1960s and 1970s. Their experiences contained many positive aspects and proved that conversion can be accomplished at relatively low cost. The *Metric Guide for Federal Construction* highlights some of these findings (1).

- There was no appreciable increase in either building design or construction cost, and conversion costs for most construction industry sectors were minimal or offset by later savings. (This comment applies to all industries, not just highway design construction.)

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- The architecture/engineering community liked metric dimensioning because it was less prone to error and easier to use than feet and inches. Engineering calculations were also faster and more accurate because there were no unit conversions and no fractions.

- Metric offered a one-time chance to reduce the many product sizes and shapes that have accumulated over the years but are no longer useful, thus saving production, inventory, and procurement costs.

- Architecture/engineering firms in these countries found that it took a week or less for staff members to learn to think and produce in metric, and most tradespeople took only a few hours to adapt.

Those nations have pointed the way to metrication in the United States. To paraphrase Canadian officials (2): metrication was easier than anticipated; it was primarily a matter of making the decision to do it, then following through in a systematic manner.

WHY SWITCH?

The United States was the center of world commerce after World War II. Since that time, the European Community (EC) has overtaken the United States as the world's largest market, Japan and other Pacific rim nations have emerged as fierce economic competitors, and America's largest trading partners—Canada and Mexico—are predominantly metric countries. The share of the world's product types manufactured in the United States has shrunk from 75 to 25 percent since World War II (3), and metricating its industries is essential to maintaining economic leadership. A number of benefits that the United States can gain by converting to the metric system are discussed below.

International Competitiveness

The EC has indicated that it will not import nonmetric products after 1992. Japan has identified the nonmetric nature of U.S. products as a major impediment to their sale in Japan. All in all, it has become increasingly difficult for United States' products to compete in the international arena.

Conversion by Private Sector Companies

U.S. industries such as IBM and General Motors (GM) already have converted. GM was pleasantly surprised to find that conversion costs were less than 1 percent of original estimates. The elim-

ination of dual fastener sizes during metric conversion allowed IBM to reduce its total number of fasteners from 30,000 to 4,000. When the liquor industry converted, the number of container sizes dropped from 53 to 7 (1).

System Simplicity

Design and construction tasks eventually will be performed more efficiently because the metric system is simpler to use than the customary system. The metric system is decimally based, and there is no need to convert from one measurement unit to a different measurement unit. For example, the area of a billboard does not have to be obtained by multiplying 17 ft $4\frac{1}{16}$ in. by 21 ft $8\frac{1}{16}$ in.

BACKGROUND

Government and industry leaders have been urging America to switch to the metric system for almost 200 years. For example, Thomas Jefferson and John Quincy Adams were among the founding fathers who unsuccessfully lobbied the nation to convert. More unsuccessful attempts were made over the years, with the most recent failed effort taking place in 1975. The current push for the metric system started with congressional legislation in 1988.

Metric Conversion Act of 1975

Congress passed legislation in 1975 (15 U.S.C. 2056) declaring a national policy to encourage and coordinate a shift to the metric system. Conformance with the plan was voluntary, and few industries made this important change. Additionally, the public vocally expressed its desire not to convert. As a result, no significant move to metrication took place, and the experience left a bad taste in the mouths of those public agencies that had attempted conversion and met public rejection.

Omnibus Trade and Competitiveness Act of 1988

The current move to the metric system was launched in 1988 with the amendment of the Metric Conversion Act of 1975 (the Act) by Section 5164(b) of the Trade and Competitiveness Act (Public Law 100-418). As amended, the Act now designates the metric system as the preferred system of weights and measurements for U.S. trade and commerce. It requires each federal agency to use the metric system in its procurements, grants, and other business-related activities to the extent economically feasible by the end of 1992. However, conversion is not required when it is impracticable, likely to cause significant inefficiencies, or likely to cause loss of markets by U.S. firms, such as when foreign manufacturers are producing competing products in nonmetric units.

The Controller General was named to review the implementation of the Act at the end of fiscal year 1992 and report to Congress. The report would include recommendations for any further legislation.

The obvious objective of the Metric Conversion Act as now amended is to convert the United States to the metric system. The buying power of the federal government will be the impetus for

the change. Because it conducts extensive grant activities, the U.S. Department of Transportation (DOT) is included under the provisions of the Act.

Executive Order 12770

The President's Executive Order 12770, Metric Usage in Federal Government Programs, was signed July 25, 1991 (4). It required all federal agencies to formulate metric transition plans by November 30, 1991, to accomplish the metrication aims of the 1988 legislative amendment.

Further, each federal agency is directed to seek the cooperation of federal, state, and local agencies to implement metric construction. Thus, state and local highway agencies will be affected through U.S. DOT and FHWA. As pointed out earlier, all federal-aid projects must be advertised in metric units after September 30, 1996.

The Department of Commerce was given the task of coordinating the effort. It was authorized to charter an interagency council on metric policy; to issue guidelines, promulgate rules, and take other actions to implement the policy; and to report annually to the President about implementation status. On October 1, 1992, the Department of Commerce recommended additional measures and legislation to achieve the full economic benefits of metric usage.

FEDERAL CONVERSION PLANS

The 1988 legislation and Executive Order 12770 set September 30, 1992, as the deadline for each federal government agency to begin using the metric system in procurements, grants, and other business-related activities. The Department of Commerce interpreted the 1992 deadline to mean that a schedule for conversion should be in place at that time, and some metric conversion activities should be under way.

The U.S. DOT is a federal agency and was thus required to adopt a metric conversion plan. FHWA is one of nine agencies of the U.S. DOT, and each one was required to create comprehensive conversion plans.

FHWA Plan

FHWA's Metric Transition Plan was approved by the Secretary of Transportation on October 31, 1991. It is a 5-year plan to convert FHWA activities and business operations to the metric system. FHWA has four major programs, including the federal-aid highway program. It is through this program that most of the impacts of metric conversion will be felt by state and local highway agencies. It is FHWA's intent that all federal lands highways and federal-aid construction contracts advertised for bids after September 30, 1996, will contain only metric measurements. Thus, federal-aid projects let after that date at the state, county, and city level will all be affected.

FHWA Timetable

Table 1 presents a paraphrased version of FHWA's metric transition timetable as published in the *Federal Register* (5). The

timetable has been criticized by several state and local highway agencies that totally objected to metric conversion. They indicated a belief that conversion would be "impractical" or likely to cause "significant inefficiencies" in the highway industry. They also object that if conversion must take place, the timetable does not give them enough time to complete the job. FHWA counters these arguments by stating its belief that the loss of inefficiencies will not be long term, significant, or compromising to public safety. As for timetable length, FHWA states that neither the Department of Commerce nor Executive Order 12770 permits a longer time frame (5).

Conversion Costs

The *Federal Register* (5) makes reference to several studies of the cost of metric conversion. An ad hoc AASHTO Metrication Task Force in 1974 estimated the cost of metrication to federal, state, and local highway agencies at \$200 million. The task force further predicted that signing changes would compose approximately 30 percent of total conversion costs and would constitute the largest single requirement of funds. Creating and converting existing computer programs to metric was estimated to be 25 percent of total conversion costs. Training was estimated to consume 10 percent of conversion monies. Revising and reprinting existing manuals, specifications, and standard plans were estimated at an additional 10 percent.

Two states provided more current cost estimates. One state highway agency from a slightly smaller-than-average state estimated its total direct conversion costs at \$9 million. Another state highway agency from an average-sized state estimated that converting speed limit and distance signs would cost between \$1 million and \$4 million.

FHWA Participation

Although Congress has not authorized FHWA or any other federal agency special funding to provide reimbursement to states and local highway agencies for metric conversion costs, FHWA can participate in project-specific right of way, design, and construction costs. Therefore, FHWA will participate at the appropriate pro rata share for costs that state and local highway agencies incur

while changing highway signs to metric units under existing federal-aid categorical programs. As noted earlier, this is anticipated to be the most costly activity.

Other Emphases

The FHWA Metric Conversion Plan emphasizes several other guidelines, including the following:

- ASTM-E380 is designated the authoritative reference for applying metric units and conversions.
- Each FHWA region and division office has designated an individual to cooperate with state and local governments during their metric conversions.
- FHWA intends to avoid the dual use of standard and metric measurements during the conversion process.
- FHWA intends to convert historic records and data to metric units only when necessary for ongoing operations and future projections.
- FHWA advises using "hard" metric conversions when appropriate and to the extent practical. Hard conversion involves converting a customary measurement to its exact metric equivalent, then rounding the metric equivalent to a convenient value for actual use. For example, the exact or "soft" conversion of a 12-ft lane width is 3.658 m. This is an odd number that is difficult to remember. A better idea is to round this to 3.50 or 3.75 m, which is a "hard" conversion.
- FHWA believes that a campaign to make the public aware of metrication is imperative to allow it to become a part of the process and to avoid a public backlash.

CONVERSION DIFFICULTIES

Because of the involvement of both Congress and the President and the buying power of federal agencies, the most recent U.S. conversion effort is far more likely to succeed than the 1975 attempt. However, there are certain stumbling blocks to the conversion effort. The following list is provided not as reasons to avoid participating in the metric conversion but as items highway agency administrators should be aware of when making genuine efforts to implement the policy:

TABLE 1 FHWA Metric Transition Timetable

Program Elements/Activities	Target Dates (Completed)
FHWA metric conversion plan.	(Approved 10/31/91)
Initiate revision of pertinent laws and regulations that serve as barriers to metric conversion.	(1991)
Full metric conversion of FHWA manuals, documents, and publications.	1994
Full metric conversion of FHWA data collection and reporting.	1995
Newly authorized Federal Lands Highway and Federal-aid construction contracts in metric units only.	September 30, 1996

- There is lack of a national awareness of metrication and national will to metricate. Public awareness campaigns and programs of public involvement will be required to interest the public in the conversion process.

- Highway agency personnel still seem unsure that conversion will actually take place and may therefore not give their conversion activities a high priority.

- Highway agency personnel are concerned about a public backlash to conversion, the predictable negative reaction by the trucking industry, and the cost of conversion.

- There appear to be few benefits to state and local highway agencies, whereas all benefits seem to go to those involved in international trade.

As the preceding list indicates, there are many potential objections to highway metric conversion. All of them are extensions of the natural human resistance to change. A thoughtful, comprehensive conversion plan by state and local highway agencies will be required to ensure metrication's success.

FORMING A METRIC CONVERSION PLAN

Each state, county, and city highway agency is unique in terms of its size, personnel, and the amount and type of roadway projects it constructs. For these reasons, plans may be expected to differ from agency to agency. Each agency's plan must meet its own unique needs. However, any agency must start its conversion plan the same way, by instilling a will to convert—a determination by both administrators and field personnel—to make the conversion a success. Once the importance of the conversion process is understood, the ease of making the conversion will be greatly enhanced.

AASHTO's *Guide to Metric Conversion* will present a conversion sequence that can be used by highway agencies of any size. Small agencies may not use all the steps; larger agencies may enlarge the steps or add further activities. An abbreviated list of the sequence found in the AASHTO guide follows:

- The agency CEO demonstrates metric support.
- A metric coordinator is named.
- A metric committee or work group is formed.
- A study identifies activities and programs to be converted.
- An agency conversion plan and timetable are formulated.
- Conversion responsibilities are assigned to individuals.
- Metric standards are established.
- A public awareness program is planned and conducted.
- Laws and statutes are revised to reflect metric units and to encourage the conversion process.
- Coordination efforts are conducted with other government agencies, industry, contractors, material and equipment suppliers, professional organizations, and others.
- Metric training activities are conducted.
- The plan is monitored and modified as necessary to ensure implementation.
- Follow-up activities are conducted.

Several state highway agencies already have recognized that significant time and effort will be required to make the conversion. They have learned from Canada (6) that it may take over 4 years to convert existing manuals, computer programs, and so forth. To

meet the October 1996 deadline, several states have already begun their efforts, two of which are used here as examples. The Indiana Department of Transportation (IDOT) already has taken several steps. Topographic surveys are being performed already in metric units, and IDOT is rewriting their nine-volume design manual in metric units. IDOT intends to start their first metric design in November 1992.

The North Carolina Department of Transportation (NCDOT) is another agency that has positioned itself well for metric conversion. One of its first actions was to request the Institute for Transportation and Education (ITRE) at the University of North Carolina to evaluate the impacts of the metrication legislation and to recommend compliance approaches. NCDOT has appointed a metric coordinator, formed a metric committee, and expanded materials from the ITRE study to complete an agency conversion plan and a timetable that meets FHWA target dates.

SUMMARY

This paper has posed the question, "Can the highway community be ready for metric by 1996?" The answer to this question is transparent: the highway community must be ready!

The experiences of other nations, particularly the recent experience of Canada, have demonstrated that a large, industrialized nation can convert its highways from customary to metric units. U.S. DOT and FHWA have established schedules for completion of the federal highway metrication in the United States. FHWA is working with national organizations to convert the needed standards and computer programs to metric, and they will be working with state and local agencies to help them make their conversions.

Although that framework has been established, strong leadership from the Department of Commerce will be required to coordinate metrication in various industries and to provide a much needed national public awareness campaign of metrication. State and local highway agencies must be convinced that metrication will happen and that federal agencies already have begun to lead the way. Highway agencies must encourage legislators to change or repeal existing laws and regulations written in the customary system of units. The task of changing legislation may be quite large, encompassing such areas as motor fuel tax units, speed limit signs, allowable axle weights, and commercial licenses.

Everyone must be given time to become accustomed to the idea of metric highways. The public must feel that it has been given a choice in the matter or at least has been well informed of metrication before it takes place. Contractors, equipment, and material suppliers, and others directly related to the highway industry must be given time to make their adjustments. Even hotel and restaurant associations must be informed so that member establishments that are located on Interstate highways can modify their printed literature to identify their location at the new exit number. In short, education both within and outside the highway construction business must begin now.

The experience of other nations has shown that there is never enough lead time during the conversion to metrics. The time for U.S. highway agencies to start planning their conversion is now because 1996 is just around the corner.

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