Chapter 7

Setting the Standard

Containers were the talk of the transportation world by the late 1950s. Truckers were hauling them, railroads were carrying them, Pan-Atlantic's Sea-Land Service was putting them on ships, the U.S. Army was moving them to Europe. But "container" meant very different things to different people. In Europe, it was usually a wooden crate with steel reinforcements, 4 or 5 feet tall. For the army, it involved mainly "Conex boxes," steel boxes 8½ feet deep and 6 feet 10½ inches high used for military families' household goods. Some containers were designed to be shifted by cranes with hooks, and others had slots beneath the floor so they could be moved by forklifts. The Marine Steel Corporation, a New York manufacturer, advertised no fewer than 30 different models, from a 15-foot-long steel box with doors on the side to a steel-frame container with plywood sides, 4½ feet wide, made to ship "five-and-dime" merchandise to Central America. Of the 58,000 privately owned shipping containers in the United States, according to a 1959 survey, 43,000 were 8 feet square or less at the base, while a mere 15,000, mainly those owned by Sea-Land and Matson, were more than 8 feet long.[1]

This diversity threatened to nip containerization in the bud. If one transportation company's containers would not fit on another's ships or railcars, each company would need a vast fleet of containers exclusively for its own customers. An exporter would have to be cautious about putting its goods into a container, because the loaded box could go only on a single carrier's vessel, even if another line's ship was sailing sooner. A European railroad container could not cross the Atlantic, because U.S. trucks and railroads were not set up to handle European sizes, while the incompatible systems used by various American railroads meant that a container on the New York Central could not readily be transferred to the Missouri Pacific. As containers became more common, each ship line would need its own dock and cranes in every port, no matter how small its business or infrequent its ships' visits, because other companies' equipment would not be able to handle its boxes. So long as containers came in dozens of shapes and sizes, they would do little to reduce the total cost of moving freight.

The United States Maritime Administration decided in 1958 to put an end to this incipient anarchy. Marad, as it was known, was an obscure government agency, but it held enormous power over the maritime industry. Marad and a sister agency, the Federal Maritime Board, dispensed subsidies to build ships, administered laws dictating that government freight should travel in U.S.-flag vessels, gave operating subsidies to U.S. ships on international routes, and enforced the Jones Act, the venerable law dictating that only American-built ships, using American crews and owned by American companies, could carry cargo between U.S. ports. The wide variety among containers increased its financial risk: if a ship line took Marad's money, built a vessel to carry its unique containers, and then ran into financial problems, Marad could end up foreclosing on a ship that no one would want to buy. Marad's desire to set common standards was supported by the navy, which had the right to commandeer subsidized ships in the event of war and worried that a merchant fleet using incompatible container systems would complicate logistics. The situation was urgent: several ship lines were seeking subsidies to build vessels to carry containers, and if standards were not set quickly, each carrier might go off in its own direction. In June 1958, Marad named two committees of experts, one to recommend standards for container sizes and the other to study container construction.

The problems the committees faced were not entirely novel. The railway industry, for example, had gone through a standardization process. The gauge—the distance between the inside faces of a pair of rails—on North American railroads varied between 3 feet and 6 feet during the nineteenth century. Trains on Britain's Great Western Railway, with a gauge of 7 feet, could not travel on lines with the most common British gauge of 4 feet 8.5 inches. In Spain, gauges varied from 3 feet 3.3 inches to 5 feet 6 inches, and the multiplicity of gauges in Australia foreclosed long-distance rail transport well into the twentieth century. In some cases, the gauge had been chosen more or less randomly. In others, builders deliberately sought to prevent their line from interconnecting with others that might compete for traffic. Over time, these differences worked themselves out. The Pennsylvania Railroad took over lines in Ohio and New Jersey after the Civil War and converted them to its own gauge. When Prussia proposed a railway link to the Netherlands in the 1850s, the Dutch narrowed their lines so that trains could run through from Amsterdam to Berlin.[2]

The railway precedent suggested that ship lines might eventually make their container systems compatible without a government dictate. Yet the analogy is misleading. The gauge that became "standard" on railways had no particular technical superiority, and standardization had almost no economic implications; the width of the track did not determine the design of freight cars, nor the capacity of a car, nor the time required to assemble a train. In the shipping world, on the other hand, individual companies had strong reasons to prefer one container system to another. The first carrier with fully containerized ships, Pan-Atlantic, used containers that were 35 feet long, because that was the maximum allowed on the highways leading to its home base in New Jersey. A 35-foot container would have been inefficient for carrying canned pineapple, Matson Navigation's biggest single cargo, because a fully loaded container would have been too heavy for a crane to lift; Matson's careful studies showed that a 24-foot box was best for its particular mix of traffic.

Grace Line, which was planning service to Venezuela, worried about South America's mountain roads and opted for shorter, 17-foot containers. Grace's design included small slots at the bottom for forklifts, but Pan-Atlantic and Matson chose not to pay extra for slots because they did not use forklifts. Each company deemed the fittings it used to lift its containers the best for loading and discharging ships at top speed. Conforming to industry standards, each line felt, would mean using a system that was less than ideal for its own needs.[3]

There were two other important distinctions between standardizing rail gauges and standardizing containers. One was scope: the width of a railroad track affected only railroads, whereas the design of containers affected not just ship lines, but also railroads, truck lines, and even shippers who owned their own equipment. The other difference was timing. Railroads had been around for several decades before incompatible track gauges came to be seen as a major problem. Container shipping was brand-new, and pushing standardization before the industry developed might lock everyone into designs that would later prove undesirable. From an economic perspective, then, there was every reason to doubt the desirability of the standardization process that began in 1958. If government agencies in those days had made it a routine practice to conduct cost-benefit studies, most likely the entire process of container standardization would never have begun.[4]

These concerns were unrepresented when Marad's two expert committees held their first meetings on successive days in November 1958. Neither Pan-Atlantic nor Matson was seeking government construction subsidies, so the only two companies actually operating containerships in 1958 were not invited to join in the process of setting standards for the industry that they were creating.

Controversy arose almost immediately. After much debate, the dimension committee agreed to define a "family" of acceptable container sizes, not just a single size. It voted unanimously that 8 feet should be the standard width, despite the fact that some European railroads could not carry loads wider than 7 feet; the committee would "have to be guided mainly by domestic requirements, with the hope that foreign practice would gradually conform to our standards." Then the committee took up container heights. Some maritime industry representatives favored containers 8 feet tall. Trucking industry officials, who were observers without a vote, argued that 8½-foot-tall boxes would let customers squeeze more cargo into each container and allow room for forklifts to work inside. The committee finally agreed that containers should be no more than 8½ feet high but could be less. Length was a tougher issue still. The diversity of containers in use or on order presented a serious operational problem: while a short container could be stacked atop a longer one, its weight would not rest upon the longer one's load-bearing steel corner posts. To support a shorter container above, the bottom container would require either steel posts along its sides or thick, load-bearing walls. More posts or thicker walls, though, would increase weight and reduce interior space, making the container more costly to use. The length question was deferred.[5]

The other Marad committee, on container construction, defined its most important task as establishing maximum weights for loaded containers. Weight limits were crucial, because they would determine the lifting power required of cranes and the load that the bottom container in a stack might have to bear. The weight of empty containers, however, would not affect cranes, ships, or trucks, and the committee decided not to address it. Various other complicated issues, such as the strength of corner posts, the design of doors, and the standardization of corner fittings for lifting by cranes, were put off.[6]

The two committees appointed by Marad did not have the field to themselves. There was a competitor: the venerable American Standards Association. The association, supported by private industry, was in the business of setting standards, dealing with subjects as diverse as the size of screw threads and the construction of plaster walls. The work was vital but also mind-numbing; the engineers on a typical American Standards Association committee would study technical reports, hear the views and interests of the firms concerned, and eventually recommend standards that individual companies could abide by if they wished. To deal with containers, the association created Materials Handling Sectional Committee 5—MH-5, to all concerned—in July 1958. MH-5, in turn, organized itself into subcommittees, which were instructed to develop specifications that would "permit optimum interchange among carriers and also be compatible with domestic pallet containers and cargo containers, and foreign carriers."[7]

The MH-5 committee's first act was to ask the Marad committees to withdraw from the scene. The maritime industry alone should not be making decisions about standardization, MH-5 officials argued; the process should involve other affected industries, and should include foreign organizations so that the standards might eventually apply globally. The Marad committees refused to wait for a decade-long international process. They carried on over the winter of 1959, debating maximum weights, lifting methods, and the pros and cons of requiring steel posts every eight feet along container walls rather than just at the corners. The MH-5 subcommittees, involving many of the same participants, went to work on the same issues. The MH-5 subcommittee on dimensions quickly reached a consensus that all pairs of lengths in use or about to be used—12 and 24 feet, 17 and 35 feet, 20 and 40 feet—would be considered "standard." The subcommittee rejected only a proposal to endorse 10-foot containers, because members thought them too small to be efficient, and, in any case, none were planned.[8]

The MH-5 process was dominated by trailer manufacturers, truck lines, and railroads. These interests wanted to reach a decision on container sizes quickly, because once standard dimensions were approved, the domestic use of containers was expected to burgeon. The specifics mattered less: within the limits set by state laws, trucks and railroads could accommodate almost any length and weight. The maritime interests that were influential in the Marad committees, in contrast, cared greatly about the specifics. A ship built with cells for 27-foot containers could not easily be redesigned to carry 35-foot containers. Most ships then carrying containers had shipboard cranes built to handle a particular size, and they would have to be converted to handle other sizes. Large containers might prove impossible to fill with the available freight, but smaller ones would increase costs by requiring more lifts at the dock. Some lines had made large investments that could be rendered worthless if their containers were deemed "nonstandard." Maritime executives were especially concerned that Marad would deny financial help and perhaps even government cargoes to "nonstandard" operators. Bull Line, which carried containers 15 feet long and 6 feet 10 inches high on its breakbulk ships to Puerto Rico, begged to be left alone, because it had no desire to interchange containers with other companies. Other lines urged the government to let the market sort things out as the container industry matured. When the Marad committee on dimensions reviewed the MH-5 subcommittee's six proposed "standard" lengths in April 1959, it split. The deciding vote in favor of the MH-5 standards came from Marad itself, which was in a hurry to get standards, any standards, into place.[9]

The Marad committee also changed its mind about height. The previous November it had voted to make 8½ feet the maximum height for containers, but it ruled now for 8 feet. The change stemmed from concern that an 8½-foot-high container would violate highway height limits in some eastern states—a problem that was real for trucks hauling containers on standard trailers, but one that did not affect trucks pulling the specially designed chassis used by Pan-Atlantic and Matson. A lower height limit would benefit eastern truckers at the expense of ship lines: an 8-foot-high container held 6 percent less cargo than an 8½-foot-high container of the same length, and would be less attractive to shippers. On height standards as on length standards, the committee split, with the government once again casting a vote that would determine how private transportation companies would invest. The new standards were promptly tested by Daniel K. Ludwig's American Hawaiian Steamship Company, which wanted to build a ship carrying 30-foot-long containers. The Federal Maritime Board would not approve federal mortgage insurance for a ship fitted for nonstandard containers, so American Hawaiian asked the committee to declare 30-foot containers "standard." The committee rejected the request 3 to 2, with Marad once more casting the deciding vote. Federal aid was not forthcoming, and the ship was never built.[10]

The sister Marad committee, dealing with container construction and fittings, worked more smoothly. Members readily agreed that each container should be able to carry the weight of five fully loaded containers atop it, with the weight to be carried on the corner posts rather than on container walls. All containers should be designed to be lifted by spreader bars or hooks engaging the top corners. Rings on top for lifting by hooks or slots underneath for forklifts would be acceptable, but not mandatory. Those decisions gave engineers the basic criteria to use in designing new containers. The committee also recommended that each ship be designed with various sizes of steel cells so that it could carry multiple sizes of containers. With that, the two Marad committees scheduled no further meetings.[11]

Meanwhile, yet another player entered the standards business. The National Defense Transportation Association, representing companies that handled military cargo, decided that it, too, would study container dimensions. The effort's chief proponent was a brash entrepreneur named Morris Forgash, who had built the United States Freight Company into a $175-million-a-year business over two decades by picking up small lots of cargo from various shippers, consolidating them into truck trailers or containers, and shipping the trailers cross-country by rail. The outspoken Forgash impelled his committee to reach consensus quickly. By late summer of 1959, it had agreed unanimously that "standard" containers would be 20 feet or 40 feet long, 8 feet wide, and 8 feet high. The other lengths approved by the MH-5 and Marad committees, and the 8½-foot-high boxes supported by some truckers and most ship lines, would not be acceptable for military freight—a decision Forgash's committee was able to reach only because no one from the maritime industry was involved. No matter: individual companies' preferences, Forgash asserted, would have to yield to the need for uniformity. "Even if we reach the goal slowly, we must have a goal," he said. "Otherwise, obsolescence will overtake us all if each man is his own engineer."[12]

With the MH-5 subcommittee and the Marad dimensions committee having adopted one set of "standard" sizes, and with the National Defense Transportation Association having approved another, the wheeling and dealing began at the American Standards Association. Under the ASA's normal procedures, the February 1959 subcommittee recommendation to designate six "standard" sizes would have been sent for a mail ballot among all participating organizations. The vote never occurred. Instead, insiders set to work to change the recommendations.

A task force of the dimensions subcommittee convened on September 16, 1959, and its chairman, E. B. Ogden, announced that it was desirable to revisit the question of container length. All but two eastern states now permitted 40-foot trailers, Ogden said, so the length limit that had justified 35-foot boxes no longer existed. In the West, eight states had increased their length limits to permit trucks to pull two trailers of 27 feet each, rather than 24 feet apiece. Ogden, whose Consolidated Freightways was the country's largest truck line, urged the committee to approve 27-foot containers as a regional standard size for the West, to reduce costs for trucking companies.

Then Herbert Hall, the chair of the entire MH-5 process, intervened. Hall was a retired engineer at Aluminum Company of America, which made aluminum sheets used to manufacture containers. He had sparked the entire standardization process with a presentation to an engineering society in 1957. Hall knew little about the economics of using containers, but he was fascinated by the concept of an arithmetic relationship—preferred numbers, he called it—among sizes. He believed that making containers in 10-, 20-, 30-, and 40-foot lengths would create flexibility. A shipper could put freight for a single customer in the most suitable size rather than wasting space inside a full 40-foot container. A truck equipped to handle a 40-foot container could equally well pick up two 20-foot containers (their precise length was 19 feet 10.5 inches, to make it easy to fit two together in a 40-foot space), or one 20-foot container and two 10-footers. Trains and ships would be able to handle combinations of smaller boxes in the same way. Hall's enthusiasm was not shared by railroads and ship lines, because loading a train or ship with four 10-foot containers would cost four times as much as loading a single 40-footer. Hall reminded the task force that a higher body, the ASA's Standards Review Board, would have to approve any proposed standards, and he opined that it would not accept the 12-foot, 17-foot, 24-foot, and 35-foot containers that the MH-5 subcommittee had endorsed. The 10-, 20-, and 40-foot lengths Hall favored were promptly approved, while the other lengths were deleted from the list of "standard" sizes. Those recommendations, along with the proposed 27-foot standard for the West and several standards for container construction, were sent to member organizations for a vote late in 1959.[13]

The standards Hall wanted stood to have huge implications for the transport sector. No ships or containers then in use or in design would fit into the container system of the future. Pan-Atlantic and Matson would face an unwelcome choice. If they agreed to use only 10-foot, 20-foot, and 40-foot containers, they would be forced to write off tens of millions of dollars of investment, much of it undertaken within the previous two years, and to shift to container sizes that they deemed inefficient for their own purposes. If Pan-Atlantic and Matson declined to adopt the standards, they would forfeit eligibility for government ship-construction subsidies, while their competitors would be able to build "standard" containerships partially at government expense. Either way, the latecomers to containerization would gain at the expense of the pioneers. Individual companies did not vote in the MH-5 committee, but companies' interests were so disparate that more than a dozen of the industry organizations that did have voting rights failed to reach internal consensus. The proposed 27-foot regional standard was defeated, but the recommendation for Hall's "modular" lengths met with large numbers of abstentions.[14]

Matters were so confused that Hall decided to organize a revote. This time, the questions about container construction were left off the ballot, which now had only a single question: should the association establish standard nominal dimensions 8 feet wide, 8 feet high, and 10, 20, 30, and 40 feet long? The 30-foot container had not been debated in the various task forces and subcommittees, but Hall added it in order to have "a definite relationship between the capacities of adjacent sizes"; the fact that it appealed to Europeans worried about moving big containers through narrow city streets was an added attraction. Many steamship organizations abstained once again because of internal divisions, and again Marad backed the proposal. No vote count was released, but Hall, as chairman, decided that the 10-foot multiples had won sufficient support. On April 14, 1961, 10-, 20-, 30-, and 40-foot boxes were declared to be the only standard containers. The Federal Maritime Board promptly announced that only containerships designed for those sizes could receive construction subsidies.[15]

The standards wars were by no means over. In fact, they had barely begun. At American urging, the International Standards Organization (ISO), which then had thirty-seven nations as members, agreed to study containers. At the time, only very small containers were being shipped across borders, but bigger ones obviously were on the way. The ISO project was meant to establish worldwide guidelines before firms made large financial commitments. Delegates from eleven countries, and observers from fifteen more, came to New York in September 1961 to start the process. Most were appointed by their governments, with the United States, represented by the American Standards Association, being an exception. The United States, as the convener of the meeting, held the chair.[16]

ISO's practice, wherever possible, was to decide how a product must perform rather than how it should be made. This meant that ISO Technical Committee 104 (TC104) would focus on making containers easily interchangeable, not on the details of construction. TC104 was thus able to avoid prolonged debate between proponents of steel containers, popular in Europe, and advocates of the aluminum containers more common in America. No standard would dictate aluminum or steel. TC104 established three working groups and began what would inevitably be a slow-moving process, with many interests involved. The American Standards Association's MH-5 subcommittees continued work on other domestic standards, with the hope that whatever they agreed would later be accepted by ISO. Many leading U.S. transport engineers were involved simultaneously in both groups.[17]

The wrangling over container sizes, which had consumed three years in the United States, was now repeated at the international level. By 1962, much of Europe was allowing larger vehicles than was America, so the new American standard sizes, 8 feet high, 8 feet wide, and 10, 20, 30, or 40 feet long, faced no technical obstacles. Economic interests were another story. Many continental European railroads owned fleets of much smaller containers, made for 8 or 10 cubic meters of freight rather than the 72.5 cubic meter volume of a 40-foot container. The Europeans wanted their containers recognized as standard. The British, Japanese, and North American delegations were all opposed, because the European containers were slightly wider than 8 feet. A compromise was struck in April 1963. Smaller containers, including the European railroad sizes and American 5-foot and 6 2/3-foot boxes, would be recognized as "Series 2" containers. In 1964, these smaller sizes, along with 10-, 20-, 30-, and 40-foot containers, were formally adopted as ISO standards. Not a single container owned by the two leading containership operators, Sea-Land Service (the former Pan-Atlantic) and Matson, conformed to the new "standard" dimensions.[18]

While one set of ISO subcommittees and task forces was hashing out dimensions, other groups of experts were seeking common ground concerning strength requirements and lifting standards. In both North America and Europe, small containers were often moved with forklifts, and some had eyes on the top through which longshoremen or railroad workers could insert hooks connected to winches. The larger containers introduced in North America had steel fittings at each corner, which were welded to the corner post, to a top or bottom rail running the length of the container, and to cross-members running across the front or back end. The corner fittings were cast with holes, through which the containers could be lifted, locked to a chassis, or connected to one another. These castings were simple to make, costing about five dollars apiece in 1961.[19]

The problem came with the lifting and locking devices that fit into the holes. Pan-Atlantic, the first out of the gate, had applied for a patent on its particular system, which used conical lugs that could slip through the oblong holes of its corner fittings and automatically lock into place; a double-headed device to hold two containers together could be secured with the twist of a handle. Pan-Atlantic threatened to bring suit against anyone infringing on its design, forcing other ship lines and trailer manufacturers to develop their own locks and corner fittings. This meant that, even if container sizes were standardized, Sea-Land's cranes would not be able to lift Grace's containers, and Sea-Land containers could never ride on Matson chassis. Railroads that carried the containers of various ship lines needed complicated systems of chains and locks to secure all of the different containers, because one simple locking system would not work for all. Agreeing on a standard corner fitting thus was crucial to making containers readily interchangeable. The obstacle was that every company had financial reasons to favor its own fitting. Adopting some other design would require it to install new fittings on every container, to buy new lifting and locking devices, and to pay a license fee to the patent holder.

An MH-5 task force had tried, and failed, to come up with a new design compatible with all existing corner fittings in 1961. Inevitably, the question arose: could any of the patented corner fittings serve as the U.S. standard? It could, Hall advised at an MH-5 meeting in December 1961, so long as it was in widespread use and was available to all for a nominal royalty. The task force chairman, Keith Tantlinger, had designed the Sea-Land fitting while working for Malcom McLean in 1955. He was now chief engineer at Fruehauf Trailer Company, and he offered royalty-free use of Fruehauf's newest design, in which a steel lug slipped through the hole in a corner fitting and locked into place with a pin. Strick Trailers, a Fruehauf competitor, objected that the Fruehauf design was not good for coupling containers together, and, besides, it had not been proven in actual use. Strick's own design, however, was mired in a patent dispute and could not be offered as a standard. National Castings Company threatened a lawsuit unless any new standard was compatible with its own system, which used lugs designed to spread apart when they passed through the hole in the corner fitting.

The technical differences between these systems were important, especially for ship lines. Containerships were hugely capital-intensive, and the industry's viability depended upon minimizing port time and maximizing the time that each vessel was under way, earning revenue. The ship lines thus had special concern about "gathering," the tendency of the lugs of the lifting device to position themselves in the holes in the corner fittings. If a fitting was poor at gathering when a crane lowered its spreader to pick up a container, the crane operator often had to raise the spreader and lower it a second time. Matson chief engineer Les Harlander calculated that if gathering difficulties added just one second to the average time required to lift a container, his company would lose four thousand dollars per ship per year. After a full day of debate, the subcommittee voted on the Fruehauf design and split badly. There was no ringing endorsement of a national standard.[20]

More meetings through 1962 failed to break the deadlock. Finally, Fred Muller, an engineer serving as the MH-5 committee's secretary, offered a thought: since the Sea-Land corner fitting was working smoothly with the world's largest fleet of containers, perhaps the company would be willing to release its patent rights. Tantlinger made an appointment with Malcom McLean. McLean had no reason to be fond of the American Standards Association, which only recently had excluded Sea-Land's 35-foot containers from its list of standard sizes. Nonetheless, he understood that common technology would stimulate the growth of containerization. On January 29, 1963, Sea-Land released its patents, so that the MH-5 committee could use them as the basis for a standard corner fitting and twist lock.[21]

Agreement on a single design proved elusive. Various trailer manufacturers were still pushing their own products. Numerous ship lines and railroads had started to buy containers, albeit in small numbers, and they employed a wide variety of lifting systems. Lack of consensus meant that the U.S. delegates did not have an official design to offer when the ISO container committee met in Germany in October 1964. The Americans promoted the Sea-Land fitting as the basis for a potential international standard, with Tantlinger distributing half-size ceramic models to show other delegates what it looked like, but no design was put to a vote.[22]

Back home, the engineers' debate over the stresses and tolerances of corner fittings flared into a bitter commercial dispute. The National Castings corner fitting, an elongated box with two rectangular holes in the long side and a large square opening on the top, had been adopted by more container owners than had any other. One big company, Grace Line, had modern container cranes that operated on the National Castings system. Smaller lines that carried containers along with mixed freight in their breakbulk ships liked the National Castings fitting because the large openings let them use old-fashioned hooks for lifting and lowering. Changing to a different system would be expensive; Grace Line estimated the cost of replacing the corner fittings on its containers and the lifting frames on its cranes to be $750,000. National Castings sought wider support by agreeing to royalty-free use of its designs, although only for containers to be carried on American ships. The company persuaded the Maritime Administration that it should support the National Castings fitting as the international standard rather than a fitting based on the Sea-Land design.[23]

Four of the leading steamship lines, Sea-Land, Matson, Alaska Steamship, and American President Lines, fought back, because adoption of the National Castings fitting would have required them to change all of their containers. Instead, they proposed a minor change to the fitting that the MH-5 committee was designing based on the Sea-Land patent. If the hole on the top of the fitting were moved by half an inch, they estimated, 10,000 containers—about 80 percent of all large containers used by U.S. railroads and ship lines other than Sea-Land—would be "reasonably compatible" with Sea-Land's. The fitting they recommended, they said, would cost less than half as much as the National Castings fitting ($42.24 versus $97.90) and weigh barely half as much (124 pounds versus 236). As the battle grew intense, the politics of standardization suddenly changed. National Castings Company was sold and abandoned efforts to promote its corner fitting. Marad, which had favored National Castings, reversed course and urged ship lines to accept whatever MH-5 agreed upon. Finally, an unusual decision came from the top. The American Standards Association's Standards Review Board ignored the fact that the specialists on its MH-5 committee were still debating the finer details of corner fittings. On September 16, 1965, it approved a modified version of the Sea-Land fitting as the U.S. standard, just in time for the next meeting of the ISO container committee in The Hague.[24]

The sixty-one ISO delegates were offered two competing designs when they convened in the Dutch capital on September 19. The United States presented the modified Sea-Land corner fitting as the new U.S. standard, and the National Castings fitting was put forth as the British standard. The British quickly agreed that the American favorite was superior. Only one roadblock remained. ISO rules required that the documents supporting proposed standards had to be distributed four months in advance of a meeting. The MH-5 committee had made its recommendation only a few days earlier, and no technical documents were ready. The ISO committee voted unanimously to waive the four-month rule. Three high-ranking corporate executives—Tantlinger, Harlander, and Eugene Hinden of Strick Trailers—then retreated to a railcar factory in nearby Utrecht, where they worked with Dutch draftsmen for forty-eight hours nonstop to produce the requisite drawings. On September 24, 1965, the ISO delegates approved the American design as the international standard for corner fittings.[25]

The new era of freight transportation finally seemed to have arrived. In principle, land and sea carriers would soon be able to handle one another's containers. Container leasing companies could expand their fleets in the knowledge that many carriers would be prepared to lease their equipment, and shippers could make use of containers without wedding themselves to a single ship line. "Projects awaiting the outcome of the fitting question are already underway," a trade publication trumpeted within a few months of the vote in The Hague. "Container-handling hardware can now be designed with more certainty, and an increasing number of products designed to load and carry containers will be marketed."[26]

The cart, however, had gotten ahead of the horse: the ISO container committee had agreed on what the corner fitting should look like without defining all of the loads and stresses it should be able to withstand. Starting in the autumn of 1965, dozens of ship lines and leasing companies began ordering containers with fittings based on the design that had worked for Sea-Land's operations but had never been tested under other conditions. The ISO committee had yet to set maximum container weights, for example. No one could say how thick the steel in the fitting should be, because it was not clear how much weight it might have to hold. Sea-Land's cranes lifted by connecting to the tops of the fittings in the top corners of a container; it was uncertain how the fittings would perform if a container were lifted from the fittings in the bottom corners. Railroads in Europe had different coupling systems from those in the United States, meaning that the cars in a train banged against one another with greater force, and the Sea-Land fittings and locks had never been subjected to such conditions. And what if five or six containers were stacked on the deck of a ship? In high seas, the stack of containers might tilt as much as 30 or 40 degrees away from vertical. Would the newly approved corner fittings and the twist locks connecting the containers survive such stresses?

Through 1966, engineers around the world tested the new fittings and found a variety of shortcomings. As an extra check, a container was put through emergency tests in Detroit, just ahead of another meeting of the ISO committee. It failed, the fittings on the bottom of the test container giving way under heavy loads. When TC104 convened in London in January 1967, it was faced with the uncomfortable fact that the corner fittings it had approved in 1965 were deficient. Nine engineers were named to an ad hoc panel and told to solve the problems quickly. They agreed on the tests that fittings would have to pass, and then two engineers, one British, one American, were sent to a hotel room with their slide rules and told to redesign the fitting so that it could pass the tests. Requiring thicker steel in the walls of each fitting, they calculated, would solve most of the problems. No existing container complied with their "ad hoc" design. Over the bitter complaints of many ship lines that had encountered no problems with their own containers, ISO approved the "ad hoc" design at a meeting in Moscow in June 1967. The thousands of boxes that had been built since ISO first approved corner fittings in 1965 had to have new fittings welded into place, at a cost that reached into the millions of dollars.[27]

The process of standardization was proceeding nicely. The economic benefit of standardization, however, was still not clear. Containers of 10, 20, 30, and 40 feet had become American and international standards, but the neat arithmetic relationship among the "standard" sizes did not translate into demand from shippers or ship lines. Not a single ship line was using 30-foot containers. Only a handful of 10-foot containers had been purchased, and the main carrier using them soon concluded that it would not buy more. As for 20-foot containers, land carriers hated them. Ship lines "have designed, especially in their 20-foot equipment, a highly efficient port to port container without due consideration of how the box would move efficiently from port to customers," an executive of the New York Central Railroad complained. So far as truck lines were concerned, the bigger the container, the more freight could be transported per hour of driver labor. Trucking companies' preference was revealed by the truck trailers they chose to buy, almost none of which had 20-foot bodies. Hall's notion of coupling two 20-foot containers together on a single trailer proved to be impractical, because if each container was filled to its weight limit, the combined weight would violate highway regulations in every state. Towing two 20-foot containers in tandem was impractical as well, because the same truck could move more weight by pulling two 24-footers or, in many states, two 27-footers.[28]

The most powerful evidence against the international standards came from the marketplace. Despite the U.S. government's pressure on carriers to use "standard" sizes, nonstandard containers continued to dominate. Sea-Land's 35-foot containers and Matson's 24-footers, all a nonstandard 8 feet 6 inches high, accounted for two-thirds of all containers owned by U.S. ship lines in 1965. Only

16 percent of the containers in service complied with the standards for length, and a good number of those were not of standard 8-foot height. Standard containers clearly were not taking the industry by storm. The large ones were too hard to fill—too few companies shipped enough freight between two locations to require an entire 40-foot container—and small ones required too much handling. As Matson executive vice president Norman Scott explained, "In the economics of transportation, there is no magic in mathematical symmetry."[29]

Their business success notwithstanding, Sea-Land and Matson had reason to worry about the drive for standard-size containers. Both companies had raised tens of millions of dollars of private capital to buy equipment and convert their ships to carry containers, and so far neither had sought federal construction subsidies. That situation was now changing. By 1965, both Sea-Land and Matson were preparing to expand internationally, and they might want subsidies to build new ships. In addition, Marad dispensed other types of aid. It gave operating subsidies to U.S. ship lines sailing international routes, to compensate for the requirement that they employ only high-wage American seamen, and it enforced regulations giving U.S.-flag vessels "preference" to carry government cargo overseas. If Marad were to limit those subsidies only to companies adhering to the "voluntary" MH-5 standards, Sea-Land and Matson would be at a serious competitive disadvantage. Executives from the two companies met in Washington and decided to join forces to fight the U.S. government.[30]

They started back at the American Standards Association. The association's MH-5 committee had been quiescent, but in the fall of 1965, with the ISO beginning to adopt international standards for containers, the MH-5 committee named a new subcommittee to look at "demountable containers"—the sort that could be moved among ships, trains, and trucks. The chairman was Matson chief engineer Harlander, and now, in contrast to 1961, Sea-Land officials were prominent participants. At the first meeting, at the Flying Carpet Motel in Pittsburgh, Harlander surrendered the chair and made an appeal for Matson's 24-foot container size to be accepted as standard. He was followed by Sea-Land's chief engineer, Ron Katims, who called for the subcommittee to recognize 35-foot containers as well. Sea-Land's containers, the subcommittee was told, tended to hit weight limits long before they were filled to physical capacity, so 40-foot containers would not in practice hold more freight than 35-footers. With the longer size, however, Sea-Land would not be able to fit as many containers on each ship, forfeiting almost 1,800 tons of freight capacity per vessel. Harlander then called for the subcommittee to endorse 8½-foot-high containers as well. Marad's representative asked that all three questions be tabled.[31]

When discussions resumed in early 1966, the subcommittee agreed to increase the "standard" height for containers to 8½ feet, but it split on whether to recommend a change in policy to make 24-foot and 35-foot containers "standard." It bounced the entire issue up to the full MH-5 committee. The MH-5 committee itself then split. The dogged Hall, still pushing the standardization process along despite failing health, remained convinced that all approved sizes should be mathematically related. The various maritime associations on the committee, most of whose members had by then adopted 20-foot or 40-foot containers, had little incentive to cast a vote that might force them to share government subsidies with Sea-Land and Matson. Five trucking associations, whose members picked up and delivered containers for Sea-Land and Matson, submitted votes by telegraph in favor of the two additional sizes, but their votes were disallowed. Almost all of the government representatives in attendance abstained. With 15 no votes, 5 yes votes, and 54 voters abstaining or absent, the MH-5 committee had no consensus for anything. A revote the following year found the split persisting, with 24 participating organizations favoring 24-foot containers and 28 against them.[32]

Faced with the prospect of competing against subsidized competitors while being excluded from subsidies themselves, Sea-Land and Matson turned to Congress. Their lobbyists drafted legislation in 1967 to prohibit the government from using the sizes of containers or shipboard container cells as a basis for awarding subsidies or freight. Representatives and senators were soon delving into the obscure details of containerization. Other ship lines urged that the government push adoption of standard containers so that any company could handle others' containers. "The key to automation is the existence of a standardized product," British steamship executive G. E. Prior-Palmer testified. Sea-Land and Matson, competitors charged, were disrupting the effort to make containers compatible around the world. Of 107 container-carrying ships under construction in September 1967, all but six, commissioned by Sea-Land and Matson, were designed around standard sizes. Marad concurred, arguing that Sea-Land and Matson should accept the standards adopted by everyone else. Sea-Land could add five feet to each of its 25,000 containers and 9,000 chassis and alter all of its ships and cranes for about $35 million, acting Marad chief J. W. Gulick testified, and Matson, a much smaller company, could switch from 24-foot containers to 20-foot containers at a cost of only $9 million.[33]

Sea-Land and Matson, which had invested a combined $300 million in containerization, were less concerned about the cost of conversion than about the inefficiency of doing business with equipment ill-suited to their needs. Matson president Stanley Powell testified that using 20-foot containers instead of 24-footers would raise his company's operating costs by $500,000 per ship per year in service to the Far East, and would increase costs for trucks picking up and delivering containers as well. Malcom McLean followed, armed with a consultant's study showing that switching from 35- to 40-foot containers in Sea-Land's Puerto Rico service would reduce revenues by 7 percent and costs hardly at all. "I don't care what size container is adopted as a standard," he affirmed. "If the marketplace can find one that moves cheaper, that is the way the marketplace will dictate it and we want to be flexible enough to follow the marketplace."[34]

The Senate passed their legislation, but Matson sensed that a compromise would be needed to get the bill through the House. On the spur of the moment, Powell told a House committee that Matson wanted Marad to subsidize two ships with a radically new feature, adjustable steel cells for container stowage. The ships would initially carry only 24-foot containers, but if market requirements changed, the frames could be adjusted so 20-foot containers could be carried in the same space. This new feature, Powell said, would add only $65,000 to the $13 million cost. No such design existed; the entire scheme, cost estimate and all, had been drawn up on the floor of a hotel room the previous night. No matter: Congress ordered Marad not to discriminate against companies using nonstandard containers, Matson was granted its construction subsidy—and, when the company decided years later to switch from 24-foot containers to 40-foot containers, the adjustable cells conceived to satisfy a congressional committee made the shift cheap and easy.[35]

Two controversies remained. The MH-5 committee undertook a futile effort to make containers compatible with airplanes as well as with ships, trucks, and trains. The requirements were not easy to reconcile: air containers needed to be stronger than maritime containers, and they required smooth bottoms to travel on conveyor belts rather than corner fittings for lifting by cranes. After months of studies, it dawned on the engineers that shippers paying a premium for the speed of air freight would be unlikely to want their cargo carried in ships, and a separate standard was developed for air containers. Railroads raised a more serious problem, contending that containers needed heavier end walls. End walls bore no great loads when the containers were on ships, but the braking of a train could cause the end of a container to bump up against the end of the flatcar. Railroads in North America demanded end walls twice as strong as those needed by ship lines, to reduce the potential for damage claims. European railroads were even more concerned, because differences in couplings caused more forceful contact between railcars in Europe. Maritime interests resisted stronger end walls, which meant more weight and higher manufacturing costs. With the TC104 committee on their side, the railroads won the day, but not without cost; by one estimate, the requirement for stronger end walls added one hundred dollars to the cost of manufacturing a standard container.[36]

By 1970, as the International Standards Organization prepared to publish the first full draft of its painstakingly negotiated standards, the bitter battles among competing economic interests were finally winding down. In hindsight, the process can be faulted in almost every particular. It led to corner fittings that were too weak and needed redesign. Several newly approved container sizes were uneconomic and were soon abandoned. The standards for end walls may have been excessive, and the standards for lashing containers together on deck never quite added up. No one would declare that all of the subcommittees and task forces came up with an optimal result.

Yet after 1966, as truckers, ship lines, railroads, container manufacturers, and governments reached compromises on issue after issue, a fundamental change could be seen in the shipping world. The plethora of container shapes and sizes that had blocked the development of containerization in 1965 gave way to the standard sizes approved internationally. Leasing companies began to feel confident investing large sums in containers and moved into the field in a big way, soon owning more boxes than the ship lines themselves. Aside from Sea-Land, which still used mainly 35-foot containers, and Matson, which was gradually reducing its fleet of 24-foot containers, almost all of the world's major ship lines were using compatible containers. Finally, it was becoming possible to fill a container with freight in Kansas City with a high degree of confidence that almost any trucks, trains, ports, and ships would be able to move it smoothly all the way to Kuala Lumpur. International container shipping could now become a reality.[37]