

New carrier regulations for corrugated shipping containers are now in effect

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Long-sought Alternate Rule 41/Item 222 gives the corrugated industry the flexibility to innovate and produce more cost-effective containers.

The Alternate Rule 41/Item 222 that many of us in the industry have long sought is now in place. The Alternate Rule 41 of the Uniform Classification of the National Railroad Freight Committee became effective Jan. 26, 1991; Item 222 of the National Motor Freight Classification became effective March 30, 1991. These identical Alternates permit corrugated containers in the transportation environment to be specified by the Edge Crush Strength (ECT) of the combined board with no requirements for the basis weight of the facings used.

How did this come about? Why did the corrugated container industry propose these changes to the carrier regulations? What do these revisions mean in terms of the manufacturing requirements for corrugated shipping containers?

The effort to bring about these changes began in the early 1970s. Many boxmakers, box designers, and technical people working in the industry decried the fact that shipping container quality was being measured by bursting strength (Mullen), a test that had little bearing on containers' performance in the current shipping and warehousing environment. R. M. Morris Jr., manager of packaging R&D for the Weyerhaeuser Company, became their spokesman.

Need for modernization outlined

In an address to the International Corrugated Case Association in Munich in May 1975, and on many similar occasions thereafter, Morris outlined the need for modernization of corrugated container specifications (1). He stated that compression strength is the "single most significant index of the performance capability of the corrugated container that distinguishes it from other types of containers." He presented extensive data showing that while the variation of specified parameters, such as basis weight and burst, of linerboard being produced at that time was respectable at $\pm 4\%$ to 12% , the variation of unspecified properties, such as compression

strength, internal bond, porosity, and tensile shear strength, varied by as much as 50% .

Based on the premise that "specifications must directly relate to the performance attributes of the specific product involved," Miller argued for the adoption of a system of regulation by short column compression strength (ECT), along with minimum levels of the existing burst and facing weight requirements at 80% of the current levels. He demonstrated that textile fabrics could be found that met the current requirements for linerboard when it was obvious that they would not produce corrugated board for satisfactory shipping containers.

Morris was especially critical of the changes made in corrugating medium because bursting strength was used as the criterion of strength. Because burst is largely a measure of machine direction (MD) tensile strength and the medium is fluted in that direction, it gives only minimal increases to the bursting strength of the combined board. Yet in compression its contribution is significant, making up approximately one-third of the ECT of 200 psi test board. Consequently, during the 1950s and 1960s, the cross direction (CD) edgewise compression (ring crush) of medium steadily decreased while the flat crush (Concora or CMT) remained constant.

Ad hoc committee formed

Morris became chairman of an ad hoc Rule 41 Technical Committee that was jointly formed by the Fibre Box Association (FBA) and the Fourdrinier Kraft Board Group of the American Paper Institute (API). Another committee of the two organizations was also formed to make minor changes in the existing regulations to create a more uniform gradient in the various levels and to prepare for an easy change to the metric system of measurement.

To help in accomplishing that, the committee established liaisons with the Canadian associations concerned with corrugated container manufacture because the Canadians had converted to the metric system. This became the "short-range committee"; Morris' committee was called the "long-range committee." Under the leadership of Jerome Stone, CEO of Stone Container Corporation, several meetings of the combined committees were held. The short-range pro-

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gram was dropped when it became apparent that metrication would not be effective in the United States in the foreseeable future. The "long-range committee" continued until the new Alternates were in place in 1991.

History of regulations traced

Thomas J. Muldoon, executive vice president of the FBA, traced the history of the carrier regulations involving corrugated shipping containers in a presentation to the Association of the Independent Corrugated Converters (AICC) in December 1982 (2). The railroad's Rule 41 in 1922 included just three grades, specifying the bursting strength and thickness of the facings for various levels of gross weight of the box and contents and the united dimensions of the container. During the next 20 years the only changes were the addition of two board grades. In 1942 the specifications for facing strength and thickness were changed to the combined facings and the combined board itself. Then in 1945 the specifications for thickness were changed to basis weight, recognizing the fact that unbleached kraft linerboard could produce the desired bursting strength at significantly lower basis weight and the resulting lower thickness.

Thus it was into a history of constancy that the application of the FBA and API for an alternate based on ECT was introduced. Muldoon clearly expressed the reasoning in back of the proposal. Significant changes had been made to the shipping and warehousing process; compression strength took on greater meaning. As Morris had pointed out, compression in itself was not the only reason for the focus on ECT. Research at the Institute of Paper Chemistry (IPC) had shown that even when loaded internally and in bending, as in a beam, corrugated containers failed in compression. The studies had shown that compression forces were exerted on the container and that failure resulted in the compression mode because paper is so much weaker in compression than in tension (burst is a measure of tensile strength). With the current pressures to make greater use of alternate fiber sources such as hardwoods in linerboard and recycled fiber throughout, it is all the more important that strength be measured in the way the board will fail.

Little incentive to change

The petition of the FBA and API in 1983 did not result in an Alternate Rule, but permission was given to conduct test shipments. Unfortunately, not many such shipments were made. Continuance of the minimum basis weight requirements left little or no economic incentive to change to the alternate construction. An update of the activities toward revision of these Rules appeared in the October 1983 issue of *Tappi Journal* (3). I wrote an editorial for that same issue in which I said, "I believe the change having the greatest effect in the near future will be the increased emphasis on compression strength. In my opinion, this will occur whether or not the carrier regulations governing corrugated construction are changed" (4). Perhaps I was prophetic, but the changes did occur. By 1988, high performance linerboard and corrugating medium were produced in significant quantities. This enabled boxmakers to achieve compression

performance equal to boxes made to current regulations, but with significantly lower basis weight and, therefore, obvious economic advantages.

Industry surprised

Nevertheless, the industry was surprised when approached by the carriers for a modernized Rule in 1988. Gerald F. Earl, then chairman of the National Railroad Freight Committee, drafted a suggested revision to Rule 41 in late 1988 and asked the corrugated industry to consider the modernization. In addition to many housekeeping changes, especially elimination of many obsolete provisions, this draft proposed specification of corrugated board strength by ECT and the designation of basis weight of facings as nominal rather than a minimum as in the current Rule (5). These latter changes reflected industry practice that had become significant in the late 1980s; namely, substitution of lighter-weight performance linerboard for standard grades. The ad hoc committee was revived and AICC became a member.

In 1982 the FBA and API had sponsored a comprehensive study by the IPC of corrugated shipping containers being produced commercially. The extensive data resulting from that study were used to compute suggested ECT values for the proposal made at that time for an Alternate Rule. So in 1989, in response to Earl's request, the study was repeated. The new data were submitted to an independent statistician who suggested the minimum values now in the Alternate Rule 41/Item 222.

The bottom line is that boxes made to the Alternate Rule must be the equivalent of boxes in commerce today. They are being measured by ECT rather than bursting strength. As the boxmakers make more use of the Alternate they will commit their mill suppliers to produce liner and medium of equivalent edgewise compression strength but at lower basis weight. The boxmakers will be more conscious of good manufacturing methods to maximize compression strength and will therefore take advantage of the opportunity to produce the boxes with less fiber. Especially important is the role of the corrugating medium. As better medium becomes available, the boxmakers will have the opportunity of substituting medium fiber for liner fiber to optimize construction on an economic basis.

Still a material standard

We must remember that this Alternate Rule with ECT as the measure of strength is still a material standard. That is, the quality of the box is regulated by the strength of the material used to make the box. Performance tests such as drop or impact are important for the design of shipping containers, but regulation must be controlled by material standards which are much more closely related to performance. ECT is such a standard test. Although ECT is the largest single factor contributing to box compression, it is not the only factor. Flexural rigidity, which is not regulated in this new Alternate, box design, and fabrication are also involved in the compression strength.

ECT is largely determined by the edgewise compression strength of the liner and corrugating medium used to make

the corrugated structure. Of course, there must be adequate adhesion on the corrugator with no dry-lines at the fingers. The board cannot be excessively crushed, i.e., more than 20%–30%.

The Alternate Rules are not panaceas. They do not promise benefits without considerable hard work and learning on the part of producers and users, the mills, box plants, shippers, and carriers. They do, however, present a new concept, to be tested side-by-side in direct comparison with boxes made to the old Rules under all conditions. There will be no reduction in quality or performance, and they will permit the corrugated industry the flexibility to innovate and produce more cost-effective containers. Customers are insisting on better measures of performance. The Alternate Rules permit mills to broaden their fiber resources and economize on energy. They put the boxmaker in a better position to control raw material supply to important properties and thereby meet customers' needs. □

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