Rail Fastener Performance: The Intangibles

Last month, the performance requirements of track fastening systems, for both wood and concrete ties, were discussed in terms of *track and fastener strength*.

However, research studies[1,2] have noted that there exist two additional categories of fastener requirements which have to be addressed to properly and completely define the performance of such systems. These are *operations and maintenance requirements*, and *cost/benefits* criteria. These categories represent the "intangible" requirements of the fastener system. That is, they are often difficult to quantify but still represent important practical and economic considerations that make for ease of fastener use and effectiveness.

TABLE 1
NET ECONOMIC SAVINGS ($)*
WOOD TIE TRACK

Annual Tonnage	Curvature: 3 Degrees		6 Degrees	
	Lubricated	Unlubricated	Lubricated	Unlubricated
20 MGT	−13,457	− 5,067	− 5,067	30,013
30 MGT	− 6,021	7,456	6,958	60,500
40 MGT	1,280	18,252	18,250	88,989
50 MGT	7,957	30,900	29,517	118,026

**Net economic savings (life cycle) of track with elastic fasteners against track with cut spikes for one mile of track.*

Operations and maintenance

Operations and maintenance requirements can be as important as the track strength considerations, because they address real issues of concern for maintenance personnel who have ultimate responsibility in using rail fastening components in the field. Among the intangible considerations are: fastener life, maintainability, and, where needed, electrical isolation.

Fastener life refers to the passage of time or tonnage at which the fastener or its individual components must be replaced. If the fastener's performance drops below appropriately defined levels, such as those defined last month for track strength, or if a component degrades physically, then "failure" of the fastener occurs. Since fasteners are frequently removed and reinstalled, fastener life includes reassembly and reuse of components without loss of performance.

Besides having economic impact, service life also involves physical practicalities. Consequently, it may not be practical or economical for each of the fastener components to have the same service life. Nonetheless, a commonly used standard for fastener life is one which equals the life of rail in tangent track. Under heavy tonnage operations, this can be 500 MGT of cumulative traffic, or 25 years at 20 MGT per year. Under 100-ton car loading, this translates into over 15 million axle-loading cycles.

Maintainability, as is presented in References 1 and 2, refers to those characteristics of a fastener which provide for ease of use in the field. It includes such intangibles as ease of installation and removal, with a minimum of specialized tools and with minimum ongoing adjustment for the fastener system. Among the other maintenance characteristics are: resistance to catastrophic failure, such as under derailments, ease of visual inspection of key fastener components, and a capability for mechanized installation in conjunction with large maintenance operations.

Electrical isolation, the third requirement, covers fasteners used in concrete or steel tie track in signal territories. Specifically, it calls for the electrical insulation of the rail from the rest of track to minimize the loss of signal circuit under all operating and weather conditions. Resistance values of 20,000 ohms and higher have been used for this requirement.[2]

Overall cost

The final category of fastener characteristics is one that addresses the overall cost of the track system. It is a matter of particular importance to private freight railroads. These companies operate in an economic environment which calls continuously for the minimization of expense and the maximization of benefit. Any criterion, then, developed for both tangible and intangible performance characteristics must be evaluated in light of *total system costs*. Further, these must be life cycle costs taken within the railway operating environment as against simple first costs.

Many studies have attempted to address the life cycle costs and benefits of fastener and fastener/tie systems within wood, concrete, or steel tie track. To illustrate the importance of this type of analysis in defining fastener system criteria, Table 1 presents the results of one economic analysis for wood tie systems.[3] It can be seen that under certain operating conditions, one type of fastening system offers life-cycle savings, while under another set of conditions, an alternate fastener system offers savings instead. Thus, after technical and other intangible requirements have been met, the net economic costs of a system must be addressed.

References:

1. Zarembski, A. M. "Performance Characteristics for Wood Tie Fasteners", Bulletin of the AREA, Bulletin 697, October 1984.
2. Zarembski, A. M., "Performance Characteristics for Concrete Tie Fasteners", *Concrete Tie Systems for the 1980s*, Proceedings of the Prestressed Concrete Tie Workshop, November 1983.
3. Pandrol Inc., Economic cost-benefit analysis of fastener systems, 1983.