

Life of No. 10 and No. 20 Frogs in Revenue Heavy Haul Service

by Duane E. Otter

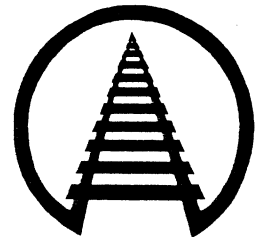
TD 95-010

Summary

The Chicago & North Western Transportation Company is using premium quality No. 10 and No. 20 frogs to achieve longer frog life on the Powder River Subdivision. Preliminary results from data collected as part of the Association of American Railroads' Heavy Axle Load Revenue Service Monitoring program showed that premium No. 10 spring-rail frogs are lasting several times longer than No. 10 rail-bound manganese frogs on this heavy tonnage line. One of these frogs has accumulated over 700 million gross tons (MGT) of traffic and is still in service.

High-integrity No. 20 frog castings are lasting much longer than standard No. 20 castings in rail-bound manganese frogs. The estimated average life of a high-integrity No. 20 frog is almost three times the average life of a standard No. 20 frog on this line. This figure may change as more tonnage is accumulated on frogs still in service.

This TD updates a previously published one entitled "Life of Rail-Bound Manganese Frogs in Revenue Heavy Haul Service" (*Technology Digest* 94-001), and is based on results from an additional 195 MGT of tonnage over the line. Frog life results may vary on lines with different traffic mixes, train operations, and maintenance practices.



Suggested Distribution:

Operating/Engineering Dept.

- Maintenance of Way
- Maintenance of Planning
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- Track Maintenance

Association of American Railroads
Research and Test Department

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INTRODUCTION AND CONCLUSIONS

The Chicago & North Western Transportation Company (C&NW) is using premium quality No. 10 and No. 20 frogs to achieve longer frog life on the Powder River Subdivision. Heavy duty No. 10 spring-rail frogs are showing outstanding service life, while high-integrity No. 20 frog castings are lasting much longer than standard No. 20 castings.

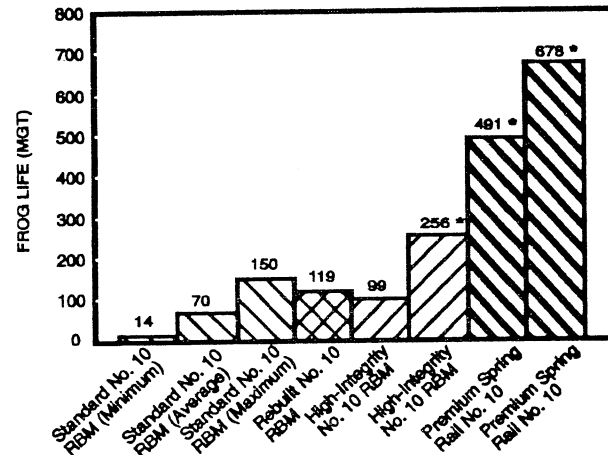
This digest updates the frog life results presented in TD 94-001 "Life of Rail-Bound Manganese Frogs in Revenue Heavy Haul Service." Since then, almost 200 million gross tons (MGT) of traffic has been accumulated over the line.

Three different types of castings are used with the rail-bound manganese (RBM) frogs: standard, rebuilt, and high-integrity. The rebuilding process includes shop grinding and welding of the casting, and restoring or replacing the wing rails. All the rebuilt frogs in this study originally had standard castings. High-integrity castings have thicker walls, more risers and less porosity as compared to standard castings.

NO. 10 FROG LIFE

Exhibit 1 shows the life of various No. 10 frogs. The two premium spring rail frogs have outlived all other No. 10 frogs by a wide margin and continue to accumulate tonnage in service.

Exhibit 2 shows one of the premium spring-rail frogs in service. These frogs are a C&NW custom design. The frog has seven wing rail hold-downs instead of three for a standard American Railway Engineering Association (AREA) design. It also has larger base plates and several rail braces ahead of the toe. It is protected by a 39-foot guard rail on the mainline side instead of the 16.5-foot guard rail for a standard AREA design. The frog is constructed of fully heat-treated rail.

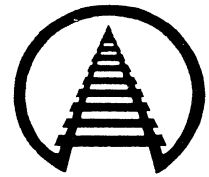


* Frog still in service accumulating additional tonnage
Exhibit 1. Life of No. 10 Frogs in Revenue Heavy Haul Service

For the standard No. 10 frogs, the average, maximum, and minimum lives of 12 frogs are shown in Exhibit 1. The one rebuilt frog had a life similar to that of a standard frog. Of the two high-integrity frogs, the one still in service is showing better life than any previous No. 10 RBM frog on this line.

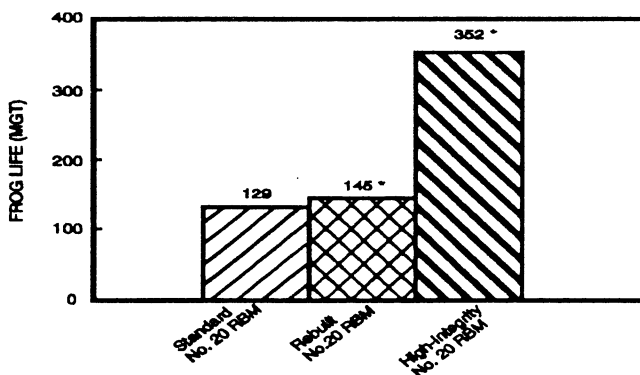


Exhibit 2. Premium No. 10 Spring Rail Frog



NO. 20 FROG LIFE

Exhibit 3 shows the average life of various No. 20 RBM frogs on this line. Since most of the high-integrity frogs, as well as one of the rebuilt frogs, are still in service, a Weibull analysis was used to predict the average lives for the rebuilt and high-integrity



*Mean life estimated using Weibull analysis to account for frogs still in service.

Exhibit 3. Average Life of No. 20 Frogs in Revenue Heavy Haul Service

The high-integrity No. 20 frogs are lasting almost three times the life of standard and rebuilt frogs. Many of these frogs continue to accumulate tonnage and their life has increased from what was previously reported. Until a steady state of high-integrity frog replacement is attained, the true average life cannot be determined. High-integrity frogs were first installed in 1990 on this line. Other factors such as improved maintenance practices and the use of heavier base plates and elastic fasteners may also contribute to this increased frog life.

As reported previously, the rebuilt No. 20 frogs are showing about the same life as the standard No. 20 frogs. Only one rebuilt No. 20 frog remains in service. All standard No. 20 frogs have been removed from service.

Exhibit 4 shows a summary of the frog life statistics. Note that in many cases, the frogs are

still in service accumulating tonnage. It is expected that those life figures will continue to rise. The fact that the premium components perform much better than standard components under heavy haul service complements the experience at the Facility for Accelerated Service Testing.

Frog failures are typically due to excessive batter and shelling of the running surface. They are removed from track when it is deemed more economical to replace them than to repair them by grinding and welding in the field. (Refer to TD 95-002 "Performance of Weld Repairs on Rail-Bound Manganese Frogs in Heavy Haul Service" for more information about the welding maintenance performed on this line.)

TRAFFIC AND TRAIN OPERATIONS

Data was collected over the past 11 years by C&NW on the Powder River Subdivision, between Horse Creek, Nebraska, and Shawnee Junction, Wyoming. Traffic is almost exclusively unit coal trains. The loads make up about 80 percent of the tonnage, all moving eastward, while the empties make up the remaining 20 percent of the tonnage, moving westward.

Speed limit on the line was originally 40 mph in each direction, but over the past three years it has been raised to 45 mph for loads and 50 mph for empties. Speed is limited to 25 mph through the diverging routes of No. 20 turnouts. As a general practice, loads hold the main track and empties take the siding when trains meet; therefore, none of the No. 20s carry more than about 20 percent of the tonnage over the diverging route. Traffic on this line was almost all 100-ton cars with 33-ton axle loads until about 1992. Since then the amount of heavy axle load (HAL) traffic with 36-ton axle loads has gradually increased. (Refer to TD 95-005 "Preliminary Analysis of Car and Wheel Loads in Revenue Heavy Haul Service" for more information about the loads over this line.) At this point it is difficult



Exhibit 4. Frog Life Statistics

| FROG TYPE | NO. OF FROGS | NO. STILL IN SERVICE | FROG LIFE (MGT) | | |
|----------------------------|--------------|----------------------|-----------------|---------|---------|
| | | | Minimum | Average | Maximum |
| Standard No. 10 RBM | 12 | 0 | 14 | 70 | 150 |
| Rebuilt No. 10 RBM | 1 | 0 | 119 | 119 | 119 |
| High-Integrity No. 10 RBM | 2 | 1 | 99 | | 282* |
| Premium Spring-Rail No. 10 | 2 | 2 | 517* | | 705* |
| Standard No. 20 RBM | 25 | 0 | 40 | 129 | 217 |
| Rebuilt No. 20 RBM | 16 | 1 | 39 | 145** | 281 |
| High-Integrity No. 20 RBM | 37 | 26 | 175 | 352** | 465* |

* Frog still in service, accumulating additional tonnage

** Mean life estimated using Weibull analysis to account for frogs still in service

to determine the effects of the HAL traffic on frog life because it is only about 10 percent of the gross tonnage. Also the high integrity frogs have not yet reached a steady state replacement level. As the amount of HAL traffic increases and the high-integrity frogs wear out, the effects of the HAL traffic may become quantifiable.

Frog life results could be considerably different on routes with different traffic mixes, tonnage characteristics, and operating and maintenance practices.

ACKNOWLEDGEMENT

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Note: Contact Duane Offer at (719) 584-0594 with questions or comments about this document.

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