BNSF RAILWAY

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Performance Based Comparison of Hot Box Detector Systems
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We in C&S have always struggled trying to evaluate the performance of Hot Box Detector systems. There are so many variables from one location to another. These variables include but are not limited to the following items:

- Traffic density
- Average speed at the location
- Loading of trains
- Weather conditions
- Geographic differences and detector orientation

If we just compare the total number of hot journal alarms, with nothing found on inspection, the comparison could be misleading.

Traffic Density: If one location has ten trains a day and another seventy-five a comparison of just nothing found stops does not take into consideration the difference, in opportunity for alarms, between the two locations.

Average Speed: If you compare a location where average speed is 45 MPH with a location where average speed is 79 MPH there will be expected differences in performance. Speed has been shown to be a major factor in the cause of failed bearings. (60's test at TTCi by the Department of Navy)

Loading: If you compare a detector location that scans mostly coal trains with a location that scans mostly intermodal trains there will be expected differences in performance. Loading has been shown to be a major factor in the cause of failed bearings.

Weather: On the **BNSF** system we have detectors in areas with extreme differences in climate. This could be as extreme as from Minot, ND to Lafayette, LA. In the winter we could easily see -20 in Minot when it is 60 in Lafayette. There could also be differences in the geographic direction of the trackage and the normal prevailing winds. Is there sun "loading" on one side of the train or a cold prevailing wind on one side of the train that can cause one location to perform different from another ?

We can not control or even normalize all of these variables in a comparison of detector performance. We do need to understand what affects detector performance and normalize as many variables as possible. We must also keep in mind that to our internal customers the only criteria that really matters is: “don’t stop my train unless you have to”.

On BNSF there are currently seven different models of HBD systems in use. There is a need to compare the performance of these systems and to improve “velocity” by ether removing poor performers from the system or to correct issues with those systems.

“If you can’t measure it you can’t fix it !”

One of the things we have always wanted to do was to compare performance based on total axles scanned by each system. This seams like a reasonable way to normalize performance. The issue I have had is there is no convenient way to capture the total axles by each HBD location on BNSF systems. All detectors are not currently reporting in to our Warm Bearing system and total axle count is not a statistic that is currently available.

To get a better understanding of HBD performance on BNSF I decided to see what information was available and see how I could leverage it to try to answer that question.

One thing I found is that on BNSF we do have our railroad system covered with AEI readers. All of these systems report in information on each train that they process. One of the pieces of information they provide is axle count for each train. This information is kept in “Data Warehouse”. I was able to get a query that would provide me a report with each AEI reader and the total axle count per month that had passed that location.

What I found was that this was over 800 records per month and there were issues in the way it was reported. First if this was a two or three track system it was reported individually by track rather than by total per location.

I don’t claim to be an “expert” on Access but that is the data base tool that is part of BNSF standard image for our computers. I have a HBD data base that is in an Access table. One of the unique things in this data is there is **TWD** number assigned to each specific HBD location. This information is used for reporting, stops by hot box detectors, in the BNSF dispatching center in Ft.Worth, TX.

The first thing I had to do was make a new table that would show each HBD location TWD number and the nearest AEI location. This table would be used to make an association of the axle count at an AEI location and apply it to a HBD location. I could then “link” the three tables, HBD Data, TWD-AEI association, and AEI axles together. This creates a query that shows TWD number and axle count. The problem is there are multiple entries for some locations.

Sometimes training is good ! While I was taking an advanced users class on Access I found the key to what I needed. In Access it is called a “Crosstab Query”. What you can do with that is “sum” all fields with the same TWD number. I then had all the information I needed.

This allows me to calculate the total number of axles for each type of system.
Note: For 2005 BNSF had almost **3 billion** axle scans.

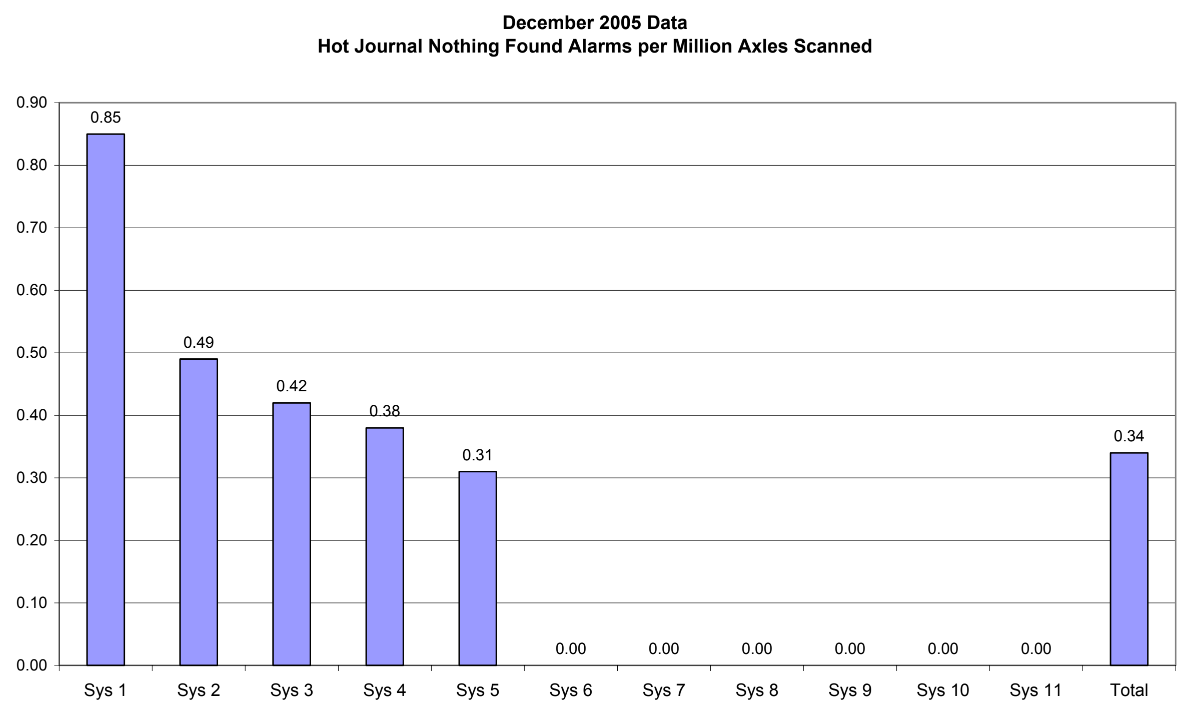
I have another report I get that shows all the HBD delays for the month. This report has the HBD TWD number, the type of alarm, and the result of the crew's inspection. I link that with my HBD data and then I have the type HBD system for each alarm. With this information I can calculate the total number of nothing found stops for each type system.

With these two reports I can then calculate and graph the performance of each type system based on per million axles scanned. This is then my definition of DPMO.

Please note. I did not want this presentation to be interpreted as my recommendation for which type detector performs the best. Your performance my be different based on many factors. Including but not limited to the following items:

Maintenance procedures
Alarm levels
Operating software in your HBD systems
Train speeds
Train Loading

The following chart has been "sanitized" to remove the HBD model and manufacture from the information shown. The chart is based on actual BNSF RR performance of the 11 current types of HBD's in service.



As information a **DPMO** of 3.45 = **6.0 Sigma**.

The shown performance of a **DPMO** of 0.34 = **6.47 Sigma**.

I use this same procedure for dragging equipment nothing found stops and Integrity Failures.

This information then is one of the tools that I use to evaluate which systems need to be replaced or upgraded. In addition I can see which are my worst acting systems and concentrate on improvements to those systems.

In conclusion we all know how important train velocity is to efficient movement of trains and utilization of existing infrastructure. Train delays caused by hot box detector alarms, with nothing found on inspection, are one of the major causes of reduced velocity. Some form of performance based comparison of Hot Box Detectors is critical to improving train velocity. A comparison based on a DPMO of nothing found alarms per million axles scanned is one way to normalize that data. This will provide one additional tool to help prioritize our limited resources and get the "most bang for our buck" out of our detector systems.