Engineering Solution(s) to Mitigate/Eliminate Incidents of Loss of Shunt at Highway-Rail Grade Crossings

Presented August 15, 2017
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Loss of Shunt

Train fails to establish and/or maintain an electrical current path between its running track rails.
Wheel – Rail Mismatch
Ice and Snow
Leaves

Trash
Sand
Chemical Spills
High Speed Trains
Jaw Tooth
https://www.youtube/watch?v=REA_qY-wrig
Fair Use Access 08/11/2017

Loss of Shunt?
Loss of Shunt?

owensri2
https://www.youtube/watch?v=GeBRd4BbjmI
Fair Use Access 08/11/2017
AMR magnetometers are all around us

Most cell phones
All smart phones
cell phone compass applications rely on AMR magnetometers
Anisotropic Magneto-Resistive (AMR) Magnetometer

Anisotropic
Wheatstone bridge configuration of four magneto-resistive elements
Bridge output varies with the direction of magnetic flux applied to the bridge elements
Moving & stopped trains are magnetic events

Whether moving or stopped, trains bend the earth’s magnetic field

AMR sensors generate output waveforms that describe the movement of the earth’s magnetic field at the sensor

Sensor output waveform is flat when the earth’s magnetic field does not change
Wisconsin & Southern Railroad
Johnson Street Yard – Madison, Wisconsin

Main test site house

Solar powered remote test site
sensor data transmitted to main site by data radio
Sensors detect stopped trains

Single locomotive
1. moves toward sensor
2. stops over sensor
3. reverses direction
4. moves beyond sensor
Metra Electric Trains – Visually Similar – Magnetically Different
Speed Sensor prototype circuit board

Two – three dimensional AMR sensor groups placed 2-1/2 inches apart
Each group measures the earth’s magnetic field 250 times each second
Train Detection and Speed

Speed: mph
Duration: sec
Length: ft
Speed Sensor Detection

• Amtrak 36
  • Southbound at Rockland Road – Metra Rail
  • March 9, 2017 – Roundout, Illinois
• Direction detection = southbound
• Entrance detection speed = 68.9 mph
• Exit detection speed = 57.0 mph
• Detection event length = 7 seconds
  • 08:59:57 to 09:00:04
• Calculated train length = 720 ft
  • Two locomotives and seven cars = 733 ft
    • 98.2% match
Speed Sensors do **NOT** need TRACK RAIL CONNECTIONS
Speed Sensors do **NOT** need Bonded Rail Joints
Speed Sensors do **NOT** need Insulated Rail Joints
Speed Sensors do **NOT** need Insulated switch rods.
Speed Sensors do **NOT** need Insulated gauge plates
Speed Sensors do **NOT** need Insulated gauge rods
Speed Sensors do NOT need

- Track Diodes
- Narrow Band Track Shunts
- Wide Band Track Shunts
- Tuned Joint Couplers
- Hardwire Track Shunts
Speed Sensors do **NOT** need Impedance Bonds
Speed Sensors are **NOT** affected by Ice or snow or roadway salt

Ballast and rail condition is not a performance factor for Speed Sensors
Speed Sensor performance

Is NOT affected by:

- Rusty Rails
- Debris or foreign matter on Rails
- Ice & snow on rails
- Wheel – Rail interface
- Train Length
- Train Weight
- Train Speed
- Track Ballast Condition
- Detection Zone Length
- Harsh track environments
- Severe weather
Speed Sensor Operation
does not interfere with the
normal operation of
conventional signal devices
Speed Sensor Advantage

- Detects ALL rail cars and trains, including runaway cars
  - No on-board train equipment required
  - Requires no data input from remote processors or train devices
- Fully modular – Speed Sensor + Node Processor + Radio + Power source
- Continuously monitors its detection space
- Train detection zone length is limited only by radio range and practicality
- Permanent installation up to 48” below top of tie
- Temporary installation – place sensor on top of ballast