Reducing Subway Wheel Flats - Line 2
Community Update

Fall 2019
Subway noise and vibration (N&V) is a by-product of subway operations

Two main sources of N&V:
- Rail Infrastructure (i.e. track condition, crossovers) - confined to a short section of line
- Rolling Stock (i.e. vehicles) - along the entire line

Update for today’s meeting.

Dominant factor contributing to N&V since October 2018

TTC operational practices and maintenance procedures have been developed that aim to reduce operational noise and vibrations.
TTC action to proactively reduce N&V

Inspection Activities

• Track Level Patrol and Riding Patrol
• Condition Based Monitoring (CBM)
• Rail Wear
• Rail Surface Corrugation Measurements (CAT and Vibration Train)
• Track Geometry
• Wheel monitoring (AURA)

Maintenance Activities

• Rail Replacement, grinding and milling
• Uneven Joint Repair/Replacement
• Rail lubrication (reduce rail wear and squeal at curves)
• Wheel truing / replacement

Some level of N&V is expected adjacent to subway operations – cannot be fully eliminated.
Wheel Flats

- Wheel Flats have a “thumping” sound and generate vibrations
- The larger the flat, the louder the thumping sound and the greater the vibrations
Wheel Flats - Background

- Expected in rail industry
- Average Backlog
  - 15 cars or 2.5 trains (4% of total fleet)
- More common in autumn (seasonal trend)
- Increase in backlog
  - 30 cars or 5 trains (8% of total fleet)

LINE 2 SERVICE REQUIREMENTS

- 45 Trains – Required for Service
- October 2018 – 90% of Fleet had Moderate to Severe Flats
- Impact to service and community along subway alignment
Wheel Flats – Causes

- Metal on metal sliding action:
  - Low traction rail conditions and
  - Emergency Brake (EB) application

Loss of traction and no wheel rotation (EB Brake) will result in wheel sliding along the track to create flat spots.
Causes of Low Traction

- Wet rail, leaves, snow, and over-lubrication can cause areas of low traction.
Causes of Emergency Brake (EB) Applications

• Operator Induced
• Speed Control System (SCS) Induced:
  ➢ Spin/Slide (Similar to traction control in automobiles)
  ➢ Over Speed (Similar to speed governor in automobiles)
  ➢ Signal Violation (Similar to collision avoidance system in automobiles)
Wheel Flats - Monitoring System

AURA Wheel Flat Detection System

• Installed on Line 2 in 2012 and Line 1 in 2015
• Early warning detection system
• AURA identifies axles and color codes according to severity of wheel flat (RED = Most Severe)
• Trains with red flats are the most severe and are removed from service as soon as possible
Repairs for Wheel Flats

- Wheels are ‘machined true’ to remove flat spots and return wheel to round
- Maximum of 6 axles (12 wheels) can be machined per 8 hr shift
- New wheel diameter = 28”
- Condemnation diameter = 25.375”
- Average Life = 4 Years (T1 Fleet)
- TTC has 2 wheel turning machines for subway vehicles located at Greenwood Carhouse and Wilson Carhouse
Impact To Community

• Starting in October 2018, an extraordinary increase in subway noise and vibration complaints were received across Line 2.

• Reports from area residents of increased N&V; frequency and levels.

• This situation was not limited to one specific section of the subway network.

• Wheel flats were not a prominent source of complaints prior to October 2018.

• No “smoking gun” found during TTC investigation into root causes of wheel flats.
Impact To Community

6 wards affected by noise & vibration

October 22, 2019
Wheel Flat - Investigation

Vehicles:
- Inspection of wheels
- Inspection of brake pads
- Testing of acceleration & brake rates
- Review of data for propulsion faults
- Review of data for EB applications

Track:
- Inspection of rail
- Inspection of wayside lubricators
- Inspection of speed control system

October 22, 2019
Action Items from Investigation

Vehicles:
• Investigation – re-design of master controller
• Replacement of brake pads
• Installation of vibration sensors on bogies/trucks

Operators:
• Supervisor audits
• Reminder campaigns

Track:
• Cleaning of rail
• Turning off of lubricators – to eliminate grease as significant contributor
• Testing of top of rail friction modifier
• Added SCS and Un-Equipped Mode (UEM) tags
• Implement restricted speed zones

Other:
• Consulted with peer agencies
• Hired Network Rail to assist with investigation
Action Plan

• Continue with action items already implemented
  - Testing of brake pad materials
  - Installation of mobile sensors on bogies/trucks for additional data collection
  - Cleaning of rail
  - Replacement of lubricators and testing of top of rail friction modifiers
  - Operate in accordance with weather conditions
  - Add additional SCS tags

• Continue investigating potential design improvements to:
  - Master Controller
  - Speed Control System
• Since mid-March 2019 the rate of new wheel flat occurrences and the total number of flats has trended downward.

• As of July 2019 TTC had been operating trains on Line 2 without severe or moderate wheel flats.

• TTC continues to monitor subway wheel flats daily and has noticed a slight increase in recent weeks (August). Moving into the fall season, it is common in the rail industry to see an increase in wheel flats.
Observations & Results - Wheel Flats

- Downward trend in wheel flats
- No trains in service with moderate or severe flats
- Wheel truing machines under maintenance for two weeks in August.
- Minor increase in flats expected in Autumn that will result in some flats heard on in-service trains.
Next Steps - Wheel Flats

• TTC will continue collaborating with other reputable N&V consultants.

• Continue regular inspections and monitoring of vehicles.

• Efforts made to avoid placing vehicles with RED flats into service.

• Expect small increase in wheel flats during Autumn season.
Questions

• Do you have any questions related to Wheel Flats or the presentation?

• Other subway N&V concerns, kindly email diego.sinagoga@ttc.ca or paul.tran@ttc.ca or call TTC Customer Service 416-393-3030.

  o If possible, please provide a description of any sound pattern you hear when subway train pass your home, as well as your address and contact information so that we can contact you to discuss further.