Journey into quality for traffic monitoring equipment

Short session monitoring operations
Introduction

- Quality assurance/quality control for short session portable equipment.
- Historically, quality assurance/quality control consisted of reliance on manufacturers’ data and advice and on-site traffic observation and recorder response at each installation.
Pneumatic tube sensors

- Pneumatic sensors are used exclusively for short session vehicle volume and vehicle classification monitoring.
- Pressure testing for subtle air leaks after each monitoring session.
- Sources of subtle leaks are pinholes and unexpectedly the knots tied in the pneumatic tubes.
Volume recorders

• Effectiveness of a quality control process using an air pulse generator.
  – No defective recorders were found during the 2000 tests conducted.
  – However, in the same period, several defective recorders were detected and removed from service during the observation of the traffic and the recorder response immediately after each installation.
  – It demonstrates that few if any volume recorders are subject to subtle failure.
  – The process was discontinued.
Classification recorders

• Quality testing evolved
  – Visual observations versus recorder results
  – Comparison testing of several recorders

• Search for a standard of reliability
  – HPMS sample size standard
  – Recorder error measured
  – Daily and seasonal traffic variation
  – Air switch sensitivity issues
Classification recorders: Quality testing evolved

• Visual observations are compared to the recorder results.
  – This follows an AASHTO guideline.
  – Reasonably assures recorders are operating similarly or normally.

• Comparison testing was made for several recorders operated simultaneously.
  – Up to 22 pneumatic tubes are installed on 1 foot centers in 2 lanes of a 4-lane rural interstate.
  – Malfunctioning recorders discovered are removed from service.
  – An unexpected amount of random variability discovered among recorders.
Classification recorders: 
Search for a standard of reliability

- HPMS sample size standard
  - For rural principal arterial interstate the precision level is (90-5)
  - The universe from the comparison test procedure was the number of 48 hour periods in a 3 year monitoring cycle.
  - The resulting sample size is the number of recorders required per monitoring session.

- Recorder error measured
  - The variability or dispersion of the data from the comparison test among a sample of recorders is a measure of the recorder error.

- Daily and seasonal variation
  - Current testing is a series of 24 standard short sessions over a year to measure traffic variation clouded by the recorder error.

- Air switch sensitivity issues
  - 20 Hz versus 30 Hz sensitivity air switches
  - Tandem axle detection (4 foot spacing): 55 mph – 81 mph
Weigh in motion recorders

- Portable configuration used
- Biennial calibration process
- Quality control initiated during calibration
Weigh in motion recorders:
Portable configuration used

- Two piezoelectric cables are located on the pavement in the outside lane.
  - The cables are placed in pocket tape.
  - The pocket tape is spaced 11 feet apart.
  - A conventional vehicle classification is performed.
  - Each axle is weighed twice and averaged.
Weigh in motion recorders: Biennial calibration process

• Calibration procedure
  – The weigh in motion (WIM) test site is set up down stream from a permanent enforcement static scale accurate within 1%.
  – Type 9 vehicles are weighed on the static scale and then weighed with the WIM equipment.

• Calibration process
  – The scale factor is adjusted until the mean of the algebraic differences between the static and WIM gross vehicle weight of the sampled (approximately 20) vehicles is zero.
  – The standard deviation of the algebraic differences between the static and recorder gross vehicle weight of the sampled vehicles is estimated for use in the pavement design process that is reliability based.
Weigh in motion recorders:

Quality control initiated during calibration

• Systematic error discovered
  – Type 9 vehicles vary in weight between approximately 34,000 pounds empty to 80,000 pounds - the legal maximum weight.
  – A scatter diagram of the static scale gross weight versus the WIM gross weight of each vehicle in a full spectrum of vehicle weights demonstrated the existence of a systematic error.
  – To avoid underestimating the effect of vehicle weight, the calibration was accomplished with Type 9 vehicles with a gross weight between 75,000 and 80,000 pounds.
  – With this calibration, Type 9 vehicles with a static scale, gross weight of 34,000 pounds was estimated by the WIM at approximately 48,000 pounds.
  – The coefficient of variation with the systematic error was 3.04 and 1.87 without it.

• New portable WIM equipment on the market that works.
Conclusion

• Our short experience with quality assurance / quality control has led to substantial improvement in the quality of the traffic monitoring data.
  – Improved operating procedures.
  – Better understanding of the equipment.

• A fringe benefit has been a rewarding and educational experience for technicians and supervisors participating in the process.
  – Understanding the importance of accurate data and what it takes to get it.
  – Appreciation of the importance of accurate data to the Department’s engineering applications.