Observations Quartz Piezoelectric WIM

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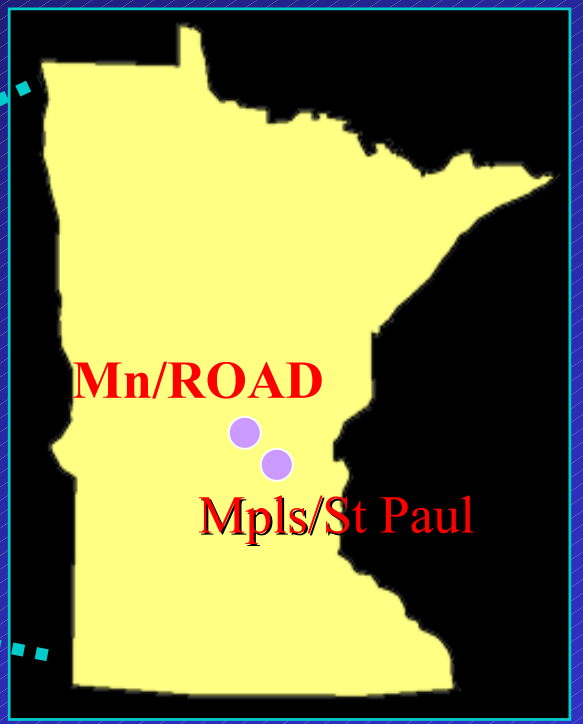
65 km Northwest of Minneapolis / St.Paul

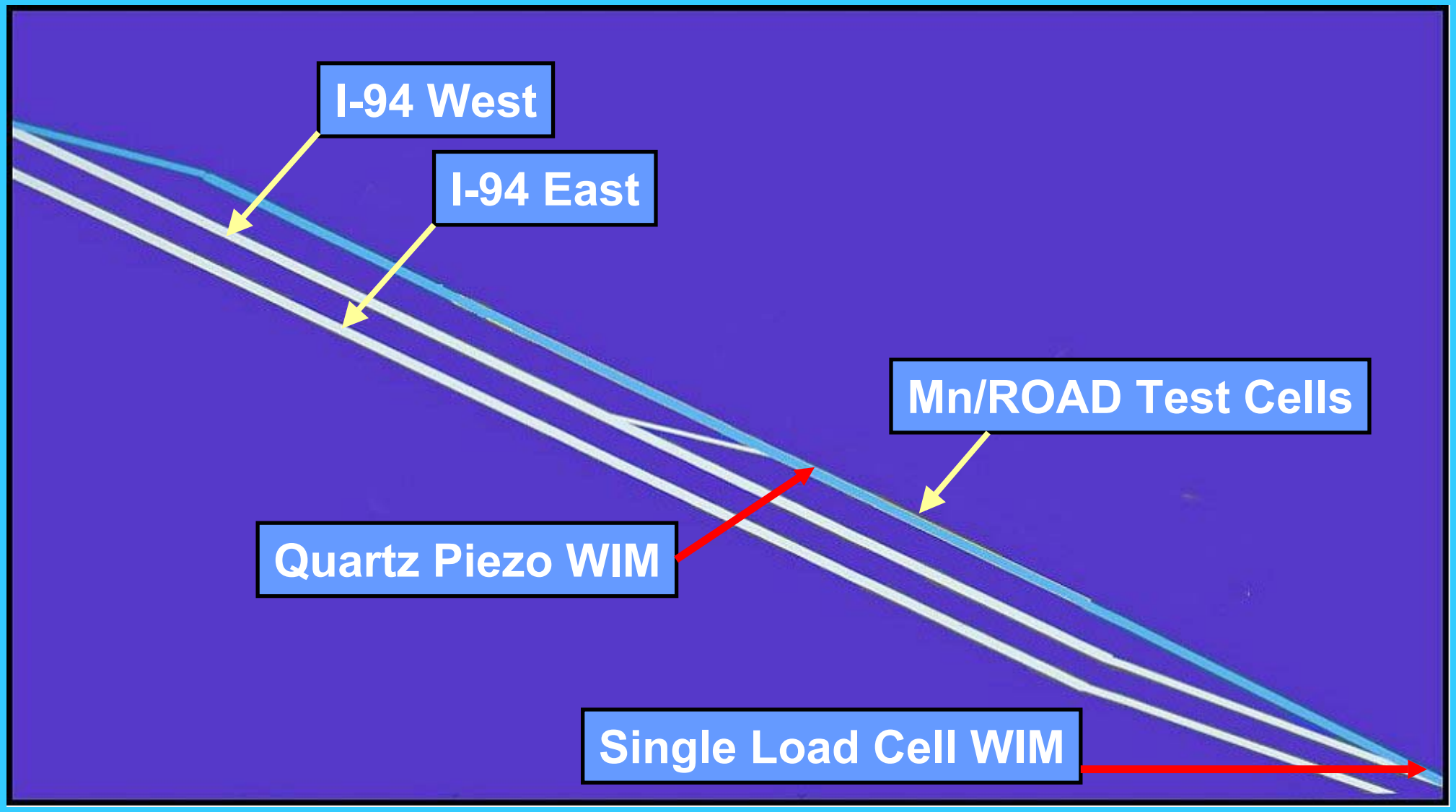


Introduction

- **Background**
  - Need for new equipment
- **Calibration Efforts**
  - Description of site
  - Comparison to SLC
- **Oberservations**
  - Configuration
- **Conclusions**

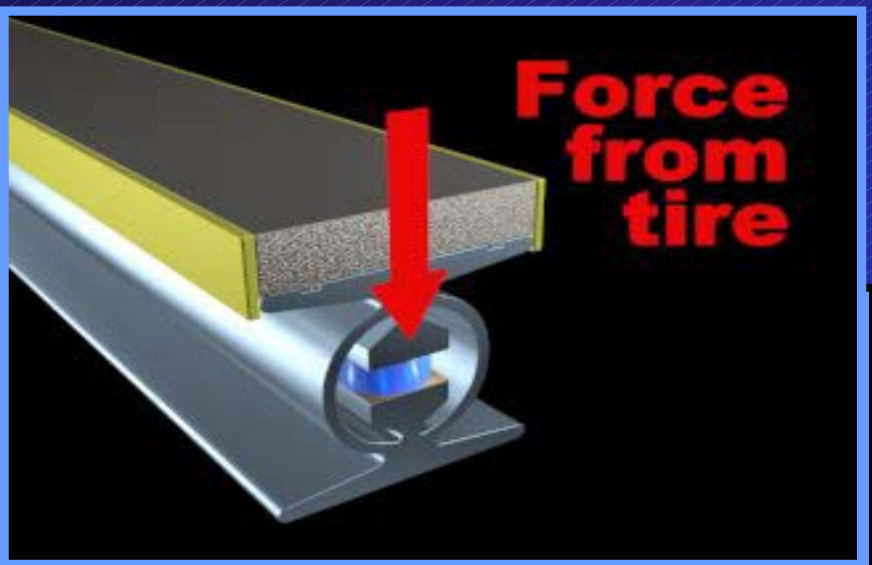
Mainline Traffic
I-94 Westbound

Data Collection Locations




Quartz Piezoelectric WIM

Kistler LINEAS



http://www.ornl.gov/dp121/hswstill.htm

- **Quartz Piezoelectric Sensor**
  - Pre-stressed quartz crystals
- **Same computer hardware and software as old system**
  - International Road Dynamics, Inc.
- **Tested in Europe**
  - Durable under extreme conditions
  - Not sensitive to thermal and aging effects
- **Four year study in Connecticut**
  - Final report presented at this conference

Manufacturer's Claims

- Not significantly sensitive to temperature changes
- Suitable for traffic at any speed
- Long term stability
- Can be ground and reground up to 1cm (.4 in) to match road profile and new deformations

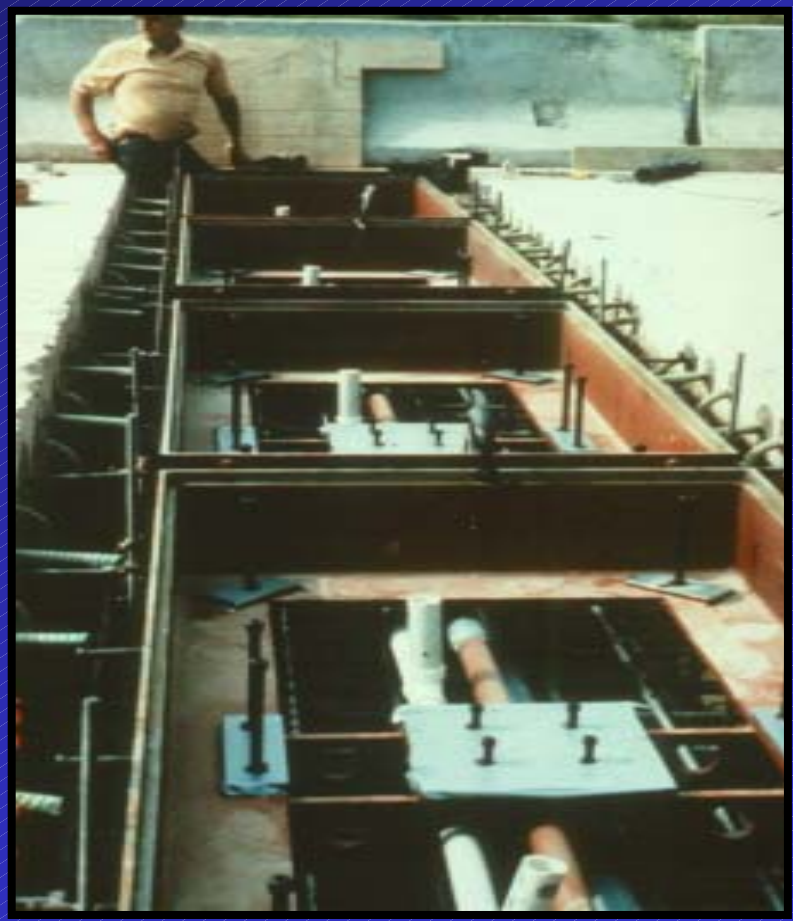
WIM Cost Comparison

- Single Load Cell
  - ~$200,000 in 1988
    - Lane closure for several days to construct concrete vault
  - routine maintenance
    - 32 hours / year + travel
  - $25,000 + shipping to refurbish one out of four scales
    - Boom truck and crew
    - Shipping 2000 lb scale

- Quartz Piezoelectric
  - ~$50,000 in 2001
    - 6 hour lane closure
  - no routine maintenance
    - Other than inspection of pavement and wiring
  - $2,000 to replace one of sixteen sensors
    - Weighs less than 5 lb
    - If sensor goes bad, cut it out and replace

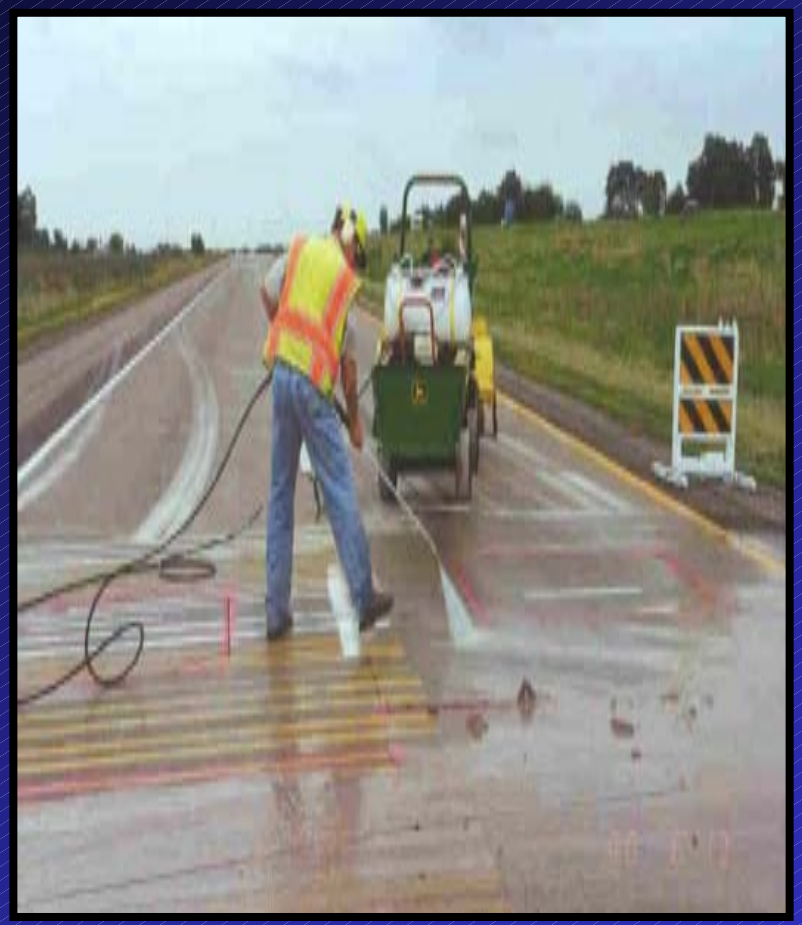
Pavement Preparation

Single Load Cell



Pavement Preparation

Quartz Piezoelectric

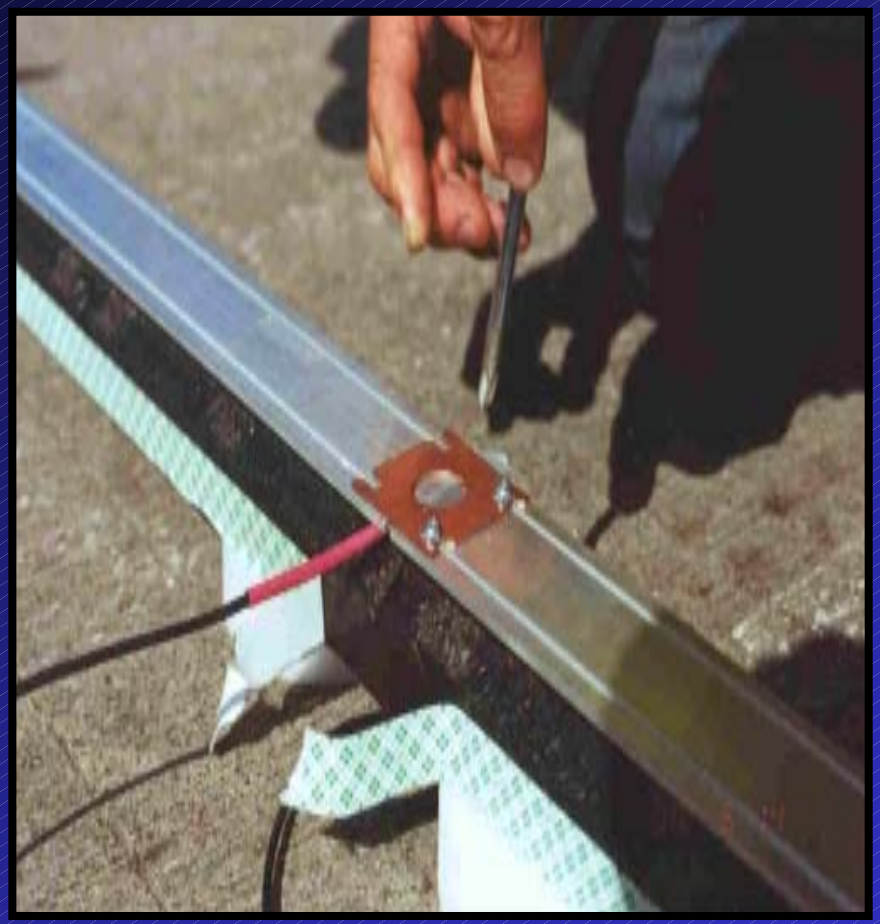


Sensor Assembly

Single Load Cell

Sensor Assembly

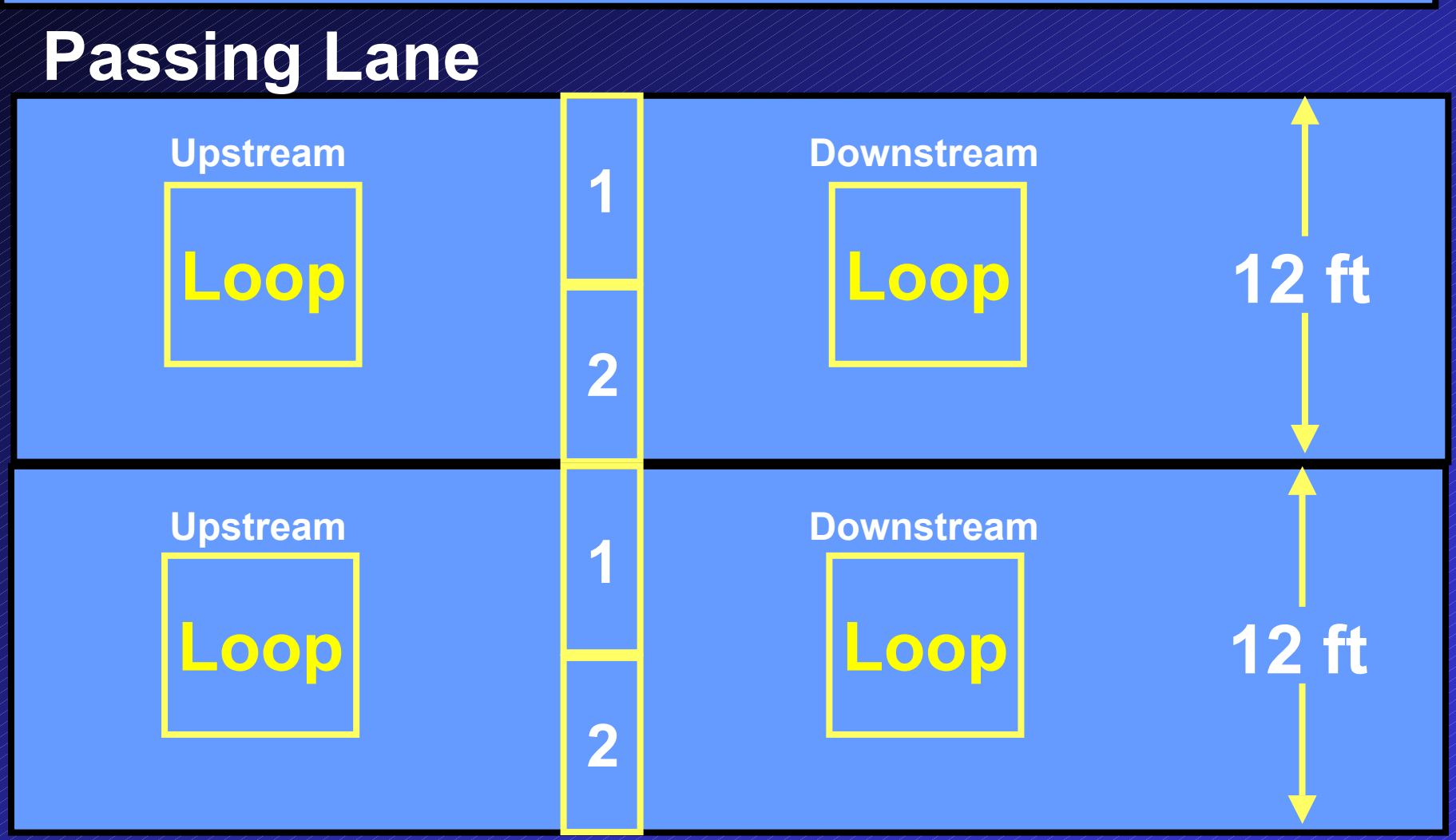
Quartz Piezoelectric



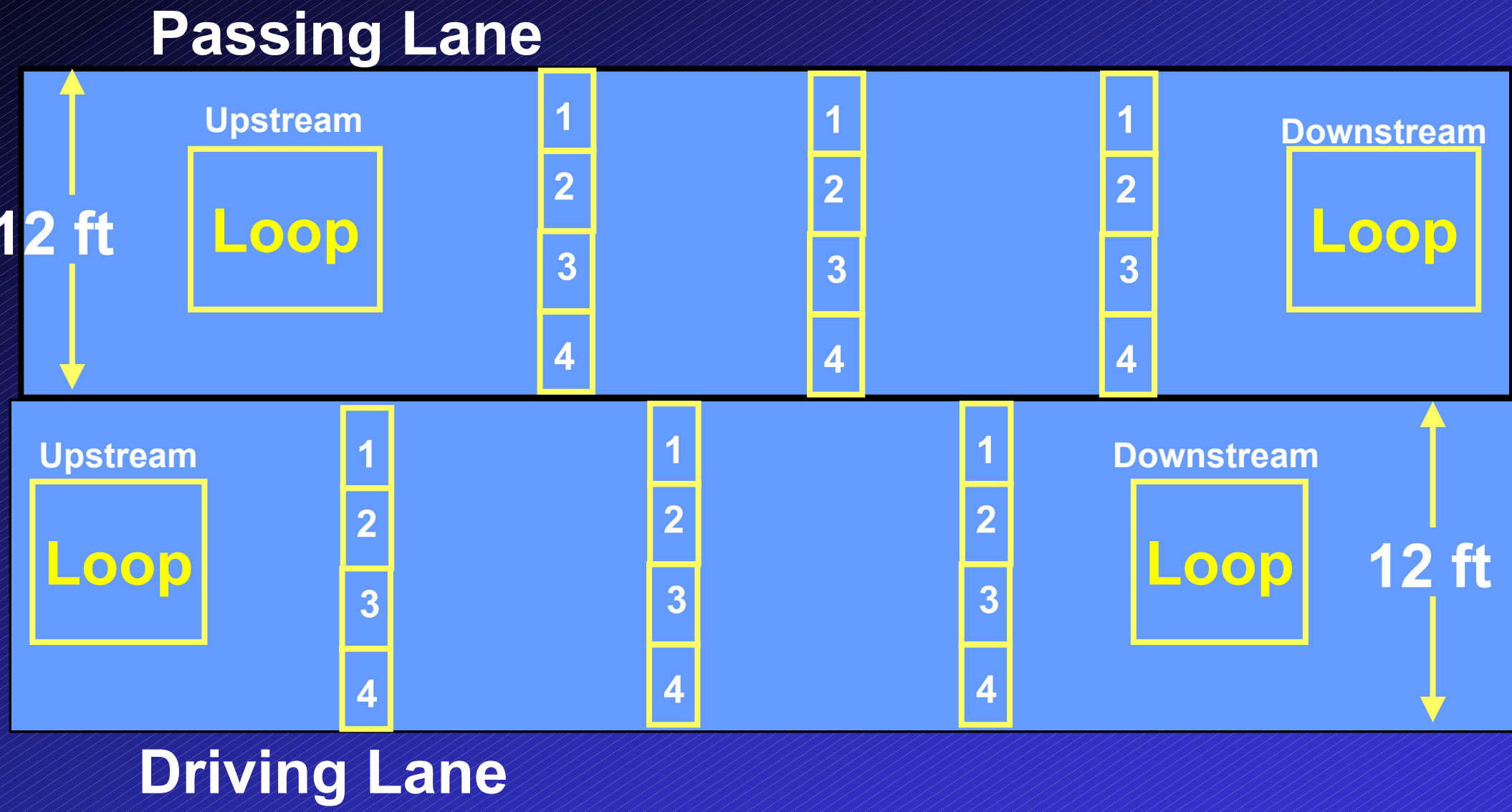
Calibration Testing Fall 2001 Both Systems

- **Mn/ROAD Test Truck (Five Axle Semi)**
- **Static Gross Vehicle Weight = 79,719 lbs**
  - Steer ax = 12,261 lbs space = 17.5 ft
  - 2nd axle = 16,936 lbs space = 4.3 ft
  - 3rd axle = 16,842 lbs space = 31.9 ft
  - 4th axle = 15,873 lbs space = 4.1 ft
  - 5th axle = 17,854 lbs

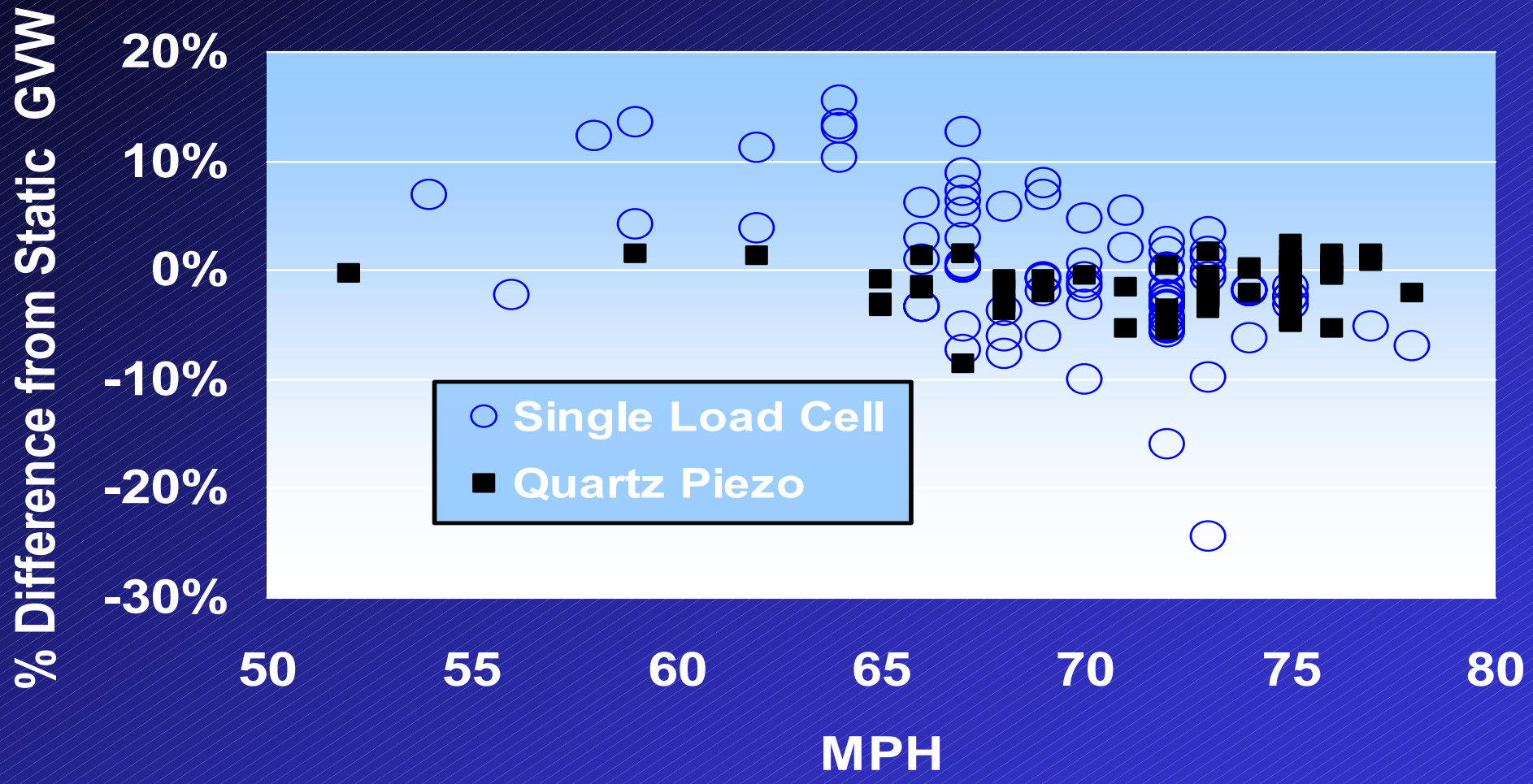
Single Load Cell Configuration



2001 Quartz Piezo Configuration



Speed Sensitivity Fall 2001
Both WIM Systems

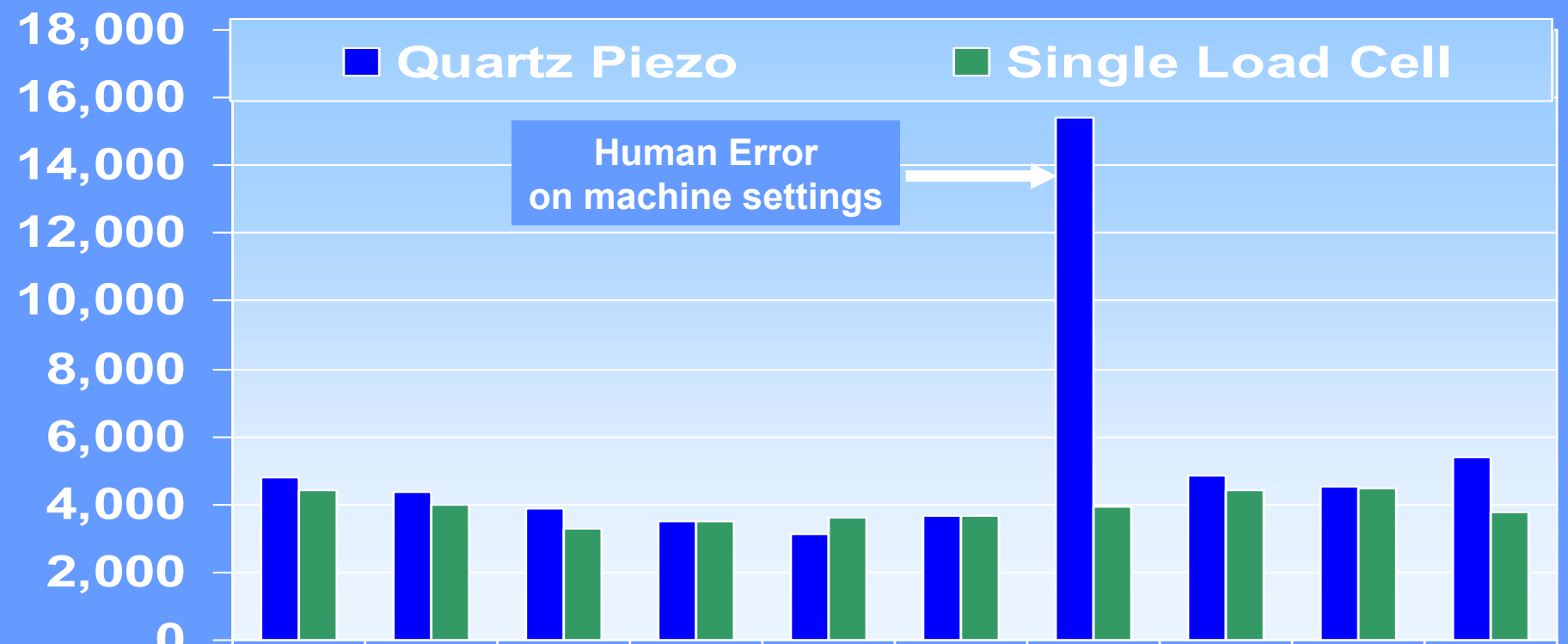


Data Comparison

- Similar distribution five-axle semi Gross Vehicle Weight
- Similar total all vehicle and truck volume
- Similar total five axle semi volume
- Similar flexible ESALs
- **CONCLUSION:** Both systems are adequate for measuring traffic under current standards
- "A Comparison of Data collected by Two Weigh-in-Motion (WIM) Systems Monitoring Identical Traffic on the Same Segment of Roadway"
  - Report: Authors: Curtis Dahlin and Margaret Chalkline

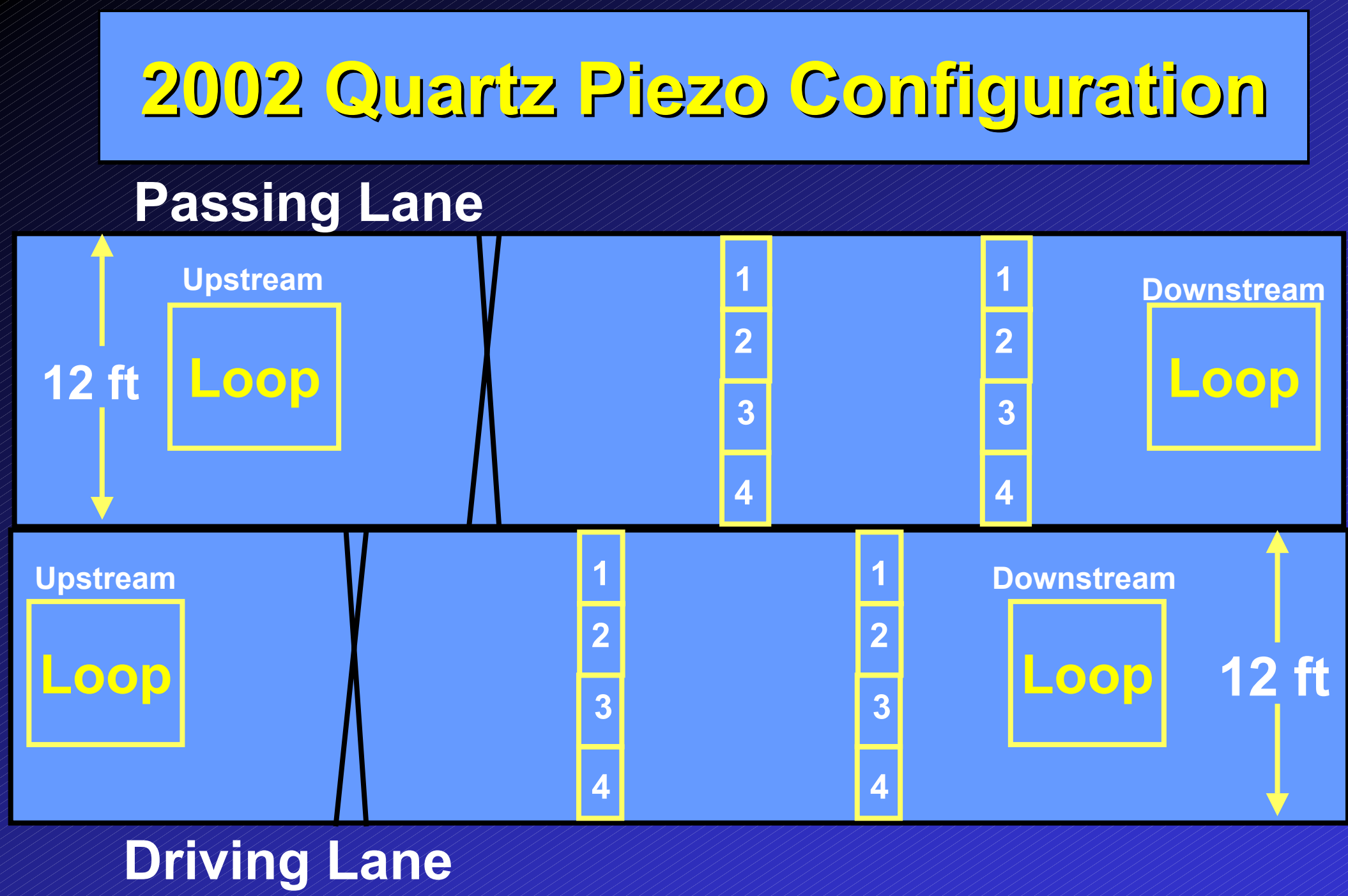
Comparison of ESALs

*Driving Lane no estimated data

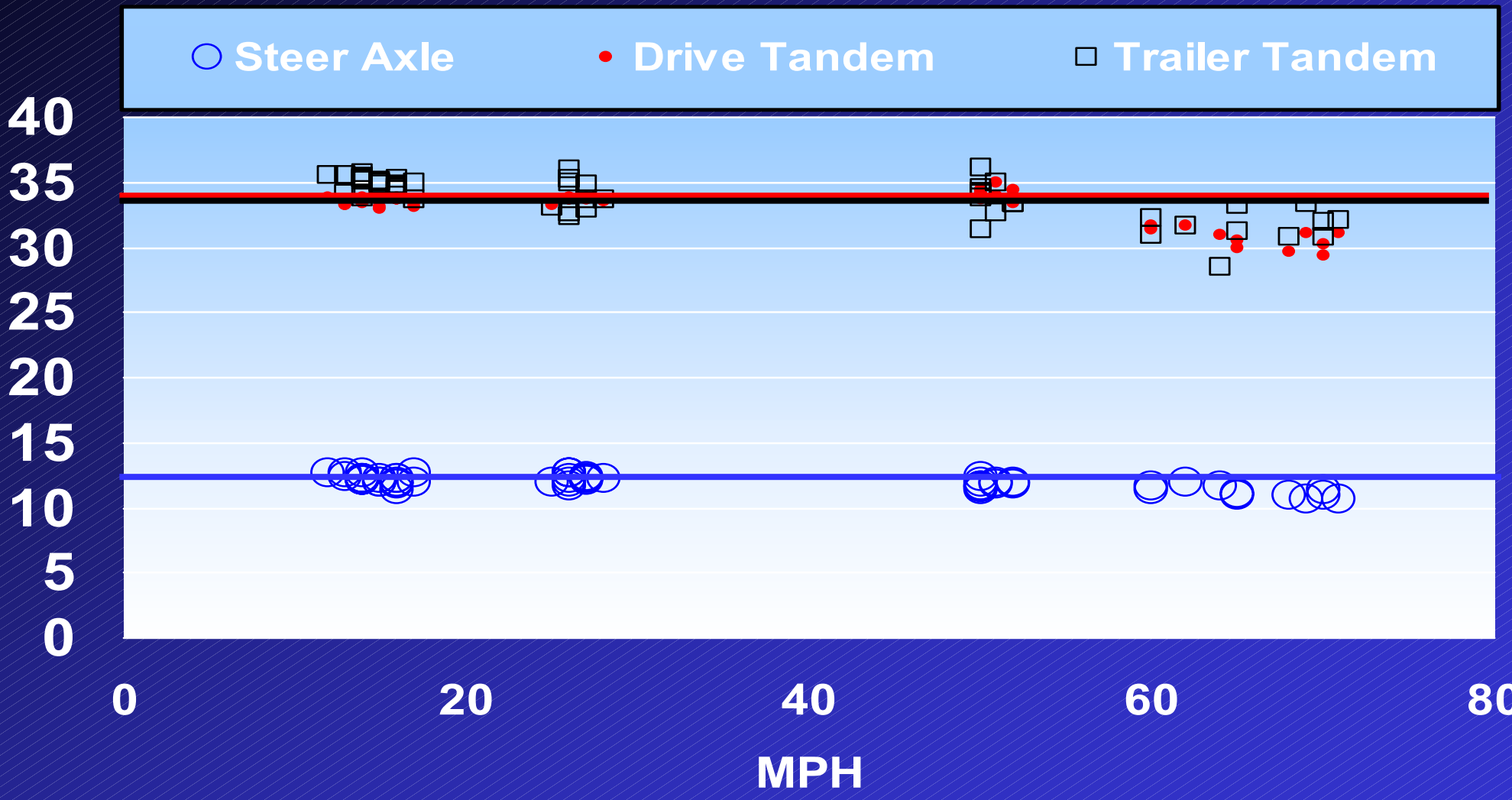


Quartz Piezo Spring 2002 Calibration Testing

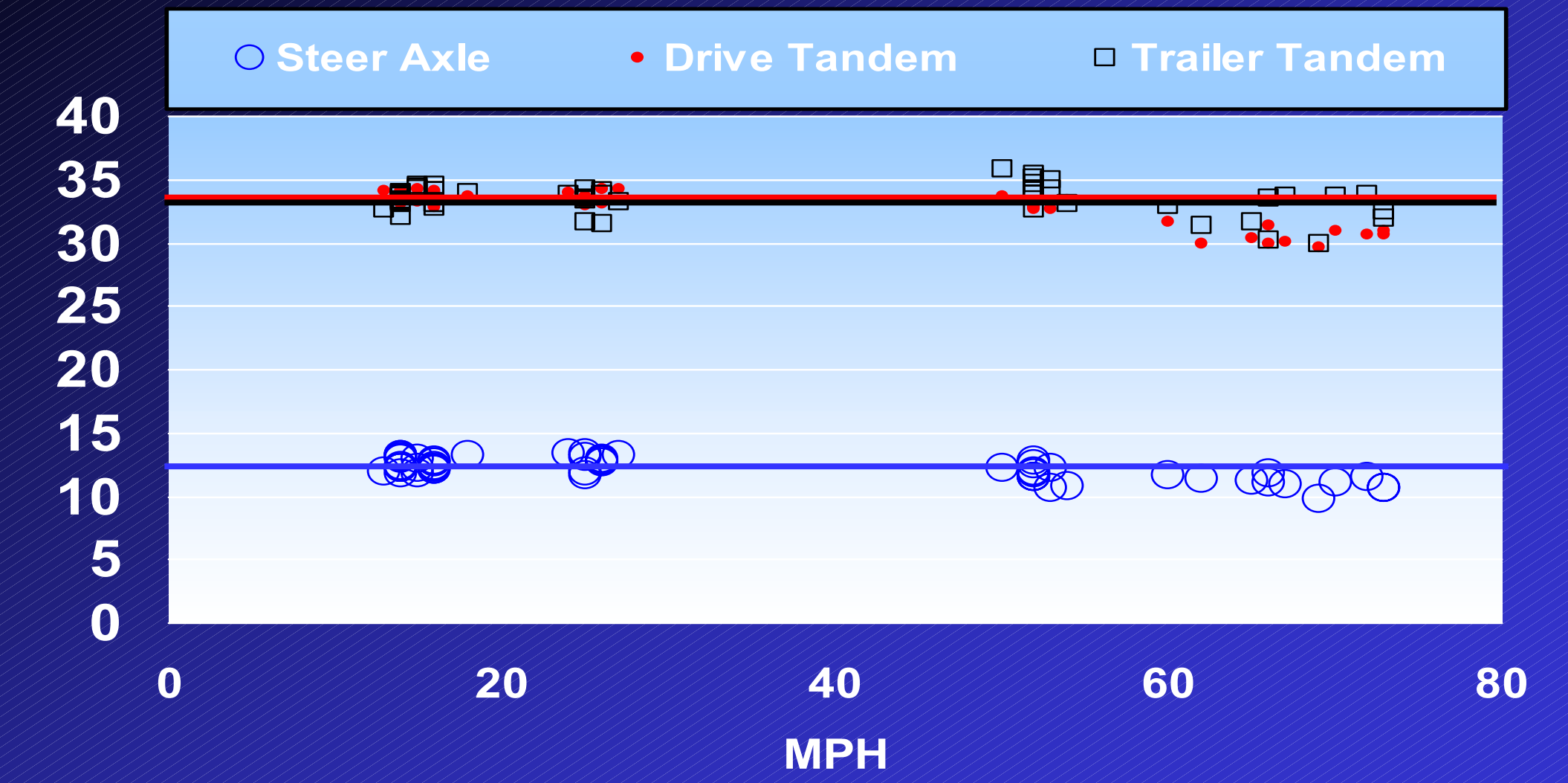
2002 Quartz Piezo Configuration



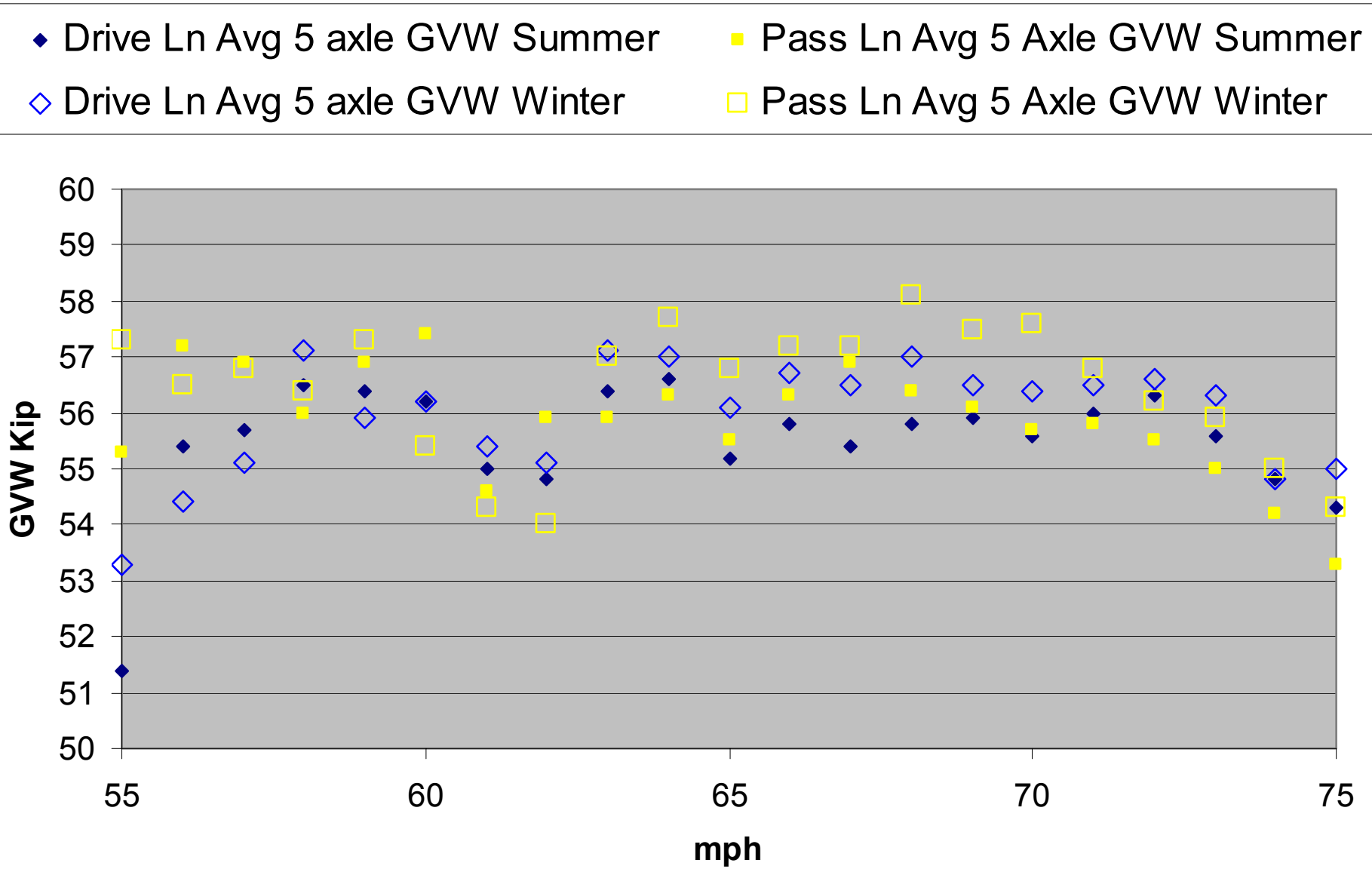
Quartz Piezo Spring 2002 Driving Lane



Quartz Piezo Spring 2002 Passing Lane



Five Axle Semi GVW vs Speed



Conclusion

- **The Quartz Piezoelectric System is a cost efficient replacement for the Single Load Cell WIM system**
  - Not using autocalibration, no noticeable drift
  - Long term durability not determined in this case
- **The interaction of the vehicle with the roadway profile hampers the accuracy of any weigh-in-motion system.**

Mistakes Made

- **Still searching for the optimum sensor spacing and configuration**
- **Needed more intense tech support**
  - Configuration,acceptance testing, calibration
  - Training and documentation
- **Pavement cracked during installation**
  - More care needed boring for wire feeds
- **The 36 feet between the loops in each lane generate false-positive tailgating errors.**
- **Sensors are not temperature sensitive but…**
  - Data collection computer temporarily shut down due to heat in the summer before cooling/heating system was installed

Side Notes

- **During 2001 Calibration on the Quartz Piezo**
  - Ran the truck in the reverse direction in each lane
  - No noticeable difference from rest of data (10 passes)
  - Accurately weighed truck between 2 and 5 mph but less than 2 mph generated error
  - Passes with tire on shoulder joint or center line, acceleration and decelerations made no noticeable difference in weight
  - Could not perform these scenarios on the Single Load Cell because of live traffic

The Future

- **Install More Quartz Piezoelectric Systems**
  - various sites in the near future.
- **New Data Processing System**
  - Testing Oracle Data Warehouse system
- **Partner with other agencies**
  - Over Weight Vehicle Permits
  - Design Build Warranties
  - Law Enforcement
  - Live Traffic Cameras

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