Appendix A

IRISystem Photographs

Figure A-1. The IRISystem, showing the housing minivan, and the camera mount on the roof (Photo courtesy of J. Bibb).

Figure A-2. The IRISystem minivan interior with video screens, VCRs and the joystick which operates the camera.

Figure A-3. The IRISystem, set-up at a scale site in Kentucky.

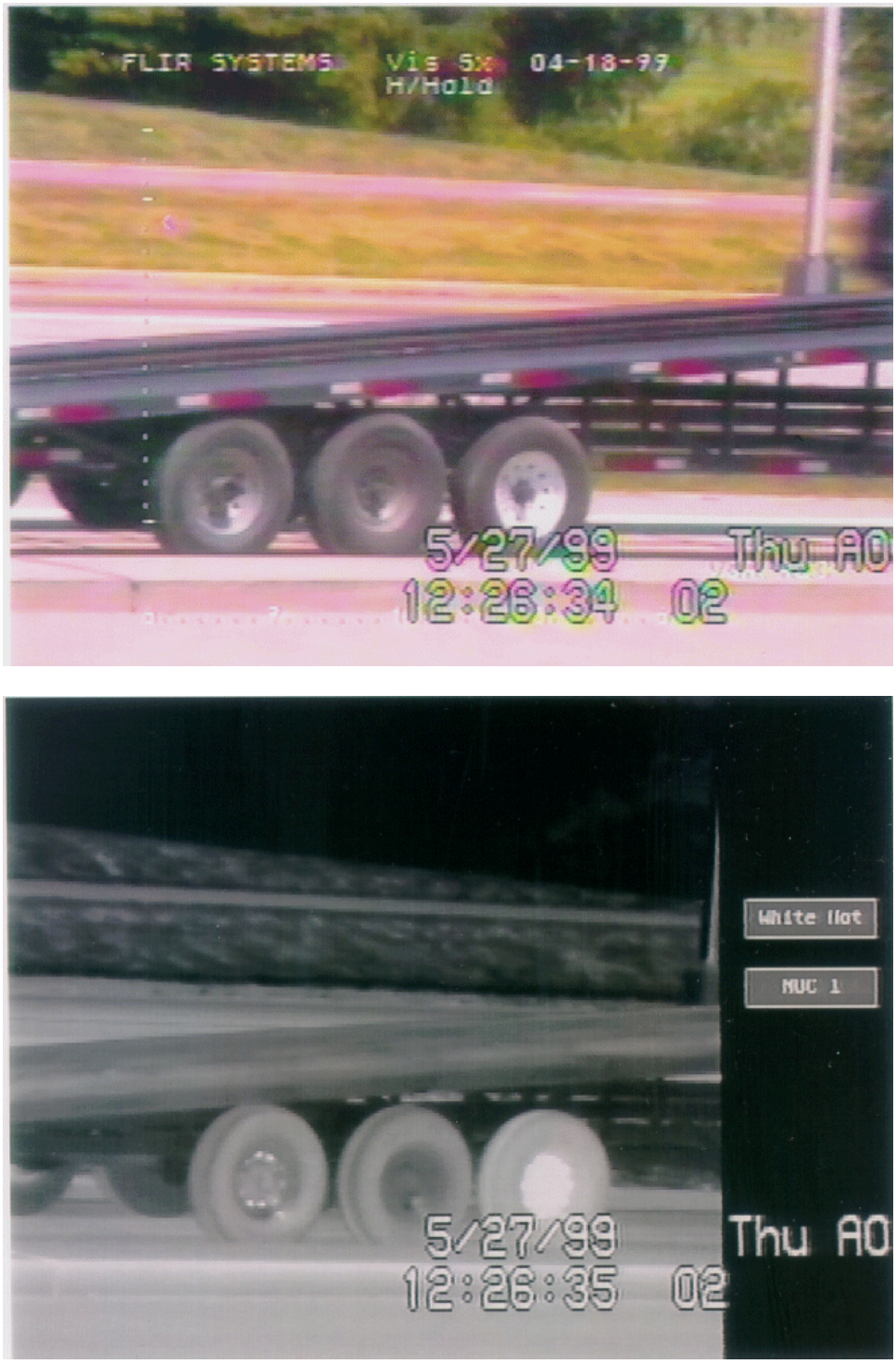


Figure A-4. Color and corresponding thermal images of a screened CMV.

Figure A-5 **IRISystem infrared photograph showing the right side of axles 4 and 5 for a tractor-trailer traveling to the right of the photograph. In comparison with wheel 4R, wheel 5R (circled) does not show white though the holes and indicates a potential defective braking system at that wheel.**

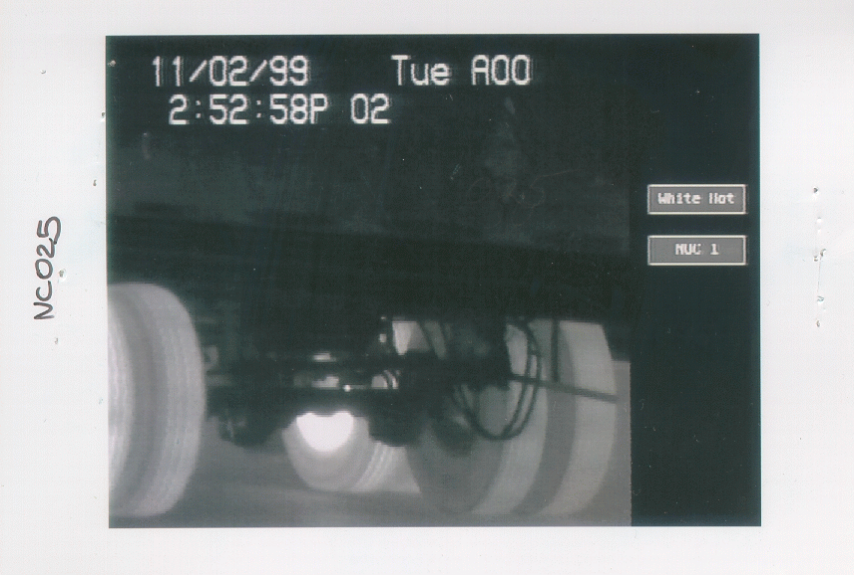


Figure A-6 **IRISystem infrared photograph showing the left side of axles 4 and 5 for a tractor-trailer traveling to the right of the photograph. In comparison with wheel 5L, the drum for wheel 4L does not show white and indicates a potential defective braking system at that wheel.**

Appendix B

IRISystem Evaluation Plan

Evaluation Plan for IRISystem Infrared Brake Screening Project

DTFH61-96-C-00044, Task Order Battelle 7704, Subtask 19
December 1999

Objective: To evaluate the effectiveness of the IRISystem (infrared imaging and video) for use as a screening tool on commercial vehicles for detecting bad brakes and unsafe vehicles due to braking.

Definitions: There are three definitions given in each group below, each based on a specific method of rating brake performance.

Definitions of a problematic brake:

1) A brake that cannot meet a minimum force or torque level[1].
2) A brake that is found to have a Federal Motor Carrier Safety Regulations (FMCSR) defect when inspected by a CVSA-certified inspector or a qualified mechanic.
3) For the IRISystem, a problematic brake is one which, in the judgement of the inspector or operator, is significantly colder or hotter than the other brakes on the vehicle.

Definitions of an unsafe vehicle:

1) A vehicle with insufficient stopping capability in its current loading condition[2].
2) A vehicle which is placed out-of-service (OOS) by a CSVA-certified inspector as a result of a Level 1 inspection. For this study, the OOS must be due to brake-related defects found during the inspection.
3) The IRISystem does not currently have an unsafe vehicle definition. A proposed definition would parallel the CVSA definition: a vehicle is unsafe if 20 percent or more problematic brakes are identified.

Effectiveness of the IRISystem for use as a screening tool[3]: As shown in Figure B1, all brakes for which both an IRISystem screening and a CVSA inspection report are available will be divided into two primary groups, based on whether or not the IRISystem screening identified a potential brake problem. Each group will in turn be sub-divided according to whether or not the defective brake was identified during a CVSA Level 1 inspection. The results will fall into one of four categories from which the evaluation of

---

[1] A brake is considered weak if it cannot produce a minimum brake force to wheel load ratio (BF/WL) of 0.25 for a steer-axle brake or 0.35 for a non-steer axle brake.

[2] For example, the vehicle cannot perform a stop within 12 meters (40 feet) from 32 km/hr (20 mph), or cannot produce a deceleration of 4.3 m/s^2 (14 ft/sec^2) during the stop. Alternatively, the vehicle cannot produce an equivalent deceleration, ratio of total brake force to gross vehicle weight (BF_{tot}/GVW) of 0.4. The equivalent deceleration can be measured using a performance-based brake tester (PBBT).

[3] Note: for their own study, Kentucky will consider the system effective if 50 percent or more of the brakes that are inspected with the IRISystem and are deemed to be problematic (hot or cold) are also found to have a brake-related FMCSR violation.

the effectiveness of the IRISystem can be quantified.

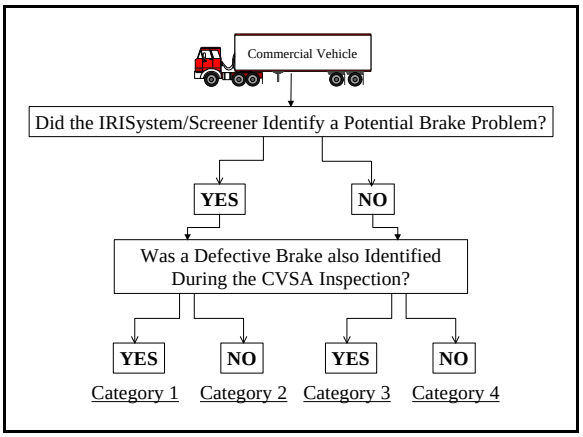


Figure B1. Possible outcomes of IRISystem screening and CVSA Level 1 inspection. The categories apply both to individual brakes and to vehicles considered out-of-service.

Categories 1 and 4 indicate the level of effectiveness of the IRISystem as an accurate screening tool, while categories 2 and 3 indicate its limitations (inaccuracy). The results will be presented in one or more pie-charts, representing, 1) the brakes for which the IRISystem operator identified a potential brake problem, or 2) the brakes for which the IRISystem operator did not observe any potential brake problems. An example from a hypothetical population of brakes is shown in Figure B2.

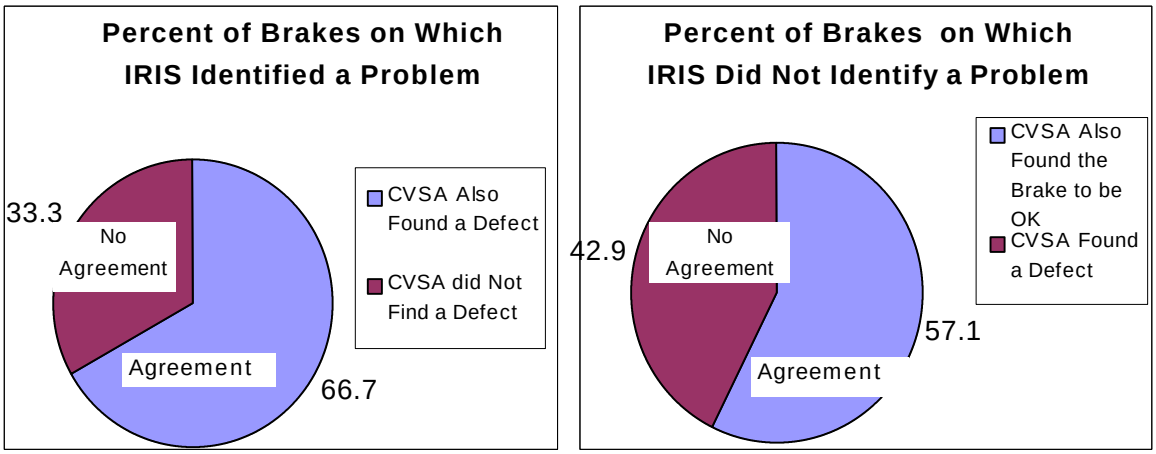


Figure B2. Example results of the effectiveness of the IRISystem used as a screening tool from a hypothetical population of brakes.

Vehicle Population Requirements: An objective evaluation requires that an equal number of "good" and "bad" vehicles, as defined by the IRISystem, be selected for a

subsequent CVSA Level 1 inspection. Since the participating States are primarily interested in using the IRISystem for identifying inoperative brakes (for which it has already been shown that an infrared system can be effective[4]), we think that the 50/50 screening can be limited to a few days of operation, such that a minimum of 100 vehicles are evaluated from each State.

The above data analysis will be made for 100 vehicles on which valid results of both brake evaluation methods are available. If resources are available, more detailed studies, such as the influence of vehicle speed, terrain, vehicle loading, climatic conditions, State practices, and IRISystem operator subjectivity, will be included.

Comparison to Brake Performance: In keeping with FHWA's goal of improved highway safety through increased use of performance-based methods, it is important that the results of an IRISystem screening also be compared with the actual braking capability of the vehicle. Since a CVSA Level 1 inspection only addresses visual "defects", and not brake performance, the correlation between IRIS-selected problematic vehicles and stopping capability cannot be completely assessed through the above evaluation. Such a correlation can only be accomplished either by performing an actual vehicle stopping test, or using a performance-based brake tester (PBBT). The IRISystem screening is based on relative temperatures of components on a given vehicle. As an example, if the brake linings on a vehicle have been replaced with linings that have a lower coefficient of friction than the original linings, or if the fit between the linings and drums is poor, then the stopping capability of the vehicle will be diminished. However, the brake drum temperatures would be similar. Therefore the diminished, and possibly insufficient stopping capability of the vehicle would not be detected by the IRISystem. These types of vehicles, which have inadequate braking capability, are of primary interest to improving highway safety. As such, it would be valuable for the evaluation to include a few comparisons between the IRISystem results and a PBBT check of the same vehicle, or a stopping distance test. If additional resources become available, relationships such as those detailed above will also be sought between the IRISystem "inspection" and the results of one of these performance-based methods.

Additional Considerations for the Evaluation: During earlier field tests of PBBTs, additional factors were included in the evaluation in order to assist with a cost/benefit analysis. Some of these factors may be applicable to the overall evaluation of the IRISystem, and are listed below. These will be included in the analysis to the extent possible.

---

[4] Earlier studies of a drive-over array of infrared sensors showed the technique effective for identifying inoperative and significantly misadjusted brakes. These results are contained in Section 8.4.4 of the Final Report submitted to FHWA in January, 1998, entitled "Development, Evaluation, and Application of Performance-Based Brake Testing Technologies."

Factors Concerning Technical Operation

Can screening be done at highway speed?
What are the best locations for use as a brake screening tool?
How effectively can other types of defects be detected using the IRIS? Examples include tires, wheel bearings, cracks in frames and suspension, or exhaust leaks.
How would the number of vehicles selected through screening with IRISystem change if a greater number of CVSA-certified inspectors were available for performing a Level 1 inspection?

Factors Concerning Cost of Ownership and Operation

What are the training requirements?
What is the set-up time?
What are the maintenance costs and effort requirements?
How adequate are the owners/users manuals?
What are the skill level requirements of the IRISystem operator?

Data required for Evaluation: The relevant data from both the IRISystem screening and the CVSA Level 1 inspection will be entered into a spreadsheet by the States participating in the evaluation. An example is shown in Table B1. These spreadsheet data files will be forwarded to Battelle, along with hard copies of the IRISystem photo(s) and CVSA inspection report for each vehicle.

For a vehicle "selected" using the IRISystem for screening, each brake on the vehicle will be sorted into one of four categories, and entered into the spreadsheet. The possible outcomes for each brake as a result of the IRISystem screening will be:

a) OK
b) cold (as defined above)
c) hot (as defined above)
d) not visible

The CVSA Level 1 inspection results will be used by the participating states to enter the data into the spreadsheet using the following categories:

a) The wheel was OK
b) A brake had an FMCSR defect
c) There was some other (wheel-specific) FMCSR defect (such as rim or tire)
d) There were non-wheel-specific FMCSR violations found (such as driver, frame, or cargo).

Table B1. Example of data entry into spreadsheet required for evaluation.

Date:	Location:	Terrain	CVSA #
Vehicle Speed	Vehicle Weight		IRISystem time

		IRISystem				**CVSA**			
Wheel #	Posi-tion	IRISystem Shows **Hot**	IRISystem Shows Cold	IRISystem Shows **OK**	Not Visible	Brake Defect	Other Defect (wheel-specific)	**OK**	Non-wheel-specific defects
1	1L			1				1	
2	1R			1				1	
3	2L		1					1	
4	2R	1					1		
5	3L			1		1			
6	3R				1	1			
7	4L			1				1	
8	4R		1			1			
9	5L			1				1	
10	5R				1	1			
Non-Wheel-Specific Defects									3

Appendix C

IRISystem Screening Report

IRISystem Screening Report

IRISystem Report # _____ Operator: _____

CVSA Inspection # _____ Date / Time: _____

Location: _____

Weather: _____ Terrain: _____

Terrain Types:	Grade > 6%
	Grade 2% to 5%
	Grade < 2%
	Metro Area

IRISystem Detectable Faults

1L ☐ ---- 1 ---- ☐ 1R _____

2L ☐☐ ---- 2 ---- ☐☐ 2R _____

3L ☐☐ ---- 3 ---- ☐☐ 3R _____

4L ☐☐ ---- 4 ---- ☐☐ 4R _____

5L ☐☐ ---- 5 ---- ☐☐ 5R _____

Fault Types:

1. Cold Brake
2. Hot Brake
3. Hot Tire
4. Hot Bearings
5. Other

Comments / Remarks (IRISystem Only)

☐ **IRISystem Checked OK**

Name/Date:

Comments / Remarks (Other than IRIS)

Name/Date:

Drawing of the location set-up (Back of IRISystem report)

Show the following on the drawing:

- Roadway
- Arrow for direction of travel of screened vehicles
- Approx. speed of vehicles
- Estimated distance from IRISystem to screened vehicles
- Location for Level 1 Inspection
- Estimated distance from IRISystem to Level 1 Inspection

Appendix D

Level 1 Inspection Report

COMMERCIAL VEHICLE ENFORCEMENT
COFFEE COUNTY WEIGH STATION
1150 FOSTER AVENUE
NASHVILLE, TN. 37249-1000
931-723-5062

DRIVER VEHICLE INSPECTION REPORT
Report #:
Date
Time Started: 07:45 Time Ended: 08:30
Insp. Level: 1 (Full Inspection)

Fleet Name
Fleet Address
ICC #: DOT #
Phone #: Fax #:

Driver
License #:
DOB
State #:
Cargo: EMP
State: GA

Location: I-24 WEST
Highway: I-24 W
Shipper: NA

MilePost: 116
County: COFFEE

Origin:
Destination:
Shipping Paper #: NA

VEHICLE IDENTIFICATION

Unit	Type	Make	Yr	Company	License	State	CVSA #	HAZARDOUS MATERIALS HM Code/Class	Qty	Wgt
1	TT	INTL	92	003	G18385	GA				
2	ST	FRUE	99	3952	2480GN	GA				

BRAKE ADJUSTMENTS

Axle #	1	2	3	4	5
Right	3/4	1 1/2	1 1/4	1 1/4	1 1/4
Left	1 1/2	2 1/2	1	1 1/4	1 1/4
Chamber	C-24	C-30	C-30	C-30	C-30

VIOLATIONS

Violation Code	St	Unit	OOS	Citation #	Verify	Violations Discovered
396.3A1BA		1	N		N	Brake out of adjustment LA1
393.75(a)(1)		2	N		N	Tire-ply or belt material exposed LA4 SIDEWALL DAMAGED
393.9		1	N		N	Inoperable lamp (other than head/tail) MARKER LAMP INOP 2

**** NOTE TO DRIVER: This report must be furnished to the motor carrier whose name is listed above.

**** CARRIER CERTIFICATION: The undersigned certifies that all violations on this report have been corrected and action taken to assure compliance with the Motor Carrier Safety and HM Regulations insofar as they are applicable to motor carriers and drivers. This certification MUST BE SIGNED by the Motor Carrier and RETURNED WITHIN 15 DAYS to the address at the top of this form.

Signature of Carrier Official: X_____ Date: _____

Report Prepared By Badge #: Copy Received By:

Page #: 1
Last Page

Appendix E

Data Collection Protocol

IRISystem DATA COLLECTION PROTOCOL

Each completed inspection/screening packets must have:
1. IRISystem screening report,
2. IRISystem photographs of defects, and
3. CVSA inspection report.

1. Instructions of completion of the IRISystem Screening Report

1. **IRISystem Report #** This is a state specific report number with each state beginning with #1 and sequencing with completed vehicles. This sequence will continue for the life of the project. Each day the numbers will continue from the previous day. Example: TN001 for first inspection and continuing to increase with each inspection conducted. Include this number on the top of completed Level 1 CVSA inspection report.

2. **Operator** Show name of IRISystem operator.

3. **CVSA Inspection #** This is the number shown on the CVSA inspection form.

4. **Date/Time** Date of inspection and local time [as printed on the IRISystem photo], show EST or CST time.

5. **Location** Show roadway, mile marker location, and direction of travel of screened vehicles. If at fixed site, include name of site location.
Example: I-75 mile marker 182, southbound, SoandSo Scales

6. **Weather** Include weather conditions (Clear, cloudy, raining, foggy, snow) and average Temperature (20's, 30's, 40's...).

7. **Terrain** Show terrain type as listed in block. Example: Grade 2% to 5%.

8. **IRISystem Detectable Faults** Check box to correspond with IRISystem fault. Example Axle #1Right and Axle #4Left. See attached completed example report.

9. **Fault Types** On the line to the right of check blocks, show fault type detected. Use faults listed in block.

10. **Comments/Remarks** Only show remarks related to the IRISystem. Example: IRISystem picture not clear, foggy. Officer/originator, if different than IRISystem operator, must initial and date entries.

11. **IRISystem Checked OK** This section is for the Blind Sample Vehicles (or "Good" vehicles), vehicles showing no defects on IRISystem screening. When this box is checked, no box for the IRISystem detectable faults should be checked. (Item 8)

Select everyday, at a minimum, 1 vehicle with NO defects showing for two vehicles with defects (1 out of 3 total number of vehicles inspected, 2 out of 6, 3 out of 9, etc...). The inspector must not be told this is a non-defect vehicle.

12. On the back on the IRISystem screening report, show the inspection location with reference to IRISystem setup, roadway, direction of travel of screened vehicles(use arrow), estimated speed at time of screening, estimated distance from IRISystem to screened vehicles, and Level 1 inspection location.. See completed screening report. This is completed for each set-up and is entered on the first inspection for that location. Multi-inspection at the same location should show Date and Inspection TN001-TN012 at this setup location. When changing location, complete a new diagram.

2. Instructions for the IRISystem Photographs

A photo is included in the example report

1. Photographs must be attached to all inspection packets.

2. The Photograph must show the correct date and time of inspection (same as on IRISystem screening report).

3. CIRCLE all defects detected by the IRISystem (Use Sharpy-type pen).
   Make sure that the defects circled match IRISystem detectable faults shown on the IRISystem report.
   If several defects are detected (see example report), then all defects must be documented by a photo. If necessary, include more than one photo.

4. Indicate the vehicle direction with an arrow (use Sharpy-pen)

5. On the back of the photograph, show the CVSA inspection number and the state specific inspection number. Example: TN0002345, TN001.

3. Instructions for the CVSA Level 1 inspections

Complete CVSA Level 1 inspection as usual.

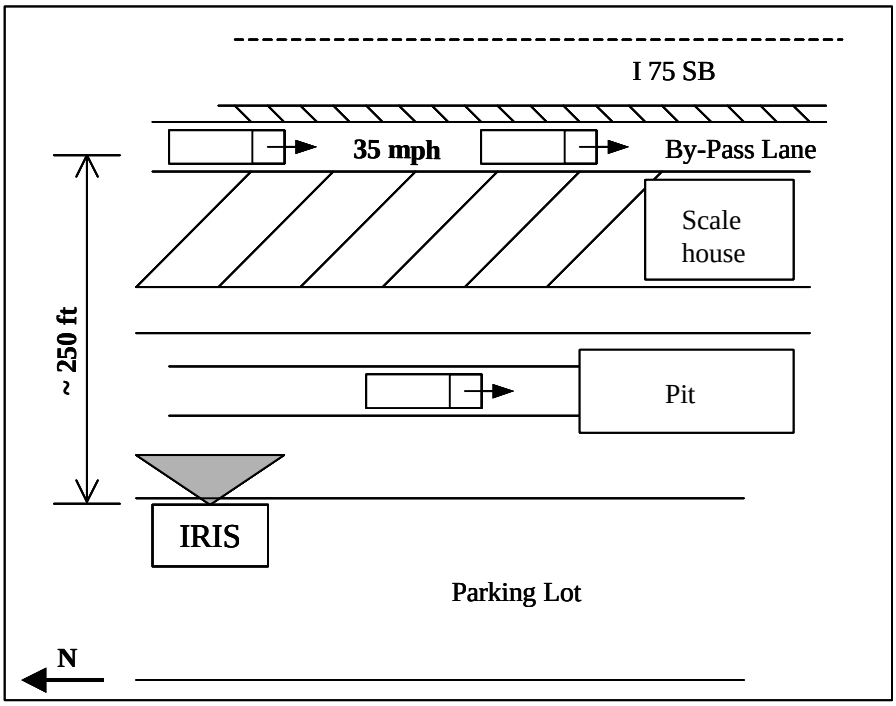
1. On the CVSA Level 1 Inspection Report, Circle the following (see example):
   a. CVSA inspection number
   b. Cargo
   c. Misadjusted brakes
   d. OOS: Yes or No

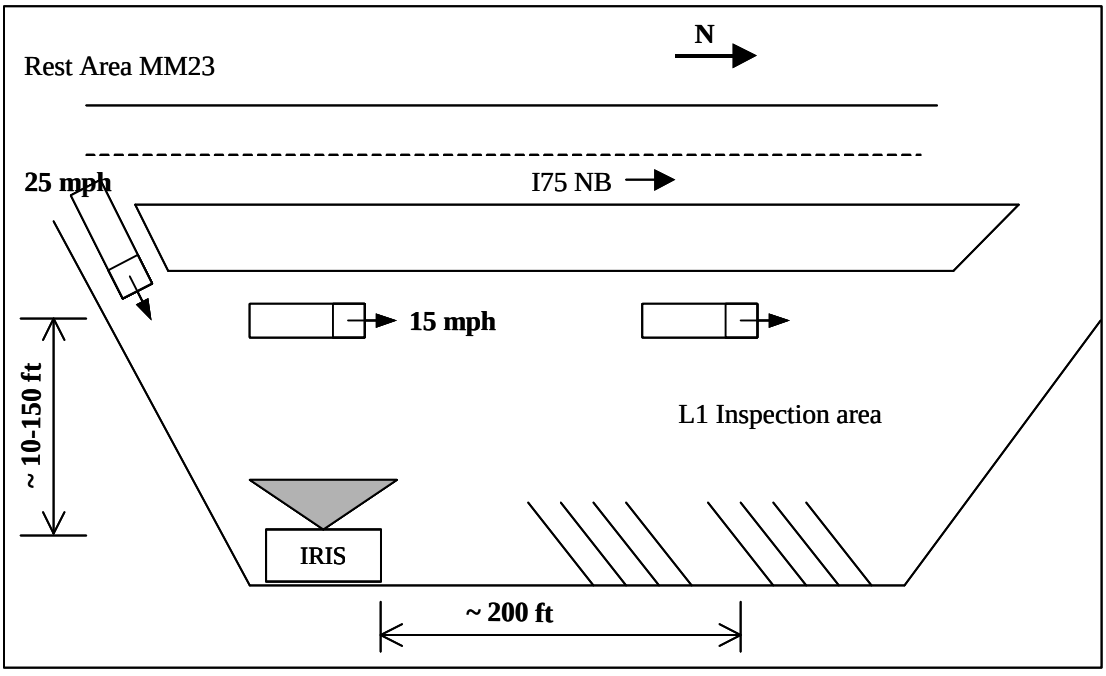
2. Include the IRISystem report number (TN001) on the top of completed Level 1 CVSA inspection report.

Appendix F

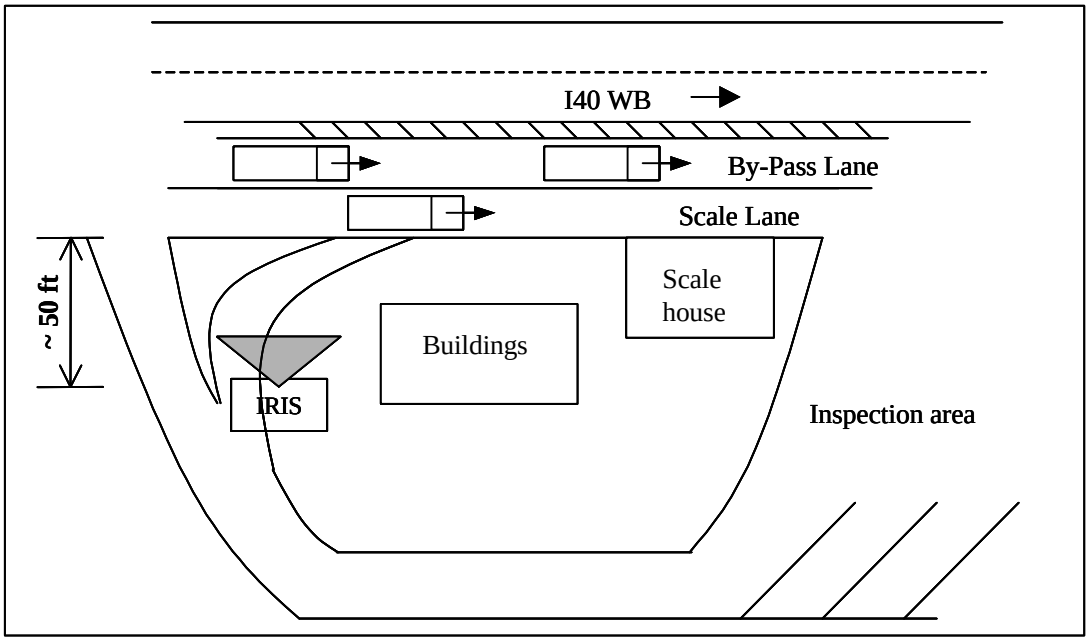
IRISystem Setup Drawings

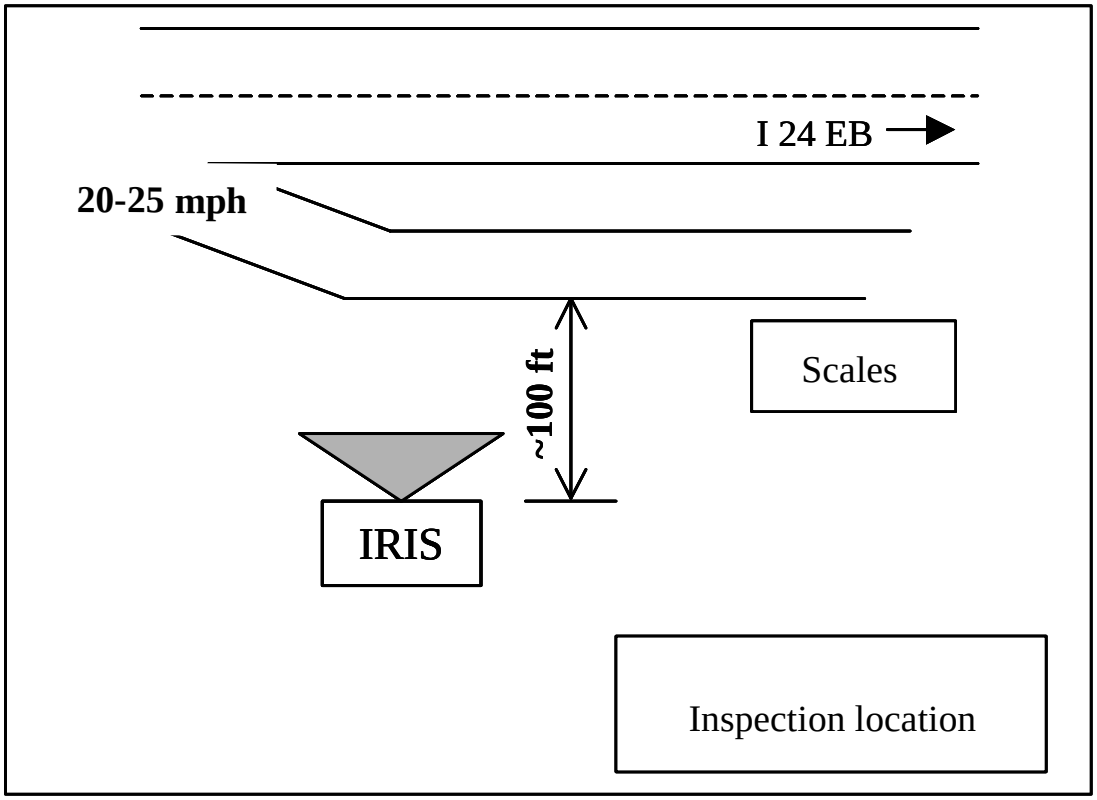
Location of IRISystem Screening:
At weigh station facilities



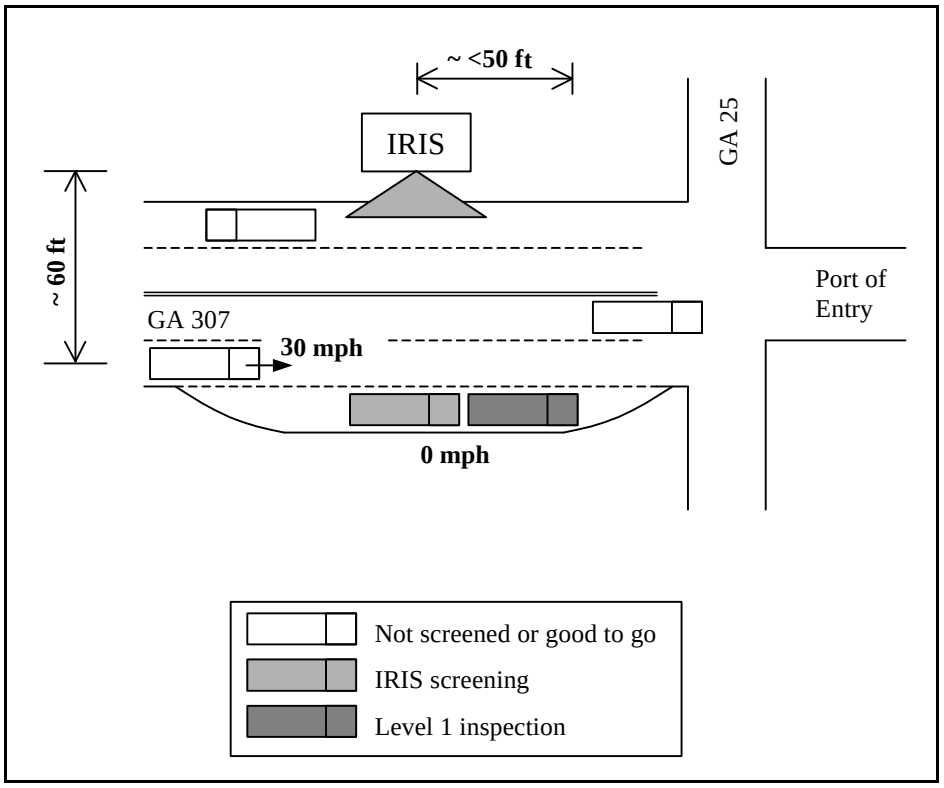


Location of IRISystem Screening:
At weigh station facilities (Continued)

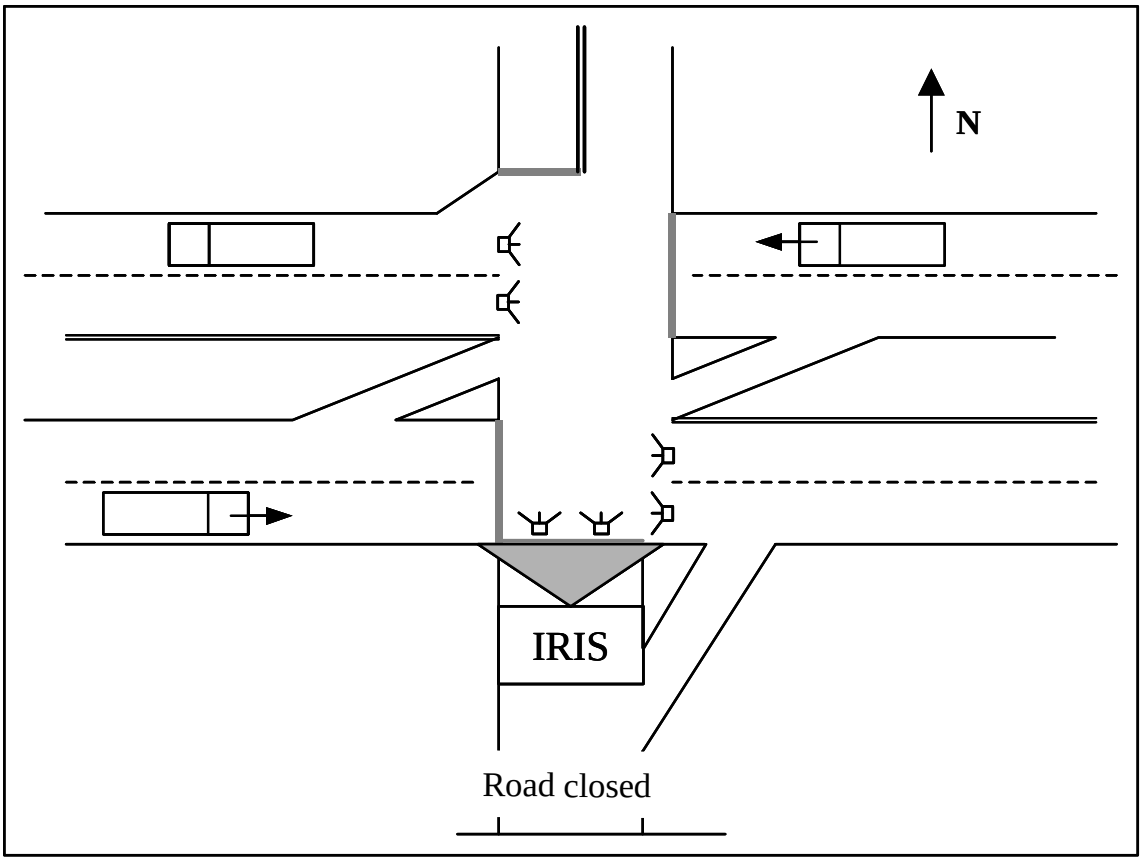




Location of IRISystem Screening:
Near a port of entry in Georgia



Location of IRISystem Screening:
On Georgia State roads



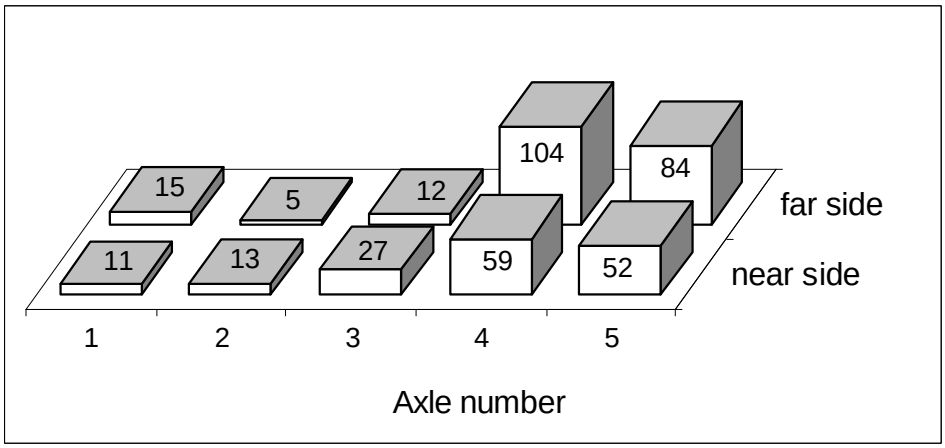
Appendix G

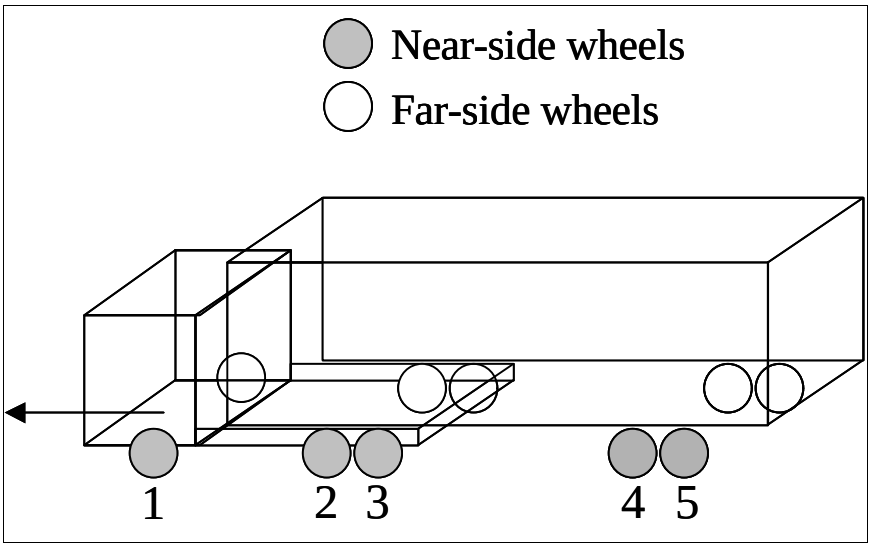
Results

Location of Problematic Wheels Identified by the IRISystem operator Out Of Service Vehicles

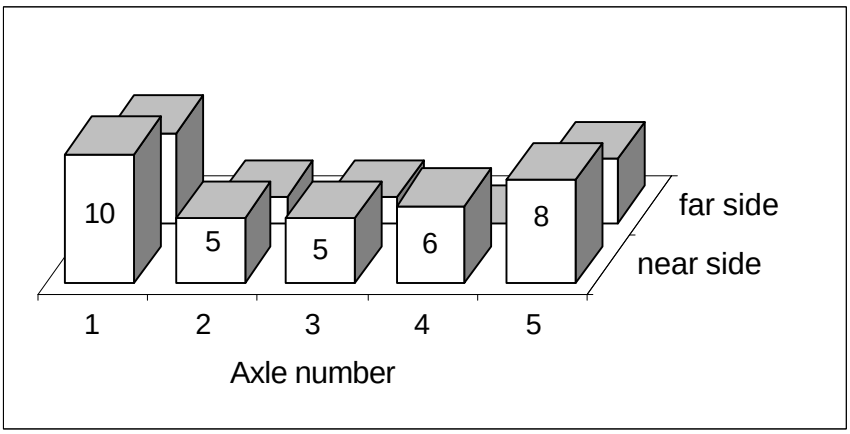
All States

Number of problematic wheels identified by IRISystem as a function of wheel location on a 3-S2 CMV. The data are for all states. The arrow indicates the direction of the vehicle. The schematic illustrates the near-side and far-side wheel location as well as the axle numbers.

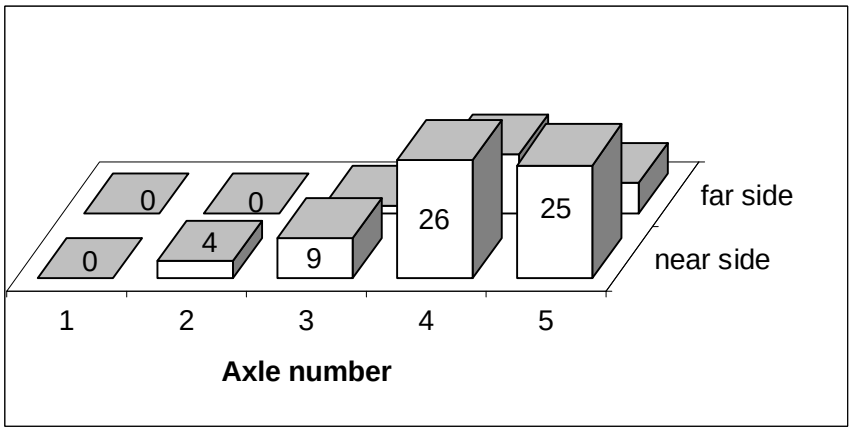




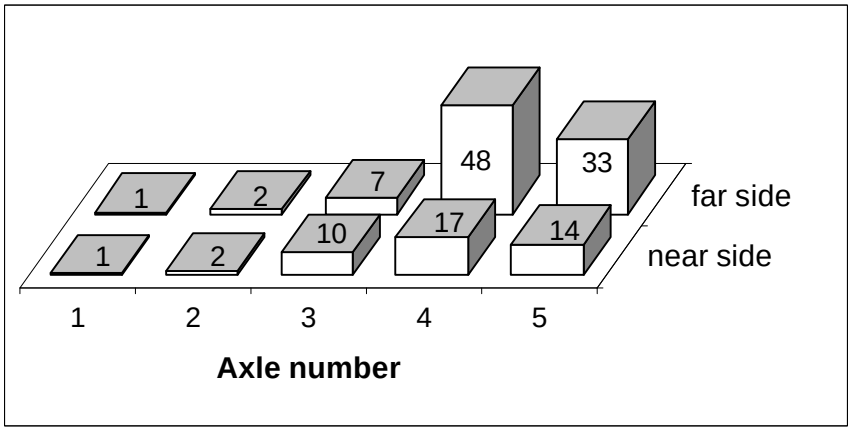
Georgia



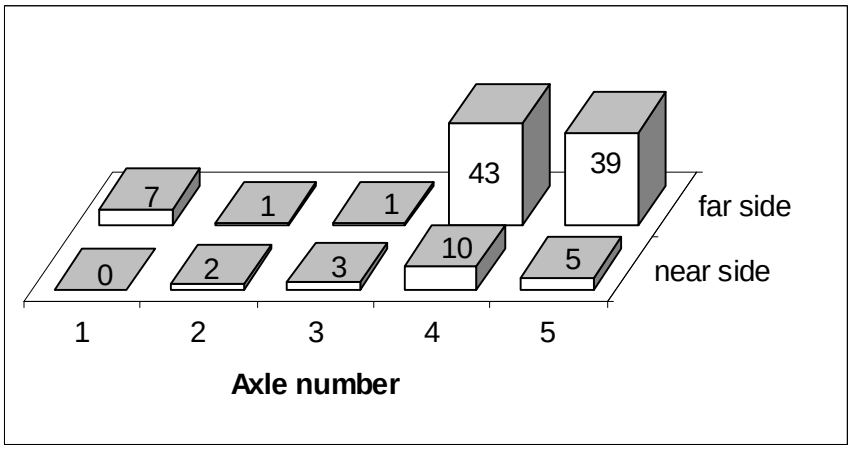
Kentucky



North Carolina



Tennessee



Appendix H

Results

Number of CVSA-Identified FMCSR Violations as a Function of IRIS-Identified Problematic Wheels

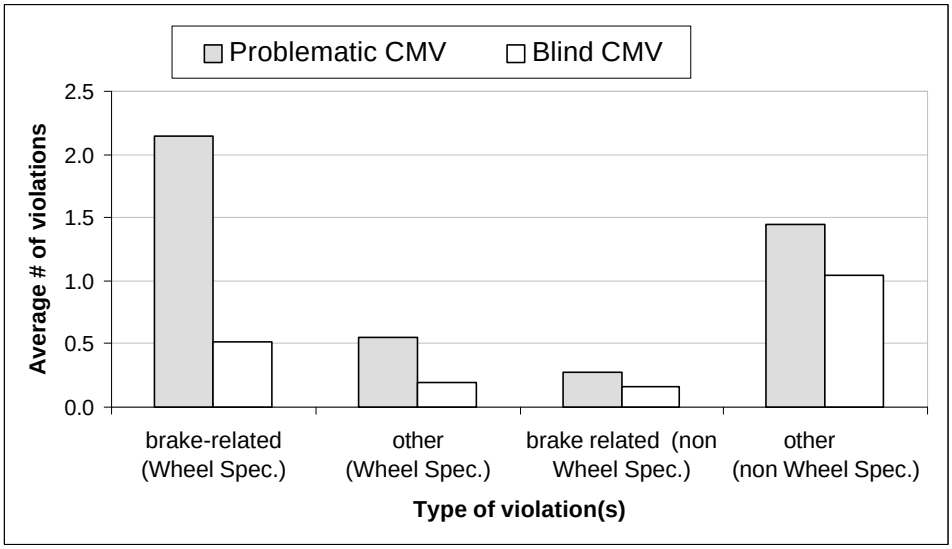
Table H-1. Summary of data collected.

	All	GA	KY	NC	TN
Number of CMVs inspected	392	39	104	130	119
Percentage of blind, non-problematic, CMVs	*16%*	*15%*	*8%*	*15%*	*24%*
Percentage of 3-S2 CMVs	*88%*	*82%*	*79%*	*87%*	*97%*
Percentage of loaded 3-S2 CMVs	*70%*	*59%*	*81%*	*68%*	*66%*
Number of days in use (for evaluation	77	10	12	23	32
Percentage of problematic (cold) wheels ††	*11%*	*17%*	*9%*	*11%*	*9%*
Percentage of problematic (hot) wheels ††	*1%*	--	*2%*	*1%*	*<1%*
Average # of IRIS-identified problems per 3-S2	1.3	1.9	1.1	1.4	1.2

† These numbers only reflect the usable data reports. †† As identified by the IRISystem operator.

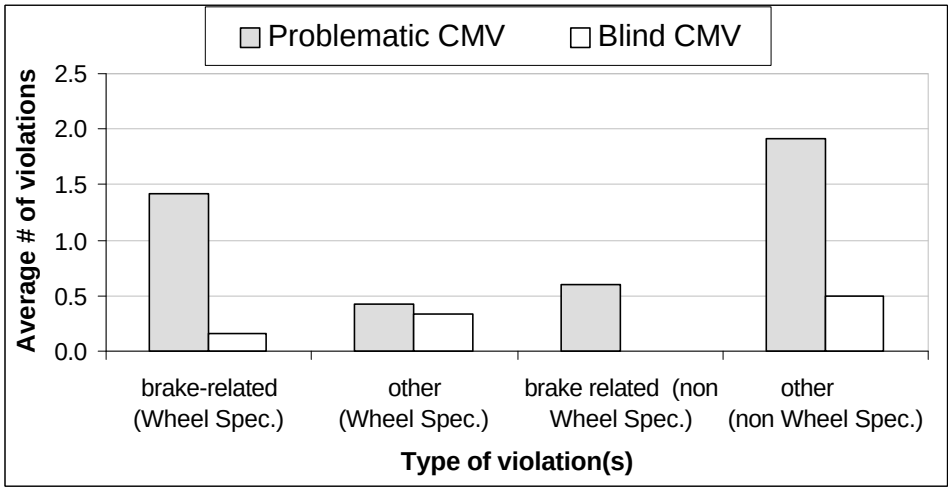
All States

Figure H-1. Average number of FMCSR violations reported in L1 inspections for CMVs screened with the IRISystem.



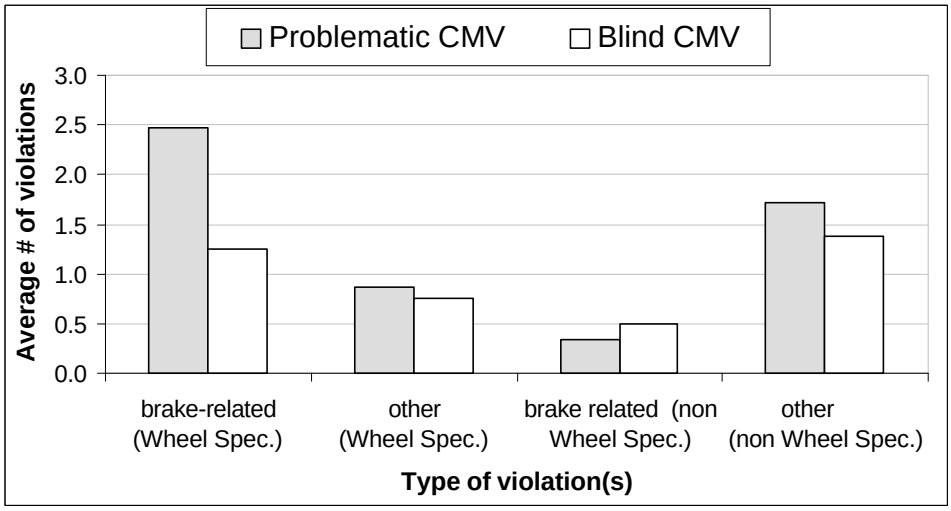
Georgia

Figure H-2. Average number of FMCSR violations reported in L1 inspections for CMVs screened with the IRISystem.



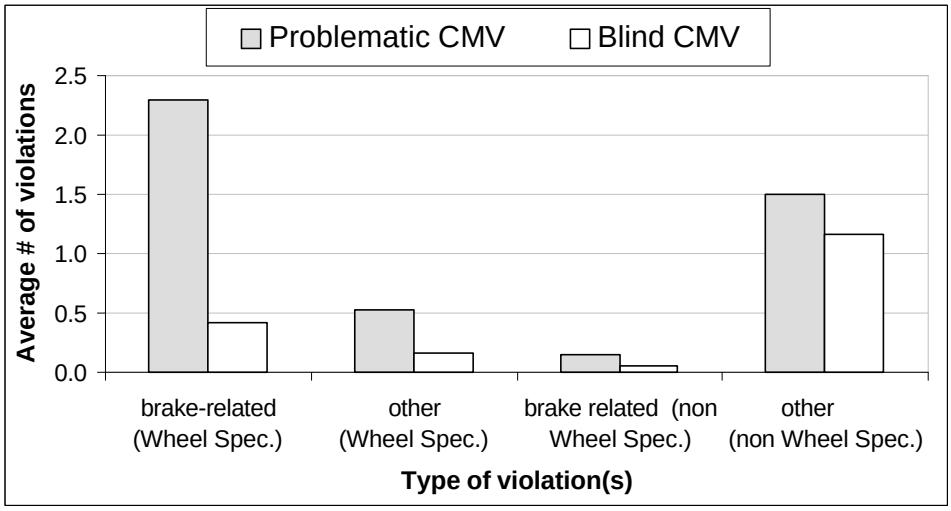
Kentucky

Figure H-3. Average number of FMCSR violations reported in L1 inspections for CMVs screened with the IRISystem.



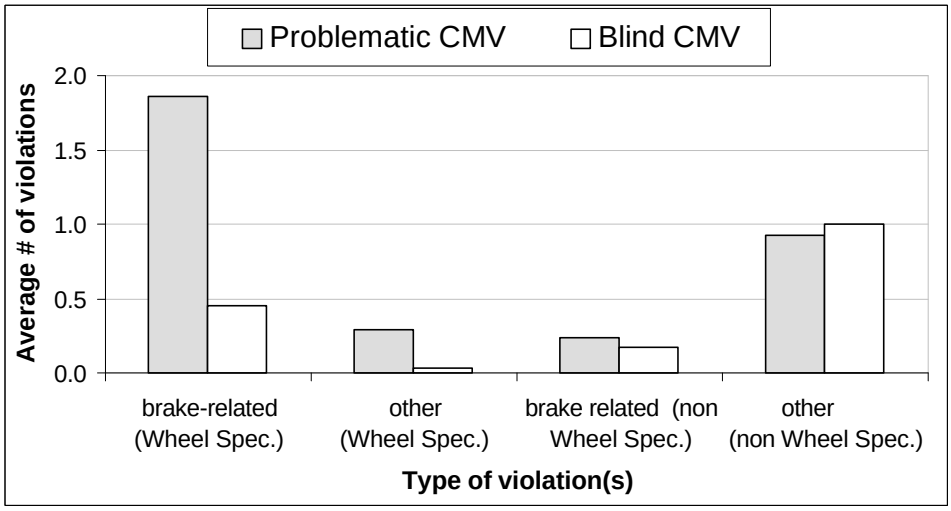
North Carolina

Figure H-4. Average number of FMCSR violations reported in L1 inspections for CMVs screened with the IRISystem.



Tennessee

Figure H-5. Average number of FMCSR violations reported in L1 inspections for CMVs screened with the IRISystem.



Appendix I

Results

Wheel-by-Wheel Analysis

Table I-1. Percentage agreement between the IRISystem screening results and the Level 1 inspection results per state and per type of IRIS-identified wheel.

IRISystem diagnostic		All States	GA	KY	NC	TN
Normal wheels	# of wheels (% total)	3326 (88%)	301 (83%)	884 (88%)	1076 (88%)	1065 (90%)
	% agreement †	***85%***	***92%***	***79%***	***86%***	***88%***
Cold Wheels	# of wheels (% total)	399 (11%)	61 (17%)	94 (9%)	134 (11%)	110 (9%)
	% agreement †, 1	***68%***	***59%***	***68%***	***84%***	***55%***
	% agreement †, 2	***76%***	***81%***	***73%***	***85%***	***65%***
Hot Wheels	# of wheels (% total)	44 (1%)	0	24 (2%)	15 (1%)	5 (<1%)
	% agreement †	***68%***	***n/a***	***71%***	***67%***	***60%***
Total # wheels		3769	362	1002	1225	1180

† Between IRISystem screening results and Level 1 inspection results

1 Level 1 inspection identified one or more wheel-specific defect, whether brake-related or not (Table 4).

2 Level 1 inspection identified one or more brake-related defect, whether wheel-specific or not (Table 4).

All States

Figure I-1. Percentage of agreement between the IRISystem screening results and the Level 1 inspection results as a function of IRISystem wheel diagnostic. "Cold 1" and "Cold 2" refer to two different comparisons, with wheel-specific violations and brake-related violations, respectively.

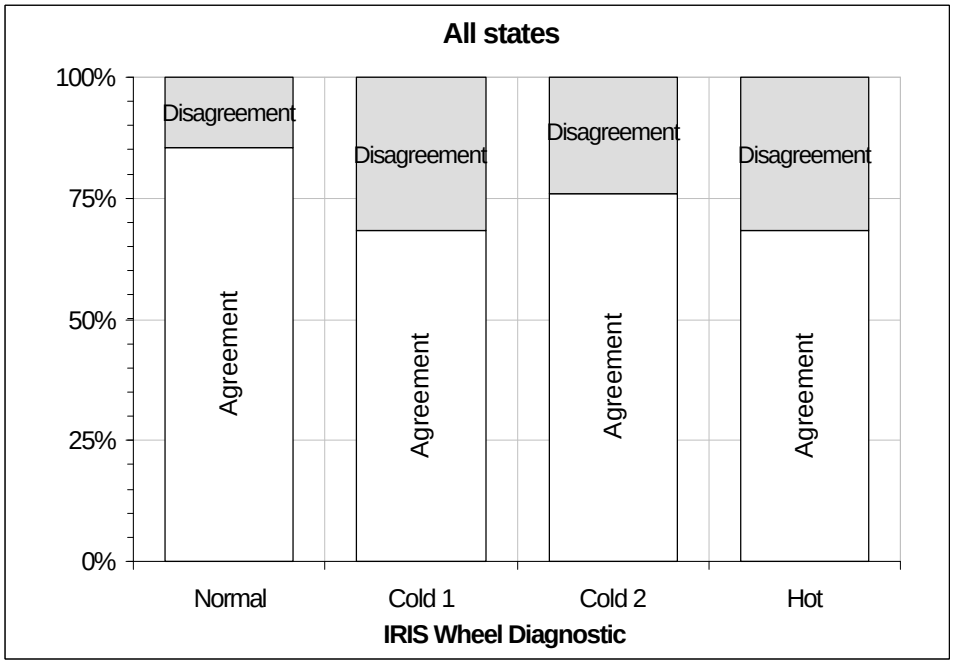


Figure I-2. Percentage of agreement between the IRISystem screening results and the Level 1 inspection results as a function of IRISystem wheel diagnostic. "Cold 1" and "Cold 2" refer to two different comparisons, with wheel-specific violations and brake-related violations, respectively.

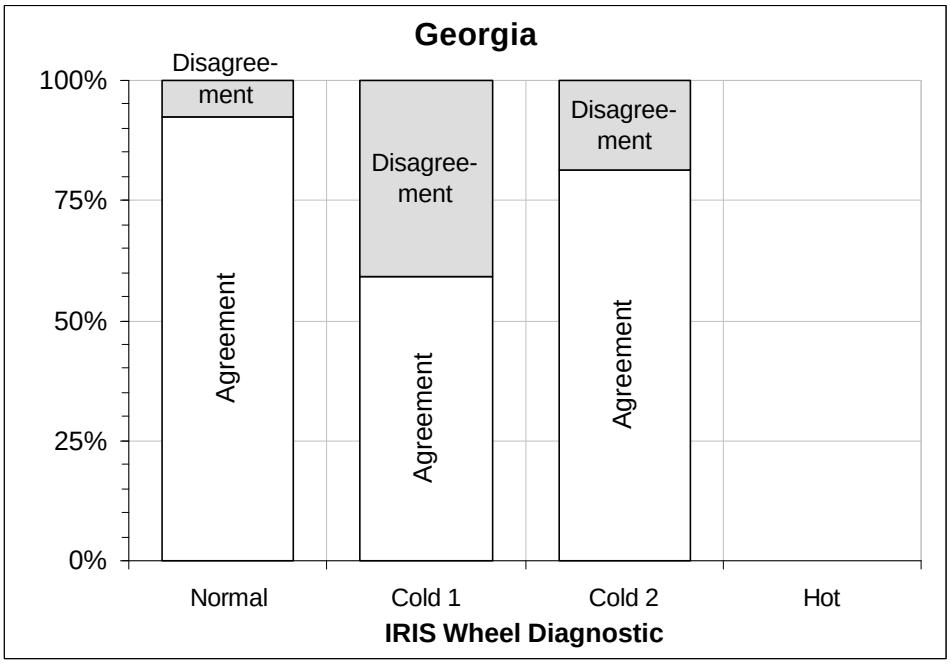


Figure I-3. Percentage of agreement between the IRISystem screening results and the Level 1 inspection results as a function of IRISystem wheel diagnostic. "Cold 1" and "Cold 2" refer to two different comparisons, with wheel-specific violations and brake-related violations, respectively.

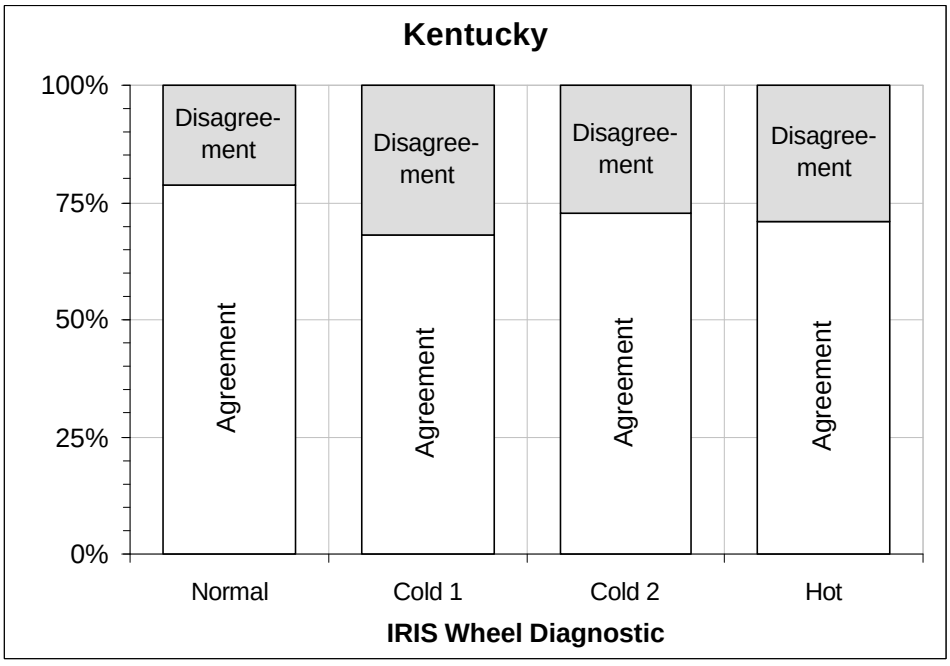


Figure I-4. Percentage of agreement between the IRISystem screening results and the Level 1 inspection results as a function of IRISystem wheel diagnostic. "Cold 1" and "Cold 2" refer to two different comparisons, with wheel-specific violations and brake-related violations, respectively.

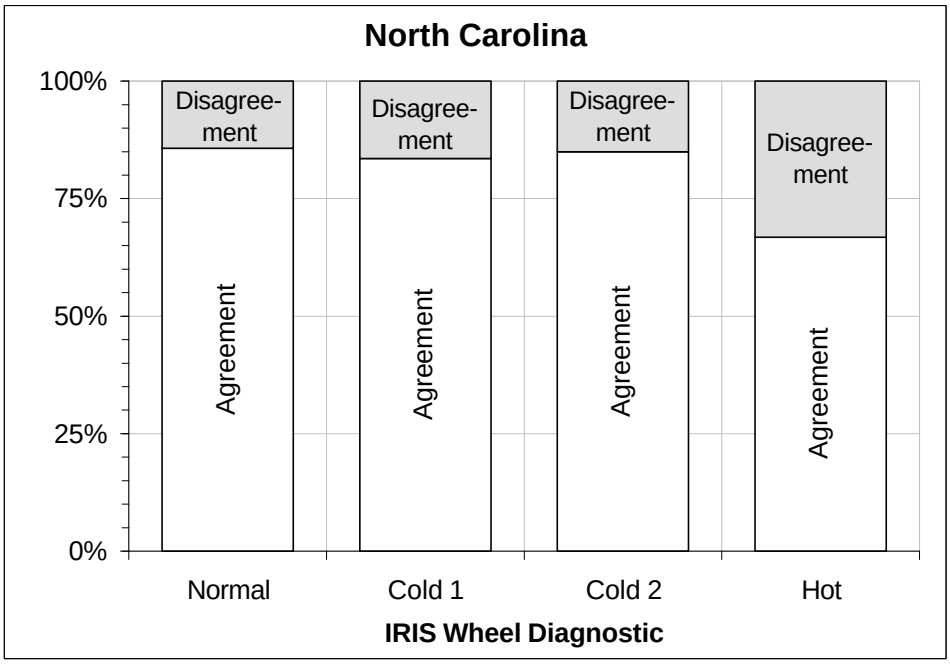
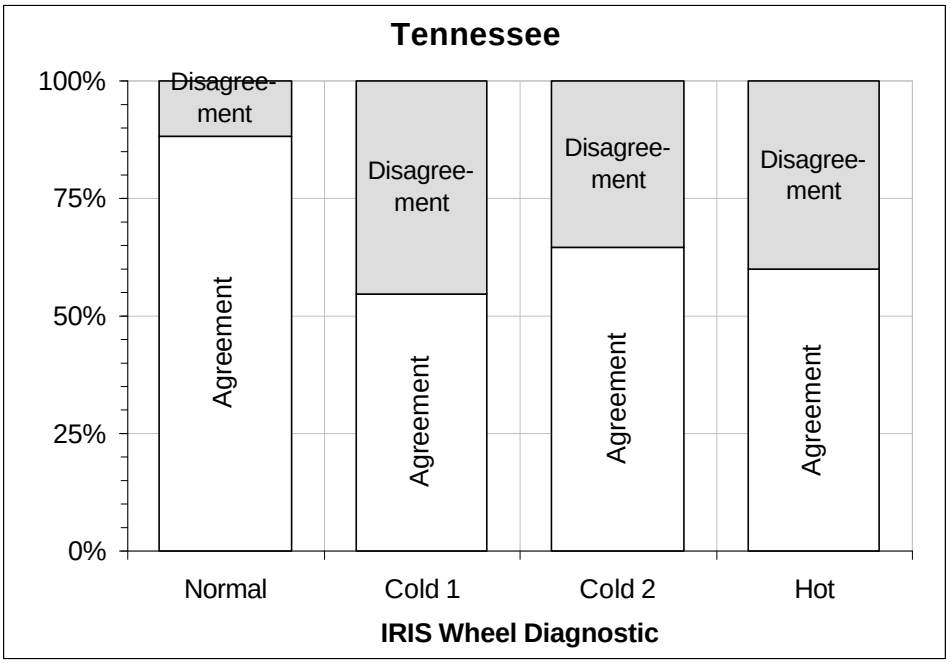


Figure I-5. Percentage of agreement between the IRISystem screening results and the Level 1 inspection results as a function of IRISystem wheel diagnostic. "Cold 1" and "Cold 2" refer to two different comparisons, with wheel-specific violations and brake-related violations, respectively.



Appendix J

Results

Out Of Service (OOS) Vehicles

Table J-1. Percentage of CMVs placed OOS after IRISystem screening

	Not placed OOS	Placed OOS			
		Any criteria	*Brake violation(s) only* ††	*Brake and other violation(s)* ††	*Other-than-brake violation(s)* ††
All CMVs (392)	47%	53%	*57%*	*21%*	*22%*
Blind, non-problematic, CMVs (62)	81%	19%	*58%*	*8%*	*33%*
Problem. CMVs (330)	41%	59%	*57%*	*22%*	*21%*
GA (33) †	45%	55%	*67%*	*17%*	*17%*
KY (96) †	47%	53%	*55%*	*20%*	*25%*
NC (111) †	33%	67%	*54%*	*27%*	*19%*
TN (90) †	43%	57%	*61%*	*18%*	*22%*

† Problematic vehicles only. †† Percentage of OOS vehicles only.

All States

Figure J-1. Percentage of CMV placed out of service in all four states after IRISystem screening detected problematic wheels.

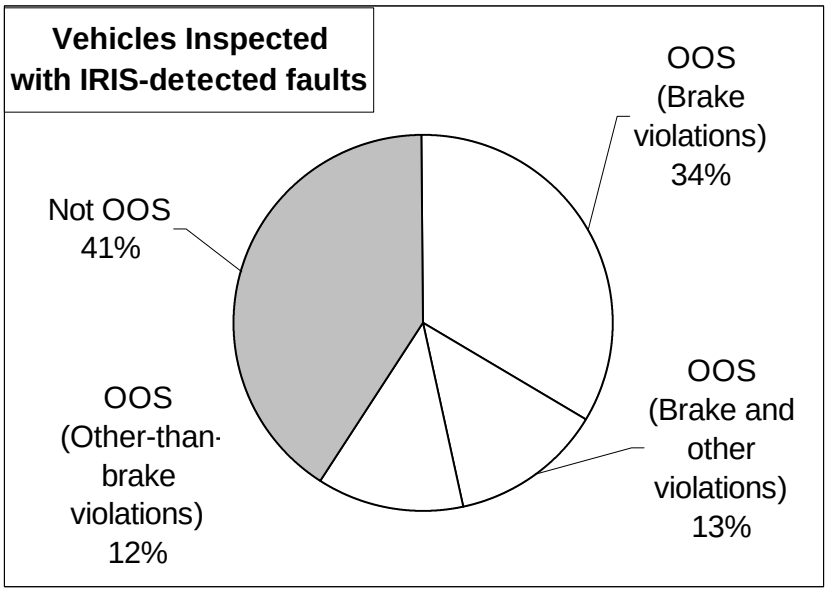
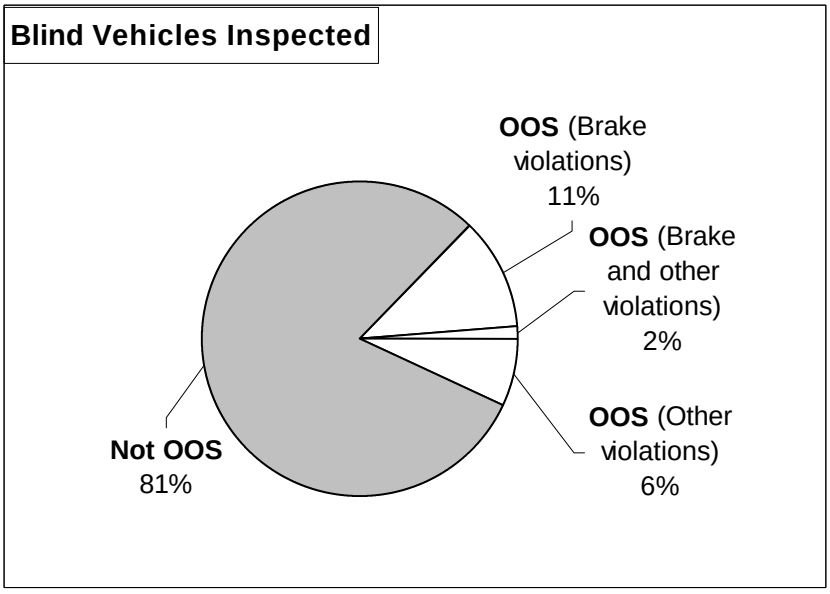


Figure J-2. Percentage of CMV placed out of service in all four states after IRISystem screening DID NOT detect problematic wheels (blind vehicles).



Georgia

Figure J-3. Percentage of CMV placed out of service in Georgia after IRISystem screening detected problematic wheels.

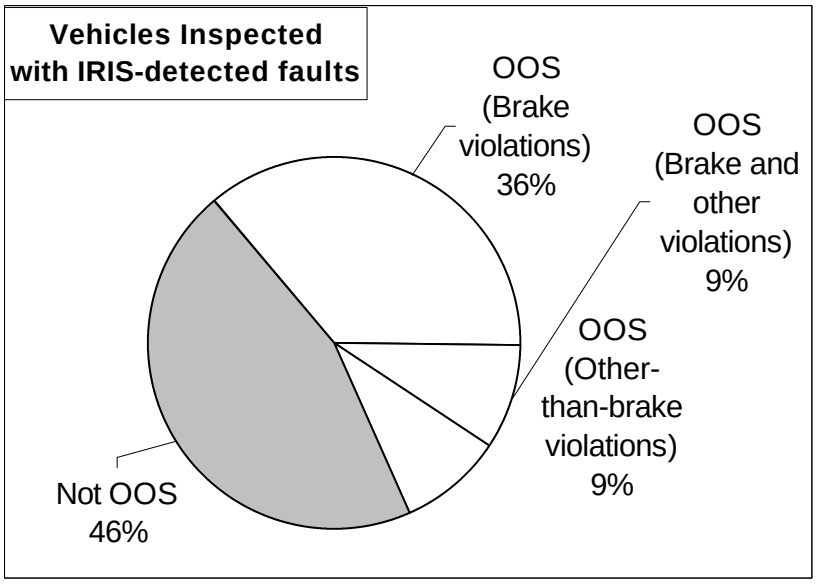


Figure J-4. Percentage of CMV placed out of service in Georgia after IRISystem screening DID NOT detect problematic wheels (blind vehicles).

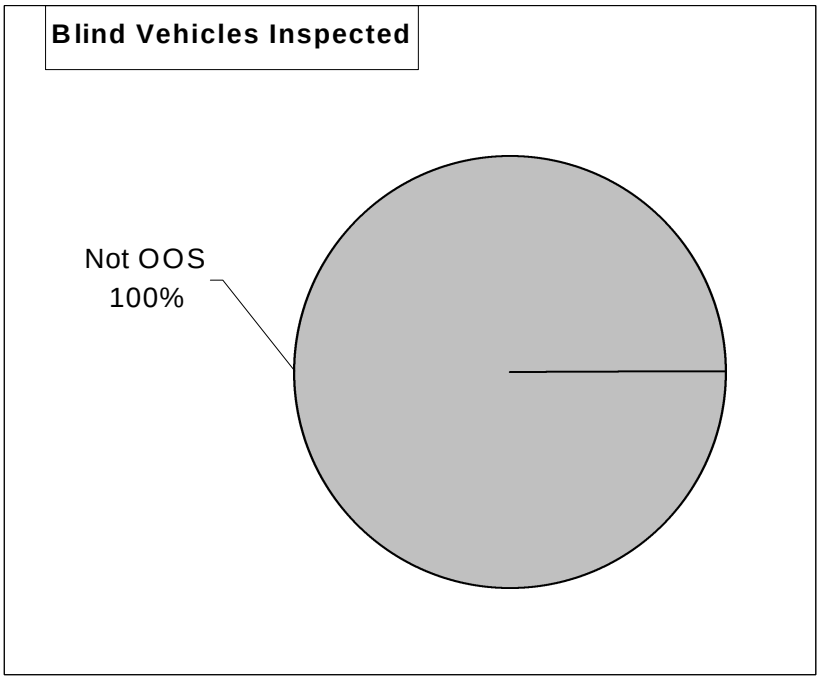


Figure J-5. Percentage of CMV placed out of service in Kentucky after IRISystem screening detected problematic wheels.

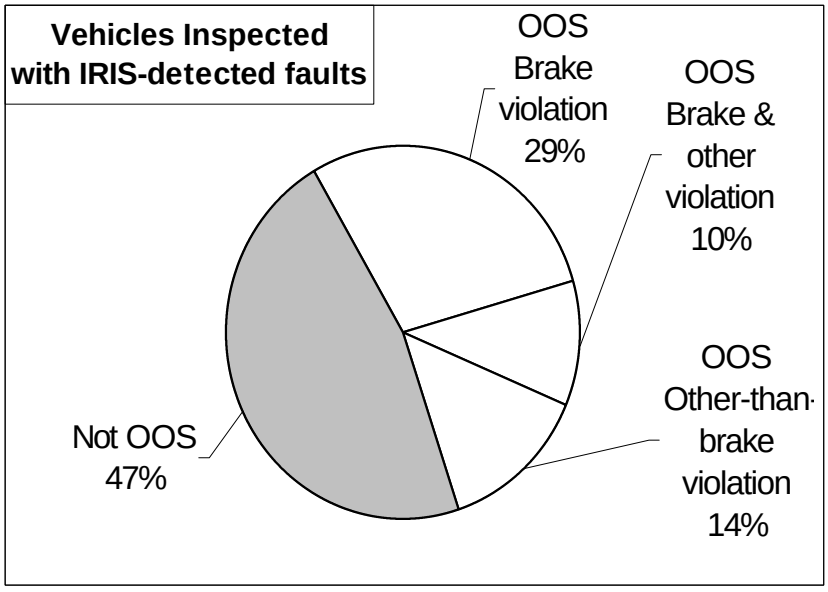
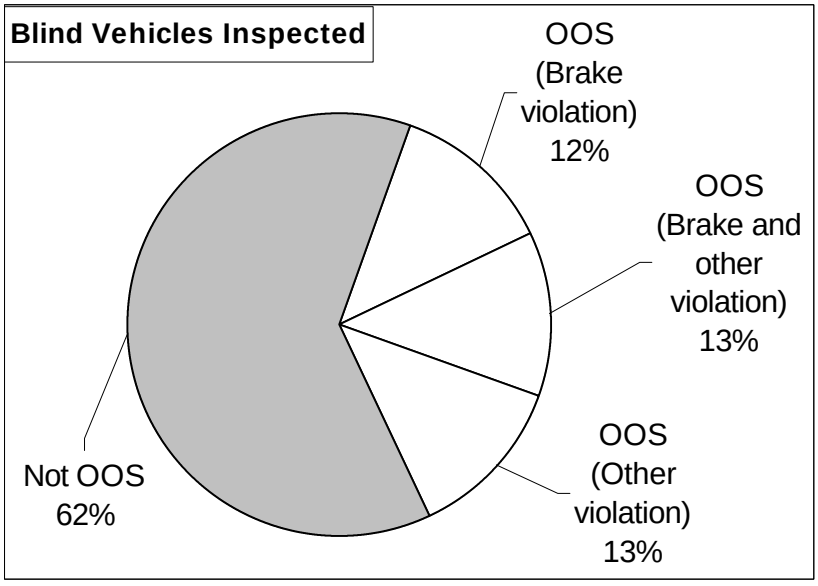


Figure J-6. Percentage of CMV placed out of service in Kentucky after IRISystem screening DID NOT detect problematic wheels (blind vehicles).



North Carolina

Figure J-7. Percentage of CMV placed out of service in North Carolina after IRISystem screening detected problematic wheels.

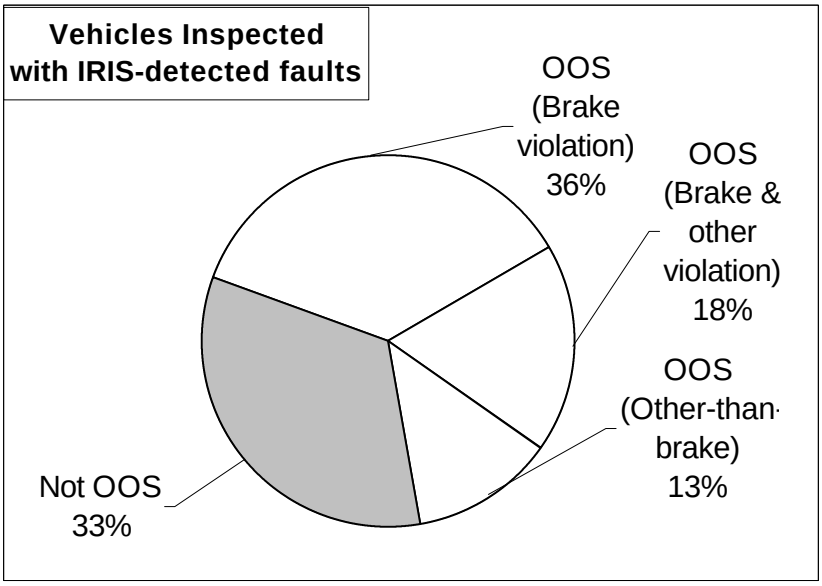
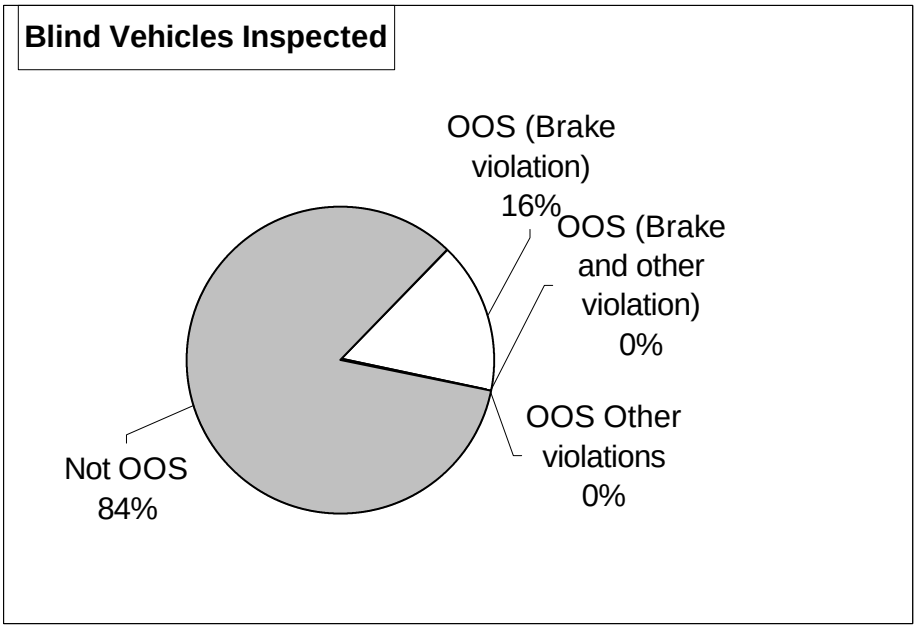


Figure J-8. Percentage of CMV placed out of service in North Carolina after IRISystem screening DID NOT detect problematic wheels (blind vehicles).



Tennessee

Figure J-9. Percentage of CMV placed out of service in Tennessee after IRISystem screening detected problematic wheels.

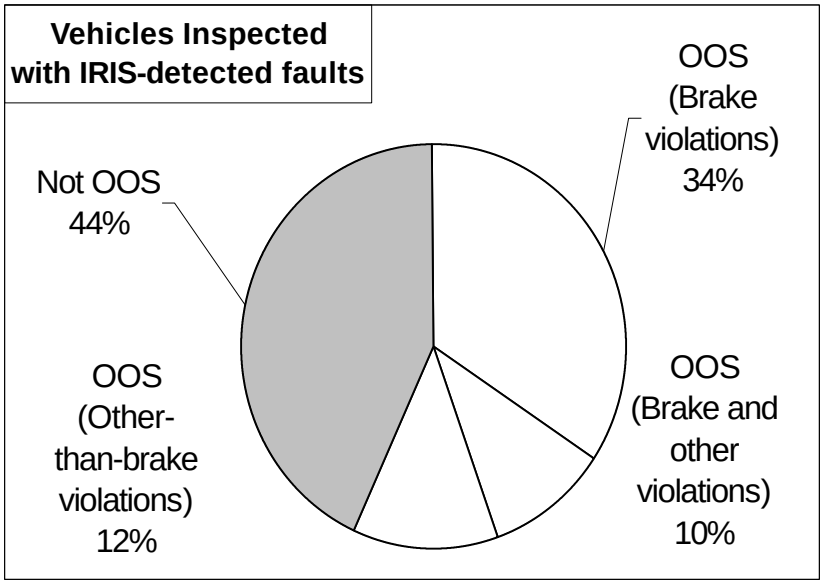


Figure J-10. Percentage of CMV placed out of service in Tennessee after IRISystem screening DID NOT detect problematic wheels (blind vehicles).

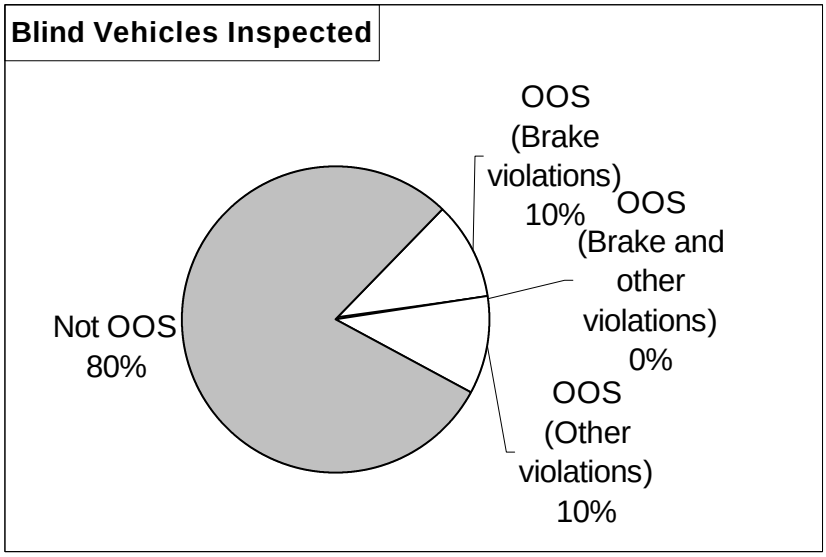
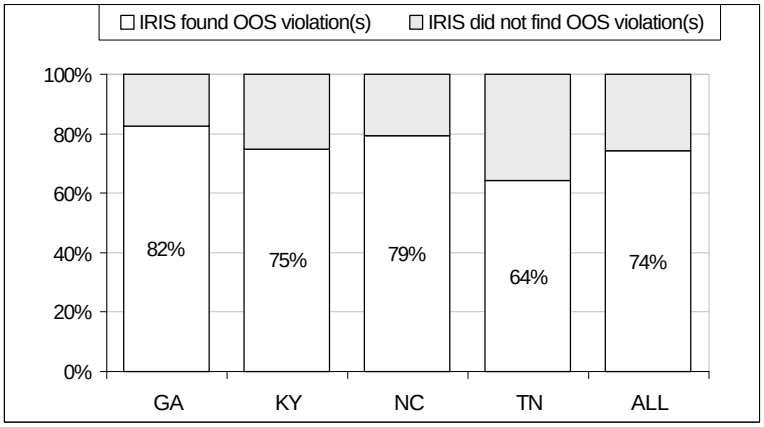


Figure J-11. Percentage of OOS CMVs for which the IRISystem found or did not find the OOS violation(s).



Appendix K

Results

Comparison with SAFETYNET data

Table K-1. Percentage of OOS, BV and OOS with BV after IRISystem Screening (for problematic CMVs only) and after current screening (SAFETYNET Level 1 inspections data for 1997-1999). The numbers indicated in parenthesis indicate the ratio of IRISystem over current screening results.

	Screening method	Number of CMV	OOS	BV †	OOS & BV †
All States	Current	216865	27%	34%	15%
	IRISystem††	330	59% (2.2)	84% (2.5)	52% (3.4)
GA	Current	23317	41%	37%	23%
	IRISystem††	33	55% (1.3)	82% (2.2)	48% (2.1)
KY	Current	104256	19%	37%	11%
	IRISystem††	96	53% (2.9)	85% (2.3)	45% (4.0)
NC	Current	32645	30%	32%	19%
	IRISystem††	111	67% (2.2)	88% (2.8)	60% (3.2)
TN	Current	56647	35%	28%	18%
	IRISystem††	90	57% (1.6)	79% (2.8)	52% (2.9)

† BV: Brake violation(s), not necessarily resulting in OOS. †† Problematic vehicles only.

Figure K-1. All States

Top plot **Percentage of CMV placed OOS for all four states after IRISystem screening (no blind vehicles) and after current screening (SAFETYNET data, for 1997-1999 and Level 1 inspections).**

Bottom plot **Same as top plot, but showing SAFETYNET data per year.**

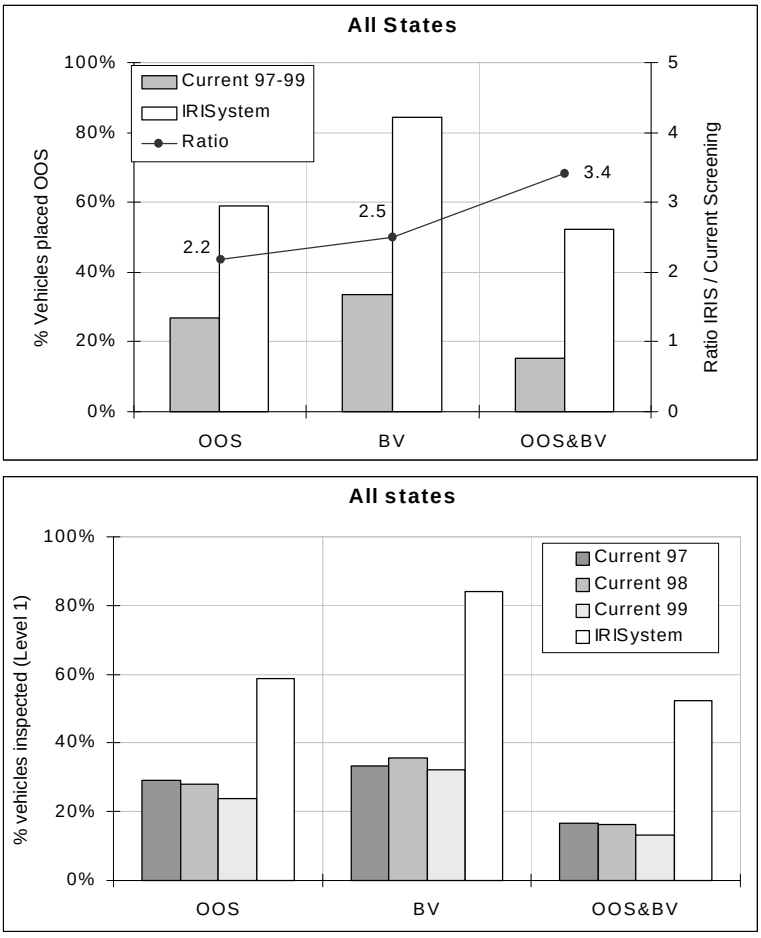
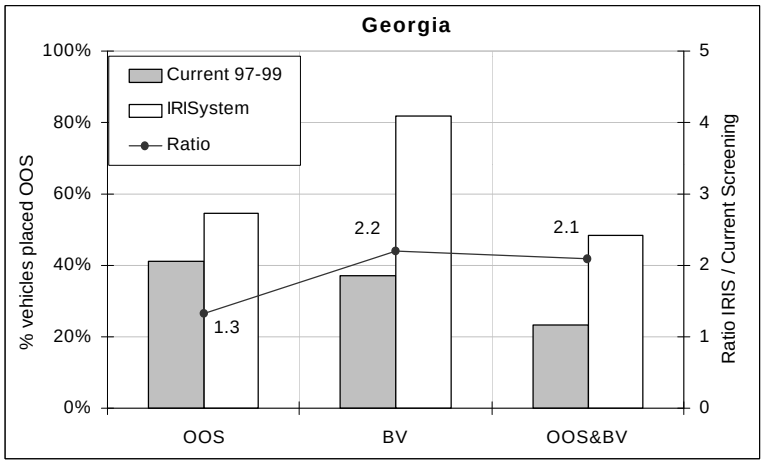


Figure K-2. Georgia

Top plot **Percentage of CMV placed OOS for Georgia after IRISystem screening (no blind vehicles) and after current screening (SAFETYNET data, for 1997-1999 and Level 1 inspections).**

Bottom plot **Same as top plot, but showing SAFETYNET data per year.**



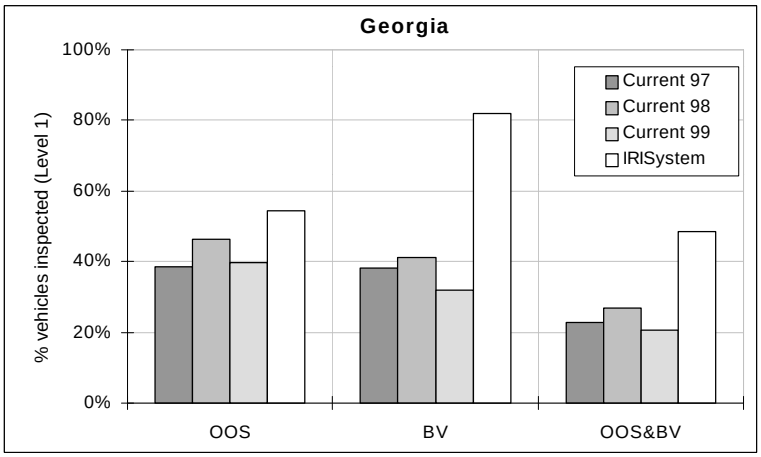


Figure K-3. Kentucky

Top plot **Percentage of CMV placed OOS for Kentucky after IRISystem screening (no blind vehicles) and after current screening (SAFETYNET data, for 1997-1999 and Level 1 inspections).**

Bottom plot **Same as top plot, but showing SAFETYNET data per year.**

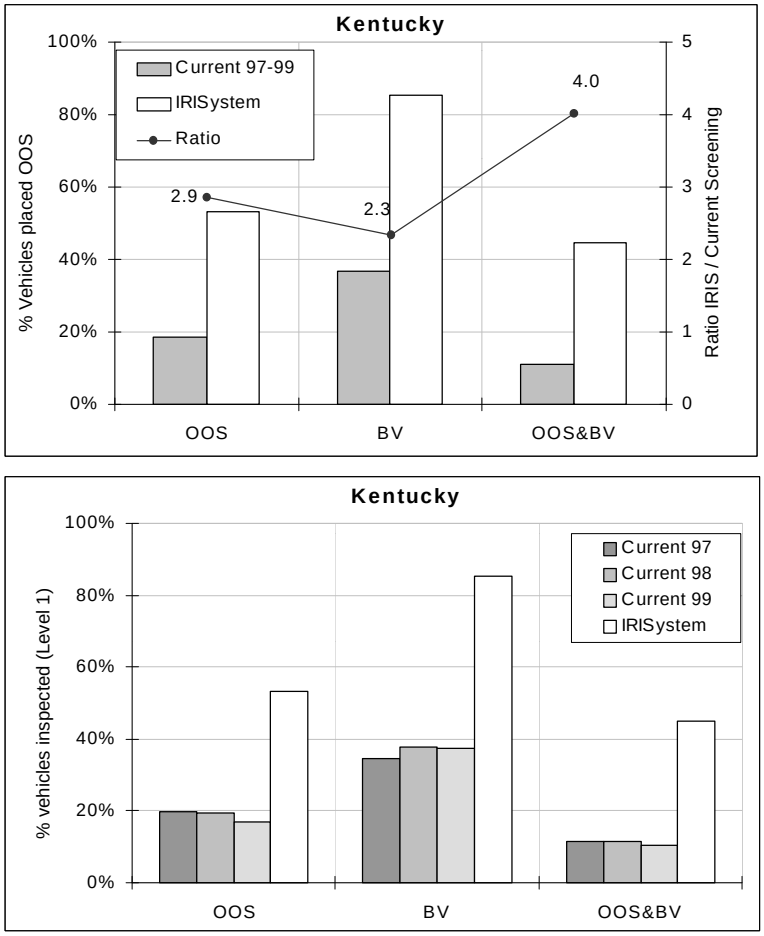


Figure K-4. North Carolina

Top plot **Percentage of CMV placed OOS for North Caroline after IRISystem screening (no blind vehicles) and after current screening (SAFETYNET data, for 1997-1999 and Level 1 inspections).**

Bottom plot **Same as top plot, but showing SAFETYNET data per year.**

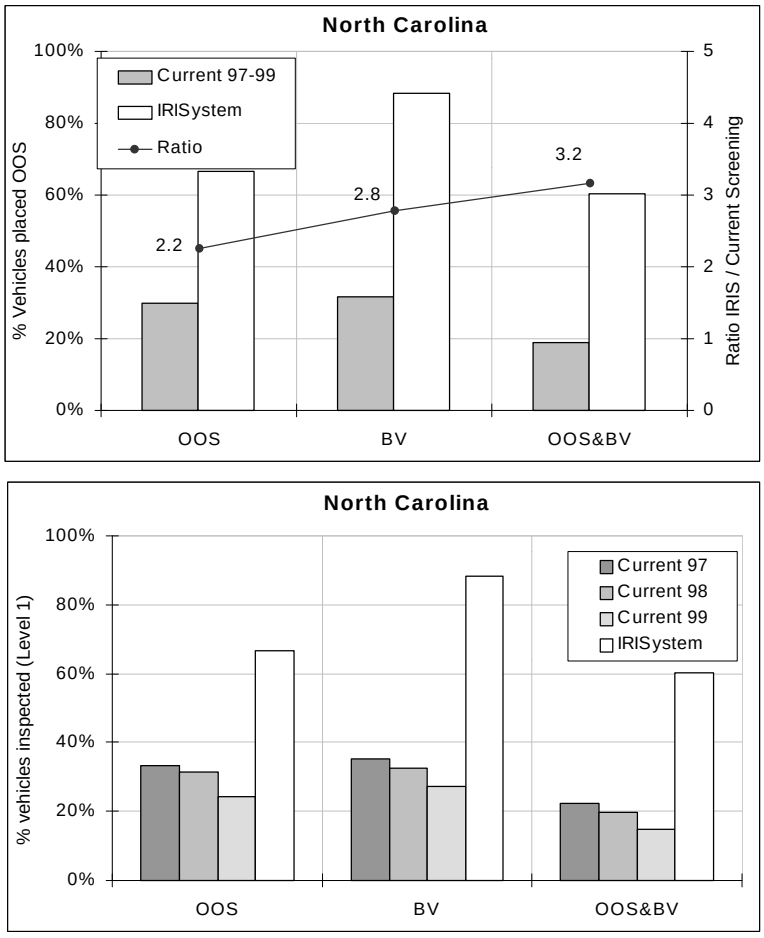


Figure K-5. Tennessee

Top plot **Percentage of CMV placed OOS for Tennessee after IRISystem screening (no blind vehicles) and after current screening (SAFETYNET data, for 1997-1999 and Level 1 inspections).**

Bottom plot **Same as top plot, but showing SAFETYNET data per year.**