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The Colorado Remote Sensing Program January – December 2015

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I. Summary

The Colorado Department of Public Health & Environment (CDPHE) and the Department of Revenue (DOR) have operated an Enhanced Inspection and Maintenance (I/M) program in the Denver metropolitan area (DMA) since 1995. Operations for a remote sensing clean screening element commenced in 2003. Previous reports, “The Colorado Clean Screening Program’ reports for July 2003 – December 2004 and annual reports for 2005-2014¹ described on-road measurement activities and the vehicles exempted from inspection. This report covers calendar year 2015.

The clean screening program uses remote sensing to measure the tailpipe emissions of vehicles as they drive by measuring equipment positioned on the side of the road. Vehicles that are determined to have low tailpipe emissions are granted an exemption from the I/M inspection. Clean screening improves convenience of the I/M program for vehicle owners.

In order to exempt vehicles from inspection, computer systems and procedures are required for administering the program and notifying vehicle owners of their inspection exemption. The I/M program is registration enforced and the administration of the clean screening program requires the transmission of information among the contractor, CDPHE and DOR who manage motor vehicle registrations.

RapidScreen provided benefits to vehicle owners of \$4.05M through reduced time and expense associated with eliminated inspection station visits. The reduction in station inspections also yielded net savings in greenhouse gases and 150,000 gallons of gasoline.

Changes to the I/M program were implemented at the start of 2015:

- The new vehicle exemption was extended from four to seven years;
- Models 8 to 11 years old with functioning OBD-II systems were subject to the OBD I/M test instead of IM240 or Idle tailpipe tests;
- All remote sensing measurements were made using RSD5000 systems monitored remotely from a nearby service van.

Collection Activity

In 2015, four single-unit RSD vans and six vans designed to transport, deploy and monitor three systems each, were used in the DMA and Northern Front Range (NFR). Nine RSD4600 and twenty-two different RSD5000 systems were used as some units were rotated for preventive or corrective maintenance. Almost 90% of data were collected by the RSD5000 systems. Units were deployed at 89 locations in the DMA and 28 locations in the NFR for a total of 22,159 active collection hours. A total 5.0 million emission measurements were collected and successfully matched to Colorado registered vehicles. Additional remote sensing productivity information is provided in Section IV.

2014 vs 2015 Collection Comparison

In 2014, RSD performed over 6.5 million emission measurements at 94 locations in the DMA and 28 locations in the NFR. Clean screens were issued in 2015 were 18% fewer than 2014,

being 195,778 in 2015 vs. 238,136 in 2014 primarily resulting from the additional three model years of newer vehicles exempt from inspection.

Vehicle Exemptions

Over 226,000 vehicles measured on-road initially met the clean screening exemption criteria. Two percent of these were reserved to provide a program audit sample and others were eliminated during the QA reviews, for example, as a result of vehicle plate changes. The owners of the remaining 219,860 vehicles meeting the clean screening criteria were issued notices granting exemption from the I/M test at an inspection station. Of these vehicles, 195,778 (89.0%) owners took advantage of the Clean Screen exemption.

Two methods were used to qualify vehicles, 2-RSD and Hybrid. With the 2-RSD method, vehicles qualified for an exemption if they had two or more on-road measurements and the most recent two measurements both showed emissions within the clean screen standards. With the 'Hybrid' clean screening method vehicles measured once by remote sensing qualified for clean screening if the emissions measurement was within the clean screen standards and the vehicle model had a historically low rate of emissions problems.

A 2% random sample of vehicles that qualified was not issued exemption notices and 3,717 of these vehicles were subsequently inspected at an enhanced inspection station. The results of the station inspections were used to evaluate the effectiveness of the program. Additional information about vehicles mailed notices is provided in Section IV.

Clean Screen Program Effectiveness

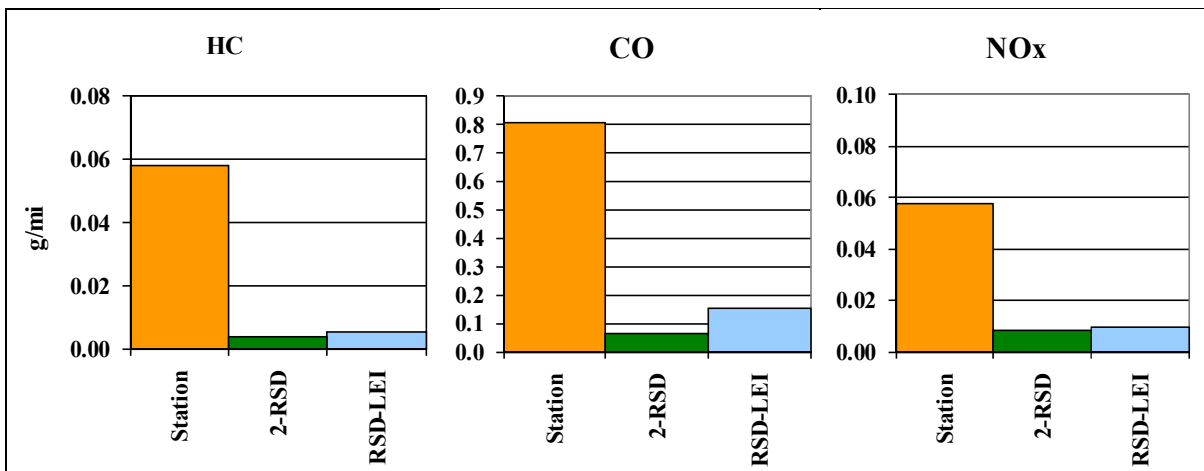
In a Clean Screen program, some vehicles passing the clean screen emissions criteria might have failed if inspected at an inspection station. Therefore, a Clean Screen program, while greatly improving convenience for vehicle owners, can slightly reduce the overall effectiveness of the I/M program.

On May 5th 2008, IM240 Denver Metro Area station test standards were tightened – especially for HC and NO_x – to bring them into closer alignment with EPA final standards. The LEI table was updated with subsequent IM240 results to reflect consequent changes in inspection result statistics for vehicle models in December 2008, and annually thereafter. The RSD standards were updated in October 2010 with the addition of an RSD NO standard of 1000ppm that first applied to December 2010 registrants. In 2015, the required LEI pass rate was changed to 96%.

Figure I-1 compares the average IM240 exhaust reductions per vehicle inspected at stations to those of the 2-RSD audit sample and the Hybrid RSD-LEI audit sample. In contrast to 2014, the 2-RSD audit sample showed smaller reductions than RSD-LEI.

For 2015, based on the 2% random audit vehicles, it was projected that 98.2%, 96.9% and 95.5% of HC, CO and NO_x of program exhaust emission reductions were retained. The impact on gas cap related evaporative emissions was projected to be another 0.9% of HC reductions.

Figure I-1 Average IM240 Emissions Reductions



The methodology for estimating clean screen effectiveness only allows for a score of 100% or less and uses the IM240 test as a “gold” standard. Any variations in vehicle performance or the IM240 test procedure that produce an anomalous IM240 test failure are scored against Clean Screen. Therefore, it is possible the Clean Screen effectiveness was better than projected.

II. Description of the Denver Clean Screening Program

A. I/M Program Overview

The Colorado Department of Public Health & Environment (CDPHE) operates an enhanced Inspection and Maintenance (I/M) program in the Denver metropolitan area (DMA) and the Northern Front Range (NFR). The clean screening component of the IM program uses remote sensing equipment to measure the tailpipe emissions of vehicles as they drive by the measuring equipment. Vehicles that are determined to have low tailpipe emissions are granted an exemption from their I/M inspection.

Operating rules for the Clean Screening program are contained in the Air Quality Control Commission's Regulation 11². The Regulation defines the maximum percentages of vehicles that may be evaluated by the clean screen program in the enhanced I/M area. In 2006, the percentage of vehicles allowed to be evaluated using remote sensing was decreased from 80% to 50% as part of an Early Action Compact (EAC) to achieve an earlier attainment designation for ozone.

Clean Screening regulations were expanded in 2007 to allow use of a single RSD measurement combined with an index of low emitting vehicles to evaluate exemption candidates. The Low Emitter Index (LEI) was developed using I/M240 data to identify vehicle groups that historically have a low probability of failing. The 2015 requirement for a vehicle group to qualify as a potential low emitter is they must have an I/M240 pass rate of 96% or greater. Individual vehicles within the group must also pass the RSD measurement cutpoints.

There are multiple requirements and restrictions for vehicles to participate in the Clean Screen program as defined in Regulation 11. The following are the primary elements for vehicles to qualify for a clean screen exemption.

- The applicable observations were within twelve months prior to the individual vehicles registration renewal date,
- The two most recent observation results are below, 200ppm, 0.5%, and 1000ppm for HC, CO, and NOx respectively, (NOx standard implemented October 2010)
- The two most recent observations must have occurred on a different day or on the same day at different site locations,

Contractor

Envirotest was contracted to operate the enhanced program by a competitive bid process and the contract was subsequently amended to include clean screening in the Denver area. Envirotest uses technology derived from that originally developed at Denver University with whom Envirotest has a royalty agreement.

Theory of operation

The RSD is a system designed for a non-intrusive measurement of vehicle emissions. It generates and monitors a non-dispersive infrared and dispersive ultra-violet beam emitted and reflected approximately 10 to 18 inches above ground preferably across a single lane road. Gasoline, diesel, or other fossil fuel powered vehicles drive through this beam and the exhaust interferes with this transmission of the beam. Quantifying the interference enables the calculation of tailpipe concentrations of CO, HC, CO₂, NO and particulate matter. A camera simultaneously captures a digitized video image of the rear of the vehicle and its license plate.

Equipment

The equipment initially deployed in the Northern Front Range counties were RSD-3000 mobile units also called AccuScanTM. Successor RSD 4000 units were introduced in 2003. Both systems were based on a technical platform developed at the University of Denver by Dr. Donald Stedman. In 2007, additional RSD4600 units were added. The RSD4600 had a more compact speed and acceleration measurement bar and more diagnostic ports. Functionally, the two systems were the same. RSD 5000's, the latest generation of RSD systems, passed acceptance testing in 2011 and began data collection in December 2011. Five additional 5000 units were added in 2013 and 2014. In 2015, RSD5000's were used to perform the majority of measurements with up to 22 units deployed at one time. The RSD 5000 is more compact, requires less power, can run on batteries instead of a generator and supports remote wireless operation.

AccuScan measures the exhaust of a passing motor vehicle in less than 0.7 seconds. Non-dispersive infrared (IR) spectroscopy, the same analytical technique used in garage based two-speed idle and ASM equipment is used to measure concentrations of CO, HC, and CO₂. Dispersive ultraviolet (UV) spectroscopy is used to measure NO_x. The system is based on the original designs and patents of Dr. Donald Stedman, professor emeritus at the University of Denver.

The following elements comprise a standard RSD5000 unit:

- Main box:
 - Enclosed Source/Detector Module (SDM) with Internal Gas
 - Calibration Cell and embedded Weather Station
 - Network Speed/Acceleration System (S/A)
 - Central System Control Unit (SCU)
 - Battery power supply
- Enclosed Corner Cube Mirror (CCM); Sapphire Windows
- Network Video Camera for License Plate Capture
- Remote Sensing Windows based Software
- Tag Editing and Data Processing Software
- Calibration and auditing subsystem consisting of:
 - Calibration gas cell
 - Audit tube

- Audit gas bottle
- Pressure regulator
- Hoses with quick disconnects

Chevy express 3500 cargo vans outfitted with a winch are used to deploy and recover the RSD5000 systems efficiently. Once a unit is lowered to the ground it is placed on a two wheel hand cart and moved to the location where it will test. Deploying the equipment from the smaller cargo van allows operators to be further away from traffic while setup is in progress. Also, not having a van permanently at each test site has improved overall safety. Setup time has been reduced from 45 minutes to thirty minutes or less for each unmanned unit. End of day shutdown of a test site has been reduced from 30 minutes to 10 minutes or less. The reductions in setup and shutdown time leave greater active vehicle measurement time per shift. Up to three RSD 5000 units can be deployed and managed by a single operator.





The RSD unit takes multiple rapid readings for each vehicle to characterize the exhaust plume profile and evaluate whether a valid measurement of a vehicle's exhaust has been achieved. The criteria include how much vehicle exhaust plume is available for the duration of the sampling period, evaluation of whether plume measurements are consistent with normal plume dissipation, and correction for changes in background concentrations of emissions.

The RSD units comply with the CDPHE, "Colorado On-road Vehicle Emissions Remote Sensing System (COVERS) Specifications" Amended July 2010³: The COVERs accuracy specifications are consistent with the California BAR OREMS Specification:¹ and include:

¹ On Road Emissions Measurement System (OREMS) Specifications, Revision L, Bureau of Automotive Repair, Engineering and Technical Research Branch, 10240 Systems Parkway, Sacramento, CA 95827; 2001 California DCA/BAR; p. 5.

Detector accuracy:

1. The CO₂% reading shall be within $\pm 10\%$ of the Certified Gas Sample, or an absolute value of ± 0.25 , or shall be within published manufacturer's specification – whichever is less restrictive. Negative values shall be included and shall not be rounded to zero.
2. The CO% reading shall be within $\pm 15\%$ of the Certified Gas Sample, or an absolute value of ± 0.25 (whichever is greater). Negative values shall be included and shall not be rounded to zero.
3. The HC reading (ppm propane) shall be within $\pm 15\%$ of the Certified Gas Sample, or an absolute value of ± 250 ppm (whichever is greater). Negative values shall be included and shall not be rounded to zero.
4. The NO_x reading (ppm) shall be within $\pm 15\%$ of the Certified Gas Sample, or an absolute value of ± 250 ppm (whichever is greater). Negative values shall be included and shall not be rounded to zero.
5. COVERS shall submit readings within the following limits:
CO + CO₂ $\leq 21.0\%$, HC $\leq 35,000$ ppm hexane, CO₂ $\leq 16.0\%$, and NO ≤ 7000 ppm.
6. The system shall record at least three and display at least two measures of plume characteristics, for example the maximum number of CO₂ molecules seen, the average number of CO₂ molecules seen, and the number of valid samples (measurements) made.
7. Each unit shall demonstrate during controlled acceptance testing the above criteria 98% of the time. Ninety-eight percent (98%) shall mean that one hundred percent (100%) of the valid records shall have the following fields filled correctly with accurate data, ninety-eight percent (98%) of the time:
CO₂%
CO %
HC ppm hexane
NO ppm

Speed and Acceleration Accuracy:

1. The vehicle speed measurement should be accurately recorded within ± 1.0 mile per hour.
2. The vehicle acceleration measurement should be accurately recorded within ± 0.5 mile per hour / second.
3. The speed and acceleration system shall demonstrate during controlled acceptance testing the above criteria ninety-five percent 95% of the time. Ninety-five percent (95%) shall mean that one hundred percent (100%) of the valid records shall have the speed and acceleration fields filled correctly with accurate data, ninety-five

percent (95%) of the time.

4. VSP shall be calculated during host processing using the most recent CDPHE approved equation.

Vehicle Identification

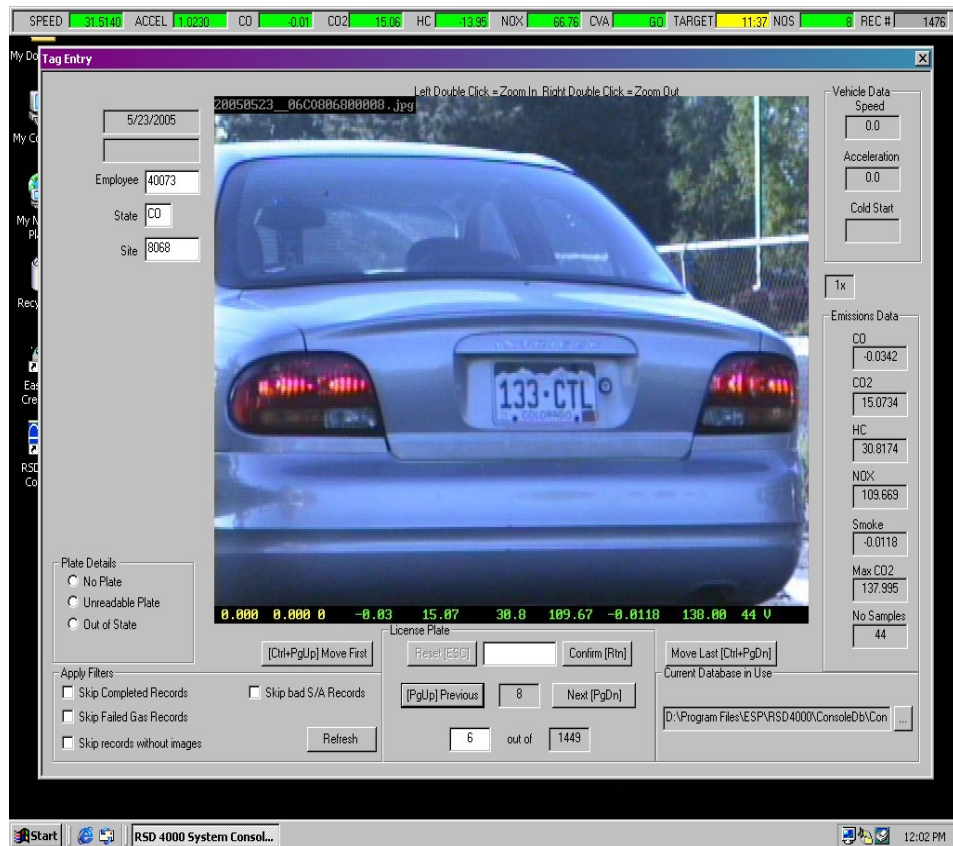
The system captures emissions readings and rear pictures of vehicles passing through the RSD infrared beam. The video and emissions readings taken are stored directly on a removable media disk and can be used for future reference.

Envirotest's TagEdit™ software is used to transcribe vehicle license plate information. Figure II-1 below shows an example of a TagEdit™ screen. This license plate editing service is superior to an automatic license plate reader because:

- All video images associated with valid emissions data get processed. This ensures the highest possible vehicle capture rate.
- Vehicles with special plates are also processed. This is especially important in areas where many unique license plates are issued. Failure to process all plate types can create a statistically skewed database that could be misinterpreted by the public as “targeting” only certain vehicle classes.

A special registration database was created for the Clean Screen program to allow vehicles to be identified (VINs) from Clean Screen license photos captured days prior to their data processing. This Clean Screen registration database is updated nightly with all the changes statewide that affect what VIN is associated with what plate. A lag time interval is incorporated to allow time for updates to get from the County Clerks Offices to the DOR database. The separate Clean Screen Registration Database on the Envirotest host contains all vehicle registration records statewide, even though only certain counties are expected to participate in the Clean Screen program. The future growth of registration could require some housekeeping, but there is plenty of hardware scalability to handle this growth.

Figure II-1: TagEdit™ Screen



B. Measurement Sites

Good remote sensing sites are critical for obtaining RSD measurements that are representative of vehicle operation. Recommended site attributes include:

- (1) Absence of cold start vehicle operating conditions
- (2) Sites where vehicles will generally be accelerating or driving at a steady speed uphill to ensure adequate engine power and exhaust plumes and avoid the problem of RSD not measuring vehicles that have virtually no exhaust under deceleration
- (3) Absence of enrichment due to high load conditions
- (4) Single lane operation
- (5) High volume traffic
- (6) Unobtrusive siting of the remote sensing equipment
- (7) Adequate median space for safe operation of the RSD equipment.

Table II-1 lists the RSD sites in the Northern Front Range (NFR), the number of days each site was used, the total hours during which measurements were collected and the number of vehicles measured per hour. The hours shown do not include travel time to and from the site, equipment set-up and equipment takedown time.

Table II-2 lists the Denver Metro Area (DMA) site locations.

Site locations in the NFR and DMA are illustrated in Figures II-2a and II b. Blue sites are active. Red sites are no longer permitted. The X's represent HQ and other stations where RSD vans are housed.

Table II-1 Northern Front Range

Site Code	Location	City	Active Days	Total Active Hours	Registered Vehicles Measured	Veh's Per Hour
2132	NB SHIELDS 100' PAST VINE DR	FT COLLINS	1	4	546	134
3017	EB TRILBY ROAD EAST OF SHIELDS STREET	FORT COLLINS	14	89	15,527	174
3019	ON RAMP TO NB I-25 FROM 402 (CR-54)	LOVELAND	18	117	13,879	119
3020	ON RAMP TO SB I-25 FROM 402 (CR-54)	LOVELAND	16	110	13,528	123
3508	ONRAMP TO NB I-25 FROM HARMONY RD.	FT. COLLINS	56	333	60,167	181
3509	ONRAMP TO NB I-25 FROM PROSPECT RD.	FT. COLLINS	20	133	5,473	41
3512	SB TIMBERLINE RD. JUST BEFORE WILLOW SPRINGS RD.	FT. COLLINS	20	134	32,612	244
3513	NB SHIELDS RD. AFTER BON HOMME RD.	FT. COLLINS	22	115	5,971	52
3514	NB TAFT HILL RD. AFTER HARMONY RD.	FT. COLLINS	26	182	39,174	215
3515	ONRAMP TO NB I-25 FROM WB US-34	FT. COLLINS	23	143	28,010	196
3516	ONRAMP TO NB I-25 FROM CROSSROADS BLVD.	FT. COLLINS	28	172	25,144	147
3517	ONRAMP TO SB I-25 FROM CROSSROADS BLVD.	FT. COLLINS	29	223	28,274	127
3527	EB 392 AFTER INTERSECTION WITH CR-9	FT. COLLINS	12	69	11,838	173
8042	ONRAMP TO SB I-25 FROM EAST PROSPECT	FT COLLINS	16	109	28,868	266
8049	ONRAMP TO SB I-25 FROM HARMONY RD	FT COLLINS	30	219	60,088	274
2989	EB US 34 BYPASS FROM 23RD AVE	GREELEY	7	46	6,609	144
3506	ONRAMP TO NB US-85 FROM HWY 52	FT. LUPTON	27	204	14,263	70
3507	ONRAMP TO SB US-85 FROM HWY 52	FT. LUPTON	9	69	10,083	145
3518	ONRAMP TO SB I-25 FROM SR-60	LOVELAND	18	133	9,679	73
3519	ONRAMP TO SB I-25 FROM SR-56	BERTHOUD	39	270	11,765	44
3520	ONRAMP TO SB I-25 FROM SR-66	LONGMONT	26	146	16,724	114
3521	ONRAMP TO SB I-25 FROM SR-52	LONGMONT	16	119	29,994	253
3522	ONRAMP TO SB I-25 FROM CR-8	DACONO	6	34	3,081	90
3523	ONRAMP TO NB I-25 FROM CR-8	DACONO	1	5	11	2
3524	ONRAMP TO NB I-25 FROM SR-52	LONGMONT	24	163	15,679	96
3525	ONRAMP TO NB I-25 FROM SR-119	LONGMONT	24	160	26,759	168
8044	ONRAMP TO EB US-34 FROM SH-257	GREELEY	25	195	25,627	131
8045	ONRAMP TO EB US-34 BYPASS FROM SH-257	GREELEY	18	143	17,796	124
Subtotal			571	3,839	557,169	145

Table II-2 Denver RSD Sites

Site Code	Location	City	Active Days	Total Active Hours	Registered Vehicles Measured	Veh's Per Hour
2169	ONRAMP TO NB I-25 FROM 136TH AVE.	THORNTON	4	19	1,860	96
2819	ONRAMP TO SB 121 FROM WB 287	WESTMINSTER	38	299	73,011	244
2821	ONRAMP TO NB I-25 FROM 120TH AVE	WESTMINSTER	8	57	11,350	198
2971	EB DILLON RD EAST OF US-287	BROOMFIELD	42	273	51,899	190
4198	ON RAMP TO NB PARKER ROAD FROM WB ARAPAHOE ROAD	AURORA	18	132	5,844	44
4204	ON RAMP TO WB I-76 FROM US-85	COMMERCE CITY	28	183	40,636	222
4207	ON RAMP TO SB I-25 FROM 144TH AVE	WESTMINSTER	4	31	2,721	86
4209	ON RAMP TO NB US-85 FROM CO-7	BRIGHTON	9	50	4,004	80
4210	EB 160TH AVE (CO-7) PAST RIVERDALE ROAD	THORNTON	7	38	3,712	98
4211	ON RAMP TO SB US-85 FROM CO-7	BRIGHTON	11	63	8,701	137
4313	ONRAMP TO WB I-70 FROM NB I-25	DENVER	51	335	131,089	391
8072	ONRAMP TO NB I-25 FROM 84TH AVE.	THORNTON	7	44	5,786	133
8073	ONRAMP TO NB I-25 FROM 104TH AVE.	NORTHGLENN	14	103	23,125	225
8087	ONRAMP TO WB I-70 FROM AIRPORT BLVD.	AURORA	33	254	41,788	165
8088	ONRAMP TO WB I-76 FROM 88TH AVE	COMMERCE CITY	28	148	11,240	76
8089	ONRAMP TO WB I-76 FROM 96TH AVE	COMMERCE CITY	26	170	25,091	148
8090	ONRAMP TO EB I-76 FROM PECOS ST.	DENVER	3	22	2,194	100
8091	ONRAMP TO WB I-76 FROM BROMLEY LN.	BRIGHTON	4	30	5,067	169
8093	ONRAMP TO WB I-70 FROM NB I-25	DENVER	136	843	415,054	492
8107	ONRAMP TO WB US-36 FROM BROADWAY	DENVER	43	319	106,514	334
8115	ONRAMP TO EB I-76 FROM FEDERAL BLVD	DENVER	6	34	2,494	73
8125	ONRAMP TO NB I-25 FROM THORNTON PKWY	THORNTON	6	34	2,936	86
8129	ONRAMP TO WB I-76 FROM PECOS ST	DENVER	17	92	13,622	149
2170	ONRAMP TO NB I-225 FROM BELLEVIEW AVE.	CHERRY HILLS	6	41	4,245	105
4200	ON RAMP TO NB SANTA FE FROM BELLEVIEW AVE	ENGLEWOOD	69	664	216,825	326
8095	ONRAMP TO SB I-225 FROM ILLIFF AVE.	AURORA	35	285	17,784	62
8098	ONRAMP TO NB I-225 FROM ILLIFF AVE	AURORA	44	381	57,239	150
8120	ONRAMP TO SB I-225 FROM ALAMEDA AVE	AURORA	36	296	45,444	153
2512	ONRAMP TO NB SH-157 FROM PEARL ST.	BOULDER	36	272	18,730	69
2513	ONRAMP TO SB DIAGONAL HWY FROM NB BOULDER RD	BOULDER	2	12	290	23
2514	ONRAMP TO 96TH AVE FROM SH-42.	BOULDER	2	11	1,481	130
8057	ON-RAMP TO SB SH 157 FROM PEARL ST.	BOULDER	31	209	33,550	161
8064	ONRAMP TO NB SH 157 (FOOTHILLS PKAY) FROM EB TABLE MESA	BOULDER	31	264	36,760	139
4205	WB DILLON ROAD BEFORE CO-287	BROOMFIELD	44	228	23,522	103
4206	EB 144TH AVE BEFORE ZUNI	BROOMFIELD	4	27	2,192	80
2171	ONRAMP TO WB I-70 FROM PECOS ST.	DENVER	1	5	154	32
2177	ONRAMP TO NB I-25 FROM EB I-76	DENVER	3	26	4,942	192
2179	ONRAMP TO EB I-70 FROM SB SHERIDAN BLVD	DENVER	3	27	1,845	67
2811	ONRAMP TO I-25 FROM WB SPEER	DENVER	65	469	90,459	193
3503	ONRAMP TO EB I-70 FROM QUEBEC ST.	DENVER	1	8	2,882	368
3505	ONRAMP TO WB I-70 FROM QUEBEC ST.	DENVER	74	534	156,667	293
8059	ONRAMP TO NB SANTA FE FROM US-285 (HAMPDEN AVE)	ENGLEWOOD	10	85	6,430	75
8060	EXIT LOOP TO NB SPEER BLVD FROM NB I-25	DENVER	2	12	2,065	174
8062	ONRAMP TO EB I-70 FROM FEDERAL BLVD	DENVER	56	382	67,907	178
8094	ONRAMP TO SB US-285 (HAMPDEN AVE) FROM FEDERAL BLVD	SHERIDAN	71	589	108,265	184
8096	ONRAMP TO NB US-285 (HAMPDEN AVE) FROM FEDERAL BLVD.	SHERIDAN	55	387	64,910	168
8113	ONRAMP TO SB US-285 (HAMPDEN AVE) FROM SHERIDAN BLVD.	DENVER	23	180	29,159	162
8122	ONRAMP TO NB I-25 FROM PARK AVE	DENVER	74	494	132,139	267
8123	ONRAMP TO NB I-25 FROM 58TH AVE.	DENVER	64	410	85,450	208
2319	ONRAMP TO EB C-470 FROM LUCENT BLVD	HIGHLANDS RANCH	49	448	79,948	178
2320	ONRAMP TO EB C-470 FROM BROADWAY	HIGHLANDS RANCH	107	842	337,841	401
2321	ONRAMP TO EB C-470 FROM UNIVERSITY BLVD	HIGHLANDS RANCH	64	445	128,332	288

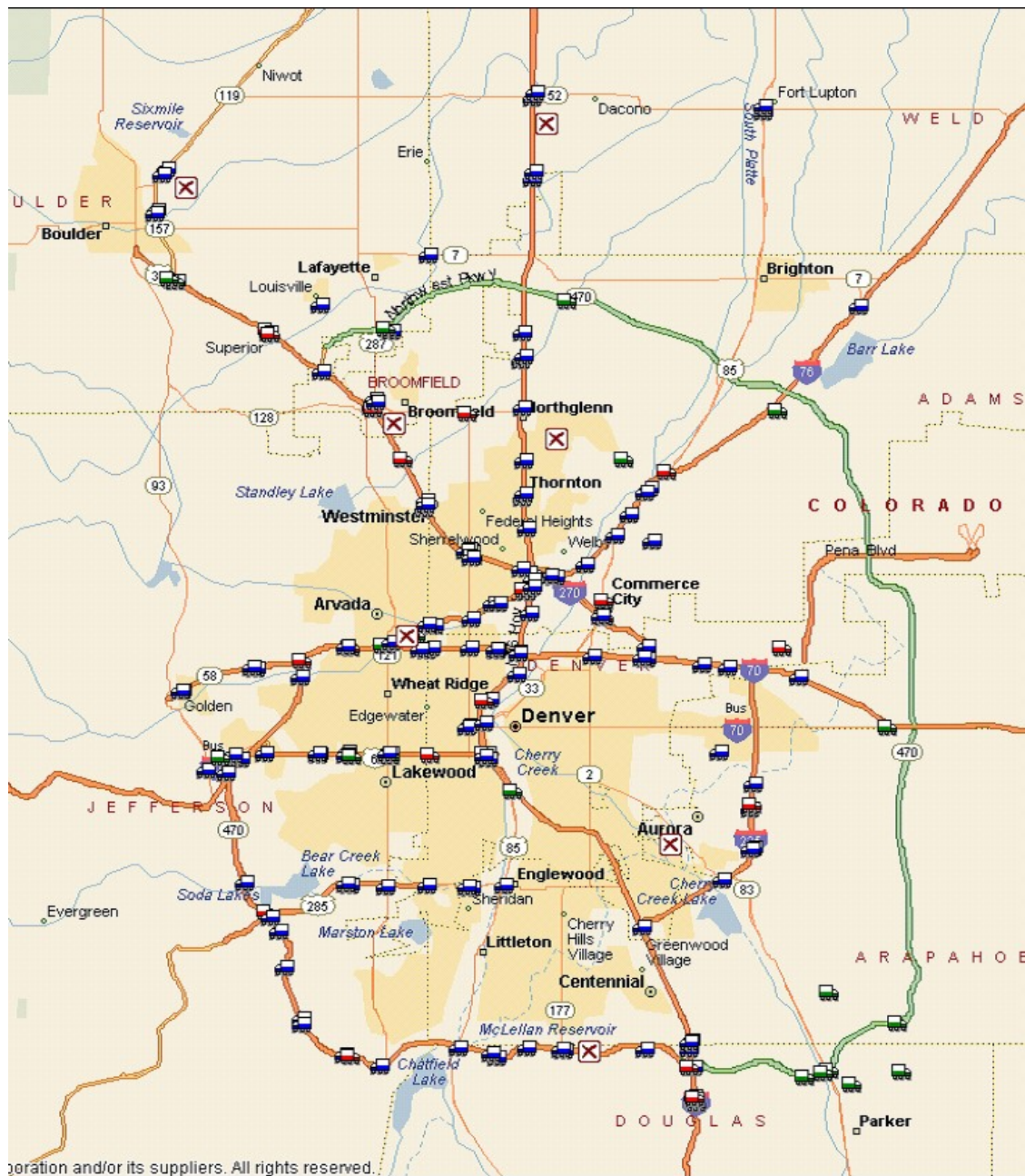
Table II-2 Denver RSD Sites continued

Code	Location	City	Days	Active	Vehicles	Per
2322	ONRAMP TO WB C-470 FROM UNIVERSITY BLVD	HIGHLANDS RANCH	37	235	40,607	173
2574	ONRAMP TO NB I-25 FROM WB COUNTY LINE RD.	HIGHLANDS RANCH	5	28	2,638	94
2576	ONRAMP TO SB I-25 FROM EB COUNTY LINE RD.	HIGHLANDS RANCH	51	452	90,982	201
2577	ONRAMP TO NB I-25 FROM EB COUNTY LINE RD.	HIGHLANDS RANCH	90	695	209,900	302
4197	ON RAMP NB I-25 FROM WB RIDGEGATE PKWY	LONE TREE	21	150	26,055	173
8077	ONRAMP TO EB C-470 FROM QUEBEC ST.	HIGHLANDS RANCH	141	1,412	678,020	480
8083	ONRAMP TO SB I-25 FROM FOUNDERS PARKWAY (EXIT 184)	CASTLE ROCK	51	405	78,822	195
8084	ONRAMP TO SB I-25 FROM LINCOLN AVE.	LITTLETON	40	317	44,579	141
8085	ONRAMP TO NB I-25 FROM WOLFENBERGER RD. (EXIT 182)	CASTLE ROCK	52	381	130,735	343
8086	ONRAMP TO NB I-25 FROM FOUNDERS PARKWAY (EXIT 184)	CASTLE ROCK	32	249	74,096	297
2172	ONRAMP TO EB C-470 FROM BOWLES AVE.	LAKEWOOD	9	61	6,511	107
2173	ONRAMP TO EB C-470 FOM KEN CARYL AVE.	LAKEWOOD	7	53	5,103	96
2174	ONRAMP TO WB C-470 FROM WADSWORTH PKWY	LAKEWOOD	6	54	4,458	83
2175	ONRAMP TO WB C-470 FROM KIPLING ST.	LAKEWOOD	7	67	6,022	90
2176	ONRAMP TO WB C-470 FROM KEN CARYL AVE	LAKEWOOD	7	32	4,775	150
2325	ONRAMP TO EB C-470 FROM QUINCY AVE	LAKEWOOD	7	61	5,426	90
2327	ONRAMP TO WB I-70 FROM WB US-6TH AVE	GOLDEN	29	177	28,468	160
2400	ONRAMP TO WB C-470 FROM NB US-285 (HAMPDEN AVE)	LAKEWOOD	10	69	11,645	168
2457	ONRAMP TO EB US-6TH AVE FROM SIMMS ST	LAKEWOOD	1	6	1,255	228
2458	ONRAMP TO WB US-6TH AVE FROM SIMMS ST	LAKEWOOD	29	215	32,478	151
2460	ONRAMP TO EB US-6TH AVE FROM SB WADSWORTH BLVD	LAKEWOOD	1	6	721	123
2461	ONRAMP TO WB US-6TH AVE FROM NB WADSWORTH BLVD	LAKEWOOD	1	8	1,701	212
2464	ONRAMP TO WB I-70 FROM NB WADSWORTH BLVD	ARVADA	5	33	1,328	41
4199	ON RAMP TO WB C-470 FROM ALAMEDA PKWY	LAKEWOOD	11	52	5,518	107
4201	ON RAMP TO EB I-70 FROM DENVER WEST BLVD	LAKEWOOD	4	26	4,279	166
8058	ONRAMP TO WB I-76 FROM SHERIDAN BLVD.	ARVADA	15	109	20,798	190
8068	ONRAMP TO EB I-70 FROM HARLAN ST.	ARVADA	13	113	17,119	152
8069	ONRAMP TO WB I-70 FROM KIPLING ST.	WHEATRIDGE	30	207	49,713	240
8100	ONRAMP TO WB US-6TH AVE FROM SB KIPLING ST.	LAKEWOOD	3	26	3,395	132
8101	ONRAMP TO WB US-6TH AVE FROM INDIANA ST.	LAKEWOOD	29	188	24,139	128
8104	ONRAMP TO SB US-285 (HAMPDEN AVE) FROM WADSWORTH BLVD.	DENVER	25	215	27,477	128
8105	ONRAMP TO SB US-285 (HAMPDEN AVE) FROM KIPLING BLVD.	DENVER	29	200	31,686	159
8106	ONRAMP TO NB US-285 (HAMPDEN AVE) FROM KIPLING BLVD.	DENVER	27	148	26,801	181
8110	ONRAMP TO EB SH-58 FROM WASHINGTON AVE	GOLDEN	6	46	8,027	173
8112	ONRAMP TO WB C-470 FROM MORRISON RD.	MORRISON	13	78	8,043	103
8130	ONRAMP TO EB I-76 FROM SHERIDAN BLVD	ARVADA	14	78	12,681	162
8131	ONRAMP TO EB I-70 FROM SHERIDAN BLVD.	ARVADA	8	60	5,114	85
Subtotal			2,471	18,320	4,478,310	244

This map shows the Fort Collins area in Colorado. Major highways include I-76 running north-south and I-25 running east-west. Local roads like E Vine Dr, E Prospect Rd, and W Horsetooth Rd are labeled. The map also shows the Horsetooth Reservoir and the Horsetooth Mountain Park-East Entrance. The city of Fort Collins is centrally located, with surrounding areas like Laporte, Timnath, and Windsor also visible. The map is color-coded with green for land, blue for water, and brown for roads.



Figure II-2 b: Site Locations – Denver Metro Area



C. Sources of Data and Description of Elements

Data used in the analyses in this report come from three primary sources:

- Remote sensing unit measurements
- The DMV database maintained on the AIR program contractor host computer

- I/M test database maintained on the AIR program contractor host computer

Data from the RSD units are loaded into a database maintained by the centralized contractor, Envirotest. Using the vehicle plate identified by RSD, the registration file is accessed to determine the vehicle identification number (VIN) and vehicle registration information. Envirotest uses the Polk VIN Decoder to add additional information about each vehicle. The combined data fields are shown in Table II-4.

Table II-4 Vehicle Measurement Information

Field Name	Description
V_DATA_VER	Data version
V_DATE_TIME	Date and time of measurement
V_RSD_UNIT	RSD system number
V_SEQ_NUM	Measurement sequence number
V_SITE_CODE	Site reference
V_PROGRAM_CODE	I/M Program
V_VAN_OPERATOR_ID	
V_CO	Carbon monoxide emissions %
V_CO2	Carbon dioxide emissions %
V_MAX_CO2	Maximum observed CO2
V_CO2_VOLUME	Volume of CO2 observed
V_HC	Hydrocarbon emissions ppm hexane equivalent
V_NOX	Oxides of nitrogen emissions ppm (NOx)
V_NOX_FLAG	Validity of NOx measurement
V_OPAC	Opacity measurement
V_SPEED	Speed MPH
V_ACCEL	Acceleration MPH/S
V_SA_UNITS	Units of speed and acceleration
V_TEMPERATURE	Ambient temperature
V_HUMIDITY	Ambient humidity
V_WIND_SPEED	Ambient wind speed
V_WIND_DIRECTION	Ambient wind direction
V_WEATHER_UNITS	
V_PLATE_CONFIDENCE	Reserved for future use
V_ALPR_VENDOR	Reserved for future use
V_TEST_COUNTY	Reserved for future use
V_CRC	
V_TAG_EDIT_MODE	
V_TAG_EDIT_ID_1	
V_TAG_EDIT_ID_2	
V_TAG_EDIT_ID_3	
V_TAG_EDIT_EMP_1	
V_TAG_EDIT_EMP_2	
V_TAG_EDIT_EMP_3	
V_PLATE	License plate
V_PLATE_STATE	State issuing license plate
V_PLATE_TYPE	Type of plate
V_VIN	Vehicle Identification Number

Field Name	Description
V_LZIP	Zip code for legal owner address
V_STATE_MAKE	Make code
V_STATE_MODEL	Model code
V_COUNTY	County of registration
V_VEH_YEAR	Model year
V_EM_FLAG	Subject to emissions test
V_POLK_VEH_YEAR	Polk decoded model year
V_POLK_MAKE	Polk decoded make
V_POLK_VEH_TYPE	Polk decoded vehicle type (P-pass, T-truck, U-unknown)
V_POLK_MODEL	Polk decoded model
V_POLK_DISP	Polk decoded engine displacement
V_VSP	Calculated vehicle specific power during measurement

III. Summary of Data Collection

Up to 9 RSD4600 and 22 RSD5000 remote sensing units were deployed for 3,042 days during 2015 to collect 5.0M measurements having a visible plate and valid HC, CO, NO, speed and acceleration values: 4.5M measurements in the Denver metropolitan area (DMA) Metro Area and 557,000 measurements in the Northern Front Range (NFR).

Clean screen exemption notices were issued for 219,860 vehicles scheduled to renew their registration in 2015 and due for emissions testing (Table III-1) comprising 185,162 DMA vehicles and 34,698 NFR vehicles.

Vehicles registered in the DMA accounted for over 4.1M measurements, the NFR for 0.5M, and El Paso County) 0.1M. Another 0.2M measurements were of vehicles registered in other Colorado counties and 0.2M measurements were not matched (Table III-2).

Table III-1 Collection Summary

Collection Summary			
Statistic	Denver Metro Area	Northern Front Range	Total
Sites Used	89	28	117
Collection Van Days	2,471	571	3,042
Active Collection Van Hours	18,320	3,839	22,159
Matched to Registration	4,478,310	557,169	5,035,479
Notices Generated for 2015 renewals	185,162	34,698	219,860

A. Monthly Collection Activity

Figure III-1 shows the monthly RSD measurements. Collection rates were lower during severe winter months.

B. Measurements by Hour of Day

Figure III-2 ‘Measurements by Hour of Day’ shows the number of vehicles measured during each hour of the day. The shape of the curve is indicative of when measurements were collected and does not represent the level of traffic during the day. Most measurements were collected between 7:00am and 7:00pm.

Figure III-1 Monthly RSD Measurements

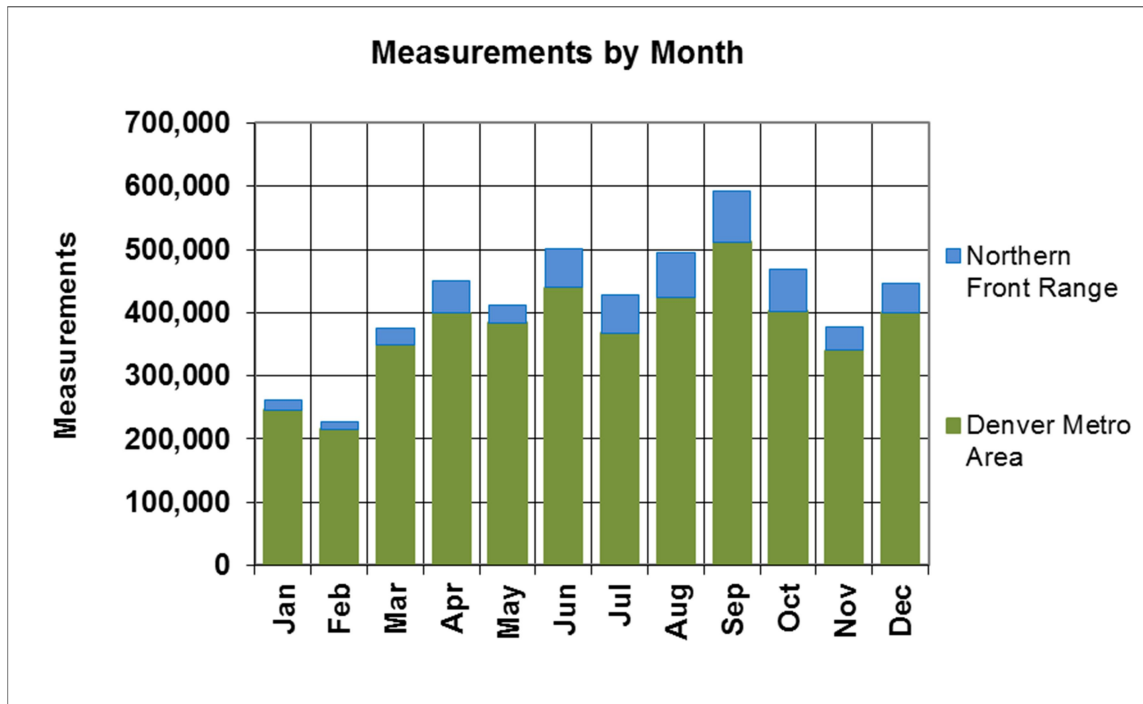
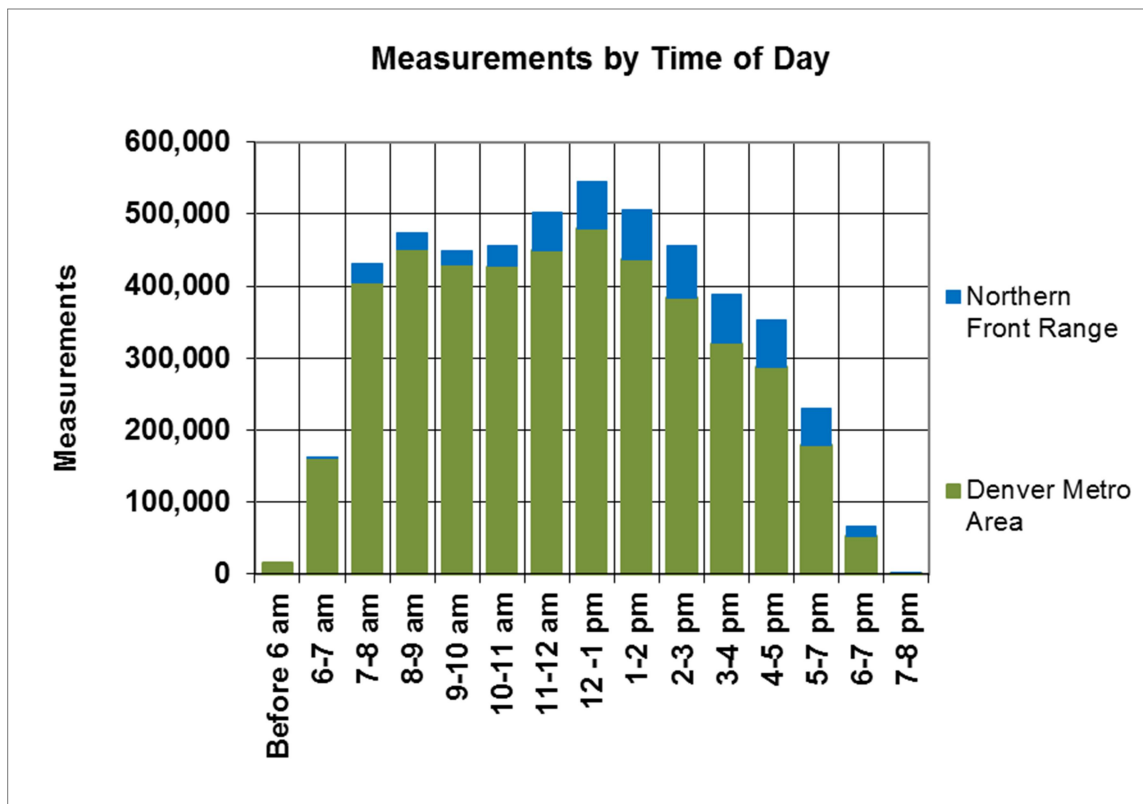


Figure III-2 Measurements by Time of Day



C. Composition of Vehicles Measured

Table III-2, Source of Vehicle Registrations Measured by RSD, shows the number of vehicles registered in each program area and the area where they were measured. The majority (97%) of Denver Metropolitan Area registered vehicles were measured within the DMA. A majority (80%) of Northern Front Range registered vehicles were measured in NFR with the remaining 20% being measured in the DMA.

Table III-3, Type of Vehicles Measured by RSD within Registration Jurisdiction, shows that 80.6% of vehicles measured were registered in the DMA, 10.0% in the NFR, 1.9% in El Paso County (Colorado Springs), 3.4% in other non-I/M counties, and 4.1% were not matched. This can occur when plates are transferred by an owner to a new vehicle. These numbers are indicative of on-road activity – not unique registrations. The same vehicle may be measured more than once.

Table III-4 shows the distribution of vehicle measurements by vehicle type, age group and registration jurisdiction. The vehicle types were identified by the Polk VIN decoder. The model years of 1980 and older vehicles and some of the newest models were determined from the registration information but the vehicle type was not available. These were classified as Unknown in Table III-3. Seventeen hundred and sixty-one measurements of motorcycles were also recorded.

Table III-2 Source of Vehicle Registrations Measured by RSD

Program	Registered County	Measured In				Total
		Denver Metro Area		Northern Front Range		
Denver Metro Area	Adams	495,111	95%	27,471	5%	522,582
	Arapahoe	728,957	98%	14,375	2%	743,332
	Boulder	134,673	85%	23,973	15%	158,646
	Broomfield	74,176	95%	3,539	5%	77,715
	Denver	654,843	97%	18,162	3%	673,005
	Douglas	1,116,006	99%	6,446	1%	1,122,452
	Jefferson	713,110	98%	13,578	2%	726,688
	State of Colorado	29,441	90%	3,335	10%	32,776
Subtotal Denver Metro		3,946,317	97%	110,879	3%	4,057,196
Northern Front Range	Larimer	31,800	11%	246,587	89%	278,387
	Weld	68,292	30%	156,057	70%	224,349
Subtotal Northern Front Range		100,092	20%	402,644	80%	502,736
El Paso	El Paso	88,437	94%	5,188	6%	93,625
Non I/M		157,843	91%	15,381	9%	173,224
Not Matched						208,698
Total		4,292,689	85%	534,092	11%	5,035,479

Table III-3 Type of Vehicles Measured by RSD within Registration Jurisdiction

Program	County	Pass	Truck	Unknown	Total	%
Denver Metro	Adams	150,294	367,573	4,715	522,582	10.4%
	Arapahoe	242,304	497,706	3,322	743,332	14.8%
	Boulder	48,641	108,859	1,146	158,646	3.2%
	Broomfield	25,101	52,330	284	77,715	1.5%
	Denver	217,874	451,524	3,607	673,005	13.4%
	Douglas	343,398	776,628	2,426	1,122,452	22.3%
	Jefferson	213,571	508,823	4,294	726,688	14.4%
	State of Colorado	6,125	22,307	4,344	32,776	0.7%
Denver Metro		1,247,308	2,785,750	24,138	4,057,196	80.6%
Northern Front Range	Larimer	89,865	186,582	1,940	278,387	5.5%
	Weld	69,438	152,972	1,939	224,349	4.5%
Subtotal North Front Range		159,303	339,554	3,879	502,736	10.0%
El Paso	El Paso	31,746	60,658	1,221	93,625	1.9%
Non I/M	0	43,594	125,652	3,978	173,224	3.4%
Not Matched					208,698	4.1%
Total		1,481,951	3,311,614	33,216	5,035,479	100.0%

Table III-4 Registered Jurisdiction and Age of Vehicles Measured by RSD

Vehicle Type	Model Year	Denver Metro Area	Northern Front Range	El Paso	Non-I/M	Total
Pass	1981 & older	150	12	7	12	181
	1982-1990	10,301	1,717	560	984	13,562
	1991-1995	37,881	6,345	1,145	2,092	47,463
	1996-2000	140,901	20,500	3,965	6,458	171,824
	2001-2005	295,889	40,783	7,193	11,829	355,694
	2006-2010	358,460	43,691	9,182	11,753	423,086
	2011 & newer	403,726	46,255	9,694	10,466	470,141
Light Truck	1981 & older	221	32	5	74	332
	1982-1990	15,509	2,499	627	2,336	20,971
	1991-1995	59,424	8,530	1,548	5,134	74,636
	1996-2000	274,103	34,471	6,103	15,551	330,228
	2001-2005	666,455	81,644	15,362	32,221	795,682
	2006-2010	775,940	91,648	16,988	32,441	917,017
	2011 & newer	994,098	120,730	20,025	37,895	1,172,748
Unknown	1981 & older	5,758	1,066	364	1,394	8,582
	1982-1990	545	112	39	155	851
	1991-1995	718	195	53	166	1,132
	1996-2000	1,667	425	90	344	2,526
	2001-2005	3,107	534	130	514	4,285
	2006-2010	3,531	583	183	571	4,868
	2011 & newer	5,417	746	158	471	6,792
Motorcycles		976	218	204	363	1,761
Total		4,054,777	502,736	93,625	173,224	4,824,362

IV.Clean Screening Program Performance

A. Vehicles Selected, Notices and Redemptions

In 2015, there were 226,611 vehicles qualifying for participation in the clean screen program. Table IV-1 summarizes the monthly number of vehicles meeting screening criteria each month, including the number withheld for the random sample and the number rejected through QA checks.

A random sample of two percent of vehicles meeting Clean Screen criteria are not mailed notices. These vehicles are required to go to a test station to obtain the station-based emission inspection. This random sample of vehicles is used to evaluate the effectiveness of the Clean Screen program.

Not all vehicles notified for clean screen or withheld in the random sample redeem the clean screen or obtain a test at that time, for example vehicles changing owner were likely to have obtained an earlier station inspection. Compared to the 219,860 vehicles notified in the year, fewer vehicles 195,778 (89.0%) obtained a clean screen.

Table IV-1 Vehicles Qualified As Meeting Clean Screening Criteria by Status

Reg Year	Reg Month	Random Sample	QA failed	Notified	Total Qualified	Random % of Qualified
2015	Jan	403	181	19,551	20,135	2.0%
2015	Feb	372	196	17,813	18,381	2.0%
2015	Mar	425	202	20,519	21,146	2.0%
2015	Apr	390	194	18,697	19,281	2.0%
2015	May	395	200	19,056	19,651	2.0%
2015	Jun	388	191	18,578	19,157	2.0%
2015	Jul	406	160	19,652	20,218	2.0%
2015	Aug	406	184	19,582	20,172	2.0%
2015	Sep	379	185	18,378	18,942	2.0%
2015	Oct	370	167	17,979	18,516	2.0%
2015	Nov	305	157	14,675	15,137	2.0%
2015	Dec	321	174	15,380	15,875	2.0%
Total		4,560	2,191	219,860	226,611	2.0%

Table IV-2 lists the number of vehicles by month and city notified via the Department of Revenue. Table IV-3 shows inspection results of the audit sample. Of the total audit sample 0.7% failed their exhaust emissions inspection up from 0.5% in 2015 and 2.0% failed OBD. Most vehicles had either an IM240 or an OBD inspection but the denominator is the total sample. Rates by test type were therefore higher. Gas cap pressure test failures of 3.1% were up from 3.0% in 2014.

Table IV-2 Notifications Transmitted to DOR

City	Registration Renewal Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
DENVER	3,182	2,795	3,318	3,192	3,303	3,237	3,339	3,243	3,106	3,033	2,603	2,666	37,017
AURORA	1,234	1,045	1,334	1,293	1,234	1,197	1,336	1,390	1,239	1,276	1,054	1,148	14,780
LITTLETON	1,226	1,137	1,281	1,128	1,113	1,150	1,204	1,270	1,155	1,117	927	1,075	13,783
ARVADA	1,005	975	1,112	978	1,021	1,024	1,004	1,035	966	974	762	826	11,682
FT COLLINS	1,059	849	1,097	962	946	990	988	1,037	895	961	771	727	11,282
HIGHLAND RCH	917	996	945	820	910	907	975	1,013	950	960	746	825	10,964
LAKEWOOD	937	829	897	809	810	770	787	742	766	722	598	628	9,295
THORNTON	735	725	856	721	734	737	764	676	699	602	545	550	8,344
CENTENNIAL	726	655	741	649	656	634	735	759	699	767	619	568	8,208
WESTMINSTER	731	647	778	639	697	659	697	678	598	609	509	569	7,811
CASTLE ROCK	567	490	547	504	551	528	638	634	593	561	493	500	6,606
PARKER	513	460	542	438	475	490	547	502	503	513	402	456	5,841
BOULDER	565	499	504	498	515	475	569	545	473	426	338	337	5,744
BROOMFIELD	494	478	533	489	553	512	464	510	493	386	336	356	5,604
LOVELAND	438	438	560	470	499	489	485	525	476	457	337	309	5,483
GREELEY	464	462	556	564	555	490	540	497	436	372	276	262	5,474
GOLDEN	515	402	405	369	387	350	390	424	345	372	323	343	4,625
LONGMONT	353	328	391	351	360	365	380	382	348	335	237	302	4,132
ENGLEWOOD	328	289	308	314	282	250	319	326	329	303	238	296	3,582
BRIGHTON	250	267	311	301	259	260	262	256	235	228	201	200	3,030
COMMERCE CITY	264	253	315	267	248	232	238	244	263	219	196	163	2,902
WHEAT RIDGE	242	222	233	239	187	197	222	204	202	198	154	180	2,480
WINDSOR	219	194	196	198	204	197	211	196	189	188	146	150	2,288
NORTHGLENN	219	220	197	183	230	221	191	190	178	176	133	132	2,270
LAFAYETTE	190	114	161	163	155	164	175	135	115	114	83	83	1,652
ERIE	153	96	153	138	130	121	129	124	137	110	81	104	1,476
EVERGREEN	126	117	117	118	111	116	133	114	124	129	87	97	1,389
MORRISON	137	115	111	102	122	103	116	106	139	116	108	112	1,387
LOUISVILLE	122	137	139	101	104	128	151	104	103	92	55	66	1,302
LONE TREE	108	86	120	77	100	98	92	114	98	118	84	110	1,205
FT LUPTON	110	72	114	108	95	101	101	115	88	99	50	66	1,119
EVANS	95	91	144	108	103	115	101	87	90	71	63	48	1,116
GREENWOOD VLG	96	89	83	96	96	80	89	91	118	92	92	82	1,104
JOHNSTOWN	70	64	90	89	85	74	94	94	92	112	71	71	1,006
FREDERICK	86	85	95	81	86	78	79	101	75	64	51	72	953
FIRESTONE	54	74	73	68	69	70	69	56	63	57	58	49	760
HENDERSON	53	66	85	78	52	67	64	50	74	43	60	65	757
CASTLE PNS N	56	66	62	47	47	64	70	72	72	59	55	47	717
BERTHOUD	58	54	59	61	60	72	57	67	58	62	55	50	713
OTHER	854	832	956	886	912	766	847	874	796	886	678	690	9,977
Total	19,551	17,813	20,519	18,697	19,056	18,578	19,652	19,582	18,378	17,979	14,675	15,380	219,860

Table IV-3 Clean Screen Audit Test Pass / Fail Statistics

Vehicle Type	Vehicles	Fail Tailpipe	Fail OBD	Fail Gas Cap / Pressure	Fail Inspection
Passenger	1,383	14	23	36	71
Light Truck	2,334	13	50	81	149
Total	3,717	27	73	117	220
Percentage		0.7%	2.0%	3.1%	5.9%

B. Clean Screen Program Effectiveness

The emissions reductions obtained during the station testing of the audit sample vehicles are used to project the total emissions reductions foregone as a result of the Clean Screen program.

Pass / Fail Statistics

Matching initial tests for audit vehicles were limited to those occurring after the second RSD measurement and before expiration of the assigned Clean Screen period. Matching re-inspections following an initial failure were sought through the end of February 2016⁵. The inspections identified for audit sample vehicles and the inspection results are tabulated in Table IV-3. As noted earlier, some of the anticipated random vehicles did not obtain a test within the Clean Screen period. In 2015, 2005 through 2008 models were normally inspected using OBD without a tailpipe emissions measurement and this included most of the RapidScreen audit vehicles from these years. The method used to estimate emissions and potential emissions reductions from these is described later in this section. In aggregate, 0.7% of the tested audit vehicles failed their tailpipe emissions inspection, 2.0% failed OBD and 3.1% failed the gas cap pressure test².

Following sections describe in detail how these results are used to evaluate the emissions impact of the Clean Screen program.

1. Tailpipe Tested Vehicles

Over 93% of the clean screen audit vehicles tested using either the Idle or IM240 tailpipe inspection, were tested using IM240. The vast majority of the few clean screen candidates inspected using the Idle test were 2000-and-newer trucks. None of the 135 Idle tested audit vehicles failed inspection. The IM240 test provides a more accurate estimate of in-use vehicle exhaust emissions than the Idle tailpipe test. Therefore, the results of the IM240 tested clean screen audit sample was used to evaluate the exhaust emissions effectiveness of clean screen program for vehicles tested with tailpipe.

Vehicle test results were sorted by VIN and test date. Vehicles were then further classified based on their first and last test result during the period. To avoid potential double counting of emissions reductions, the emissions analysis only considered the first and last result for each vehicle during the year and interim results were ignored.

In the list below, the first and last results are indicated in parenthesis, where P is pass, F is fail, W is waiver and null indicates there was only a single test result for a particular vehicle. The expected combinations applying to the vast majority of vehicles are underlined.

- P – Passed initial test (P/null, P/P, P/F, P/W)
- R – Failed and successfully repaired (F/P)
- U – Failed unresolved (F/null, F/F)

² Note that the number of emissions fails plus the number of Gas Cap / Gas Cap Pressure failures does not always equal the total number of inspection failures. In a few cases a vehicle may fail both Emissions and Gas Cap. In a few cases, vehicles fail for other reasons.

- W – Failed and Waivered (F/W)

The difference between the initial and final tests is used to determine the percentage of tailpipe emissions reduction of each group. For vehicles with only one test, the final result is the same as the initial result.

Adjustment of Fast-Pass Results

A majority of vehicles tested on IM240 fast pass the test in less than the 240-second driving cycle. To allow for comparison of emissions of vehicles tested over different durations of the IM240 test cycle, the emission results for vehicles fast-passing the IM240 inspection must be extrapolated. A method for projecting full test emissions was developed and implemented in the I/M program in 1996⁴ and the projected full test emissions values are stored in the test records and reported as the emissions results.

Unresolved Vehicles

When vehicles fail their initial inspection, they must obtain a repair and return for re-inspection. This process is normally completed in 30 days, but can take longer. Vehicles having initial tests in late 201~~5~~³ but completing repair and final test after February of the following year are treated as unresolved. Thus, the “Fail unresolved” category may be somewhat over-stated.

A number of vehicles never complete the repair/re-inspection process. In most cases, these vehicles are either scrapped or removed from the non-attainment area, which does reduce emissions in the area. Surveys in Arizona⁵ and Colorado⁶ found that some vehicles continued to operate in the area in violation of the program rules, either with expired license plates or with stolen license plates or license plate stickers. In this report, it is assumed that two-thirds of these unresolved vehicles leave the area and one third continues to operate. Recent studies in Colorado indicate the percentage leaving the area may be as high as 80%.

To minimize the number of unresolved Clean Screen audit vehicles, retests of audit vehicles were included through the end of February 201~~6~~⁵ and the audit vehicles were all assumed to remain in the area.

First and Final Emissions Results

Table IV-4 contains an example of the initial and final tailpipe results for 1982 to 1985 passenger vehicles inspected using the IM240 test. The table shows the average initial and average final emissions for each group of vehicles together with the percentage reduction.

For example, of the 785 1985 model year passenger vehicles tested using the IM240 transient test, 14.3% of vehicles initially failed inspection and were repaired (Pass) with HC, CO and NOx reductions of 55.3%, 66.9% and 3.6%. Another 7.1% of vehicles failed their initial inspection and had not successfully passed a retest by end February 2014 (Unresolved). Reductions from these vehicles are estimated to be approximately 67% for HC, CO and NOx, because follow-up studies have shown that more than two thirds cease operating in the area. Finally, 0.6% of vehicles were waived (Waiver) with an HC reduction of 9.2%, CO increase of 8.3% and a NOx reduction of 0.4%. In aggregate, including vehicles passing their initial inspection, emission reductions for 1985 passenger vehicles were 27.3% for HC, 32.6% for CO and 4.7% for NOx.

Complete tables by model year and vehicle type are provided in Appendix A for vehicles tested using the IM240. Tables are also provided for the Clean Screen audit sample vehicles.

Table IV-4 Transient Test Emission Reductions for 1982-1985 Passenger Vehicles

Appendix A1 Colorado 2015 Transient Test Emissions Reductions													
Unresolved fails remaining in area					33%								
Model	First	Last			Initial			Final			Reduction %		
Year/Type	Result	Result	Vehicles	Fail%	HC	CO	NOX	HC	CO	NOX	HC	CO	NOX
1982	Pass	-	208		1.54	19.00	1.95	1.54	19.00	1.95	0.0%	0.0%	0.0%
P	Fail	Pass	40	15.0%	2.92	45.53	1.92	1.63	20.94	1.94	44.1%	54.0%	-0.9%
	Fail	Unresolv.	18	6.7%	6.52	88.21	1.50	2.28	35.99	0.43	65.0%	59.2%	71.4%
	Fail	Waiver	1	0.4%	3.34	61.88	3.45	4.66	70.49	3.79	-39.6%	-13.9%	-9.8%
Total	Fail%		267	22.1%	2.09	27.80	1.92	1.62	20.63	1.85	22.6%	25.8%	3.6%
1983	Pass	-	330		1.26	12.34	1.88	1.26	12.34	1.88	0.0%	0.0%	0.0%
P	Fail	Pass	68	15.4%	2.67	37.79	1.76	1.37	15.66	1.92	48.5%	58.6%	-8.8%
	Fail	Unresolv.	42	9.5%	4.32	68.26	1.74	1.36	21.78	0.66	68.6%	68.1%	61.9%
	Fail	Waiver	2	0.5%	7.88	35.67	1.85	8.43	47.04	1.29	-6.9%	-31.9%	30.0%
Total	Fail%		442	25.3%	1.79	21.67	1.85	1.32	13.90	1.77	26.6%	35.8%	4.4%
1984	Pass	-	455		1.21	11.25	1.86	1.21	11.25	1.86	0.0%	0.0%	0.0%
P	Fail	Pass	99	16.1%	2.79	37.37	1.95	1.41	13.29	1.87	49.4%	64.4%	4.0%
	Fail	Unresolv.	58	9.4%	6.70	82.72	1.79	1.66	22.19	0.59	75.2%	73.2%	66.8%
	Fail	Waiver	2	0.3%	3.75	112.83	0.76	5.84	171.20	0.39	-55.6%	-51.7%	48.7%
Total	Fail%		614	25.9%	1.99	22.54	1.86	1.30	13.13	1.74	34.8%	41.7%	6.8%
1985	Pass	-	785		1.01	10.64	1.88	1.01	10.64	1.88	0.0%	0.0%	0.0%
P	Fail	Pass	144	14.3%	2.64	30.42	2.06	1.18	10.06	1.98	55.3%	66.9%	3.6%
	Fail	Unresolv.	71	7.1%	3.89	57.98	1.68	1.23	19.12	0.57	68.4%	67.0%	66.2%
	Fail	Waiver	6	0.6%	2.90	82.14	0.83	2.63	88.99	0.83	9.2%	-8.3%	0.4%
Total	Fail%		1,006	22.0%	1.46	17.24	1.88	1.06	11.62	1.79	27.3%	32.6%	4.7%

2. OBD-II Tested RapidScreen Audit Vehicles

Emissions of RapidScreen audit vehicles tested in stations using the OBD-II inspection were estimated:

- First and last inspection results for the 2015 OBD-II tested audit vehicles were determined by type and model year.
- To establish an adequate sample of representative IM240 emissions, average initial IM240 emissions by type, model year were determined from the collection of audit vehicles tested using IM240 in 2013, 2014 & 2015³ grouped by their OBD result using 2015 rules rather than the reported IM240 test result, i.e.:
 - Vehicles failing for a reason other than IM240 emissions, e.g. gas cap = Fail
 - OBD MIL on = Fail
 - OBD Not Ready per 2015 rules = Reject
 - MIL Off and Ready per 2015 rules=Pass
- The OBD result oriented average initial emissions above (referred to below as 2013/2014/2015 OBD emissions) were applied to the 2015 OBD-II audit vehicles based on their result groupings:
 - P – Passed initial test (P/null, P/P, P/F, P/W) – initial and last emissions set to 2013/2014/2015 OBD initial pass emissions.
 - R – Failed and successfully repaired (F/P):
 - initial emissions set to 2013/2014/2015 OBD initial fail emissions;
 - last emissions set to 2013/2014/2015 OBD initial pass emissions.
 - U – Failed unresolved (F/null, F/F):
 - initial emissions set to 2013/2014/2015 OBD initial fail emissions;
 - last emissions set to 2013/2014/2015 OBD initial fail emissions.
 - W – Failed and wavered (F/W):
 - initial emissions set to 2013/2014/2015 OBD initial fail emissions;
 - last emissions set to 2013/2014/2015 OBD initial fail emissions.

IM240 emissions from tests of 2013, 2014 and 2015 RapidScreen audit tests were used to estimate emissions of 2015 RapidScreen audit vehicles teste using OBD-II because:

- There was an insufficient sample of 2015 RapidScreen audit vehicles randomly tested using IM240;

³ Only results for 2015 audit vehicles randomly selected for IM240 testing were used.

- RapidScreen audit vehicles were known from previous years to have materially lower emissions than the general population of station tested vehicles; and
- Vehicles passing RapidScreen in 2013 and 2014 had to meet the same on-road emissions criteria and were expected to have similar emissions to those passing RapidScreen in 2015.

3. Audit Sample Reductions and Projected Impact

Table IV-5 shows the aggregate first and final results for the 96% of inspected audit sample vehicles tested using IM240 and OBD. The average per vehicle emissions reductions from the audit sample are multiplied by the number of exempted clean screen vehicles to project the reductions that could have been achieved if the clean screen vehicles had instead been inspected at the stations. This amount is then compared to the total emission reductions from vehicles tested at stations to determine the impact of the Clean Screen program and the percentage of emissions reductions retained.

For vehicles subject to the IM240 test, the Clean Screen program retained 97.9%, 96.8% and 95.9% of the exhaust HC, CO and NO_x reductions respectively. These reductions assume all vehicles are driven the same number of miles each year. Mileage adjusted emission reductions are calculated in section V.

Table IV-5 Clean Screen Emissions Impact for Tailpipe Emissions (OBD & IM240)

	IM240 Tailpipe Emissions			
	Vehicles	HC g/mi	CO g/mi	NOx g/mi
Audit Sample	3,311			
Mean Initial		0.089	1.728	0.272
Mean Final		0.084	1.617	0.261
Emissions reduction		0.005	0.111	0.010
Clean Screens	195,778			
Potential Reductions		1,021	21,698	1,980
Station Vehicles	814,274			
Mean Initial		0.255	3.737	0.550
Mean Final		0.197	2.929	0.492
Emissions reduction		0.058	0.808	0.057
In station reductions		47,199	657,627	46,794
Combined CS & Stn	1,010,052	48,221	679,325	48,774
Clean Screen Impact		2.1%	3.2%	4.1%
Retained Reductions		97.9%	96.8%	95.9%

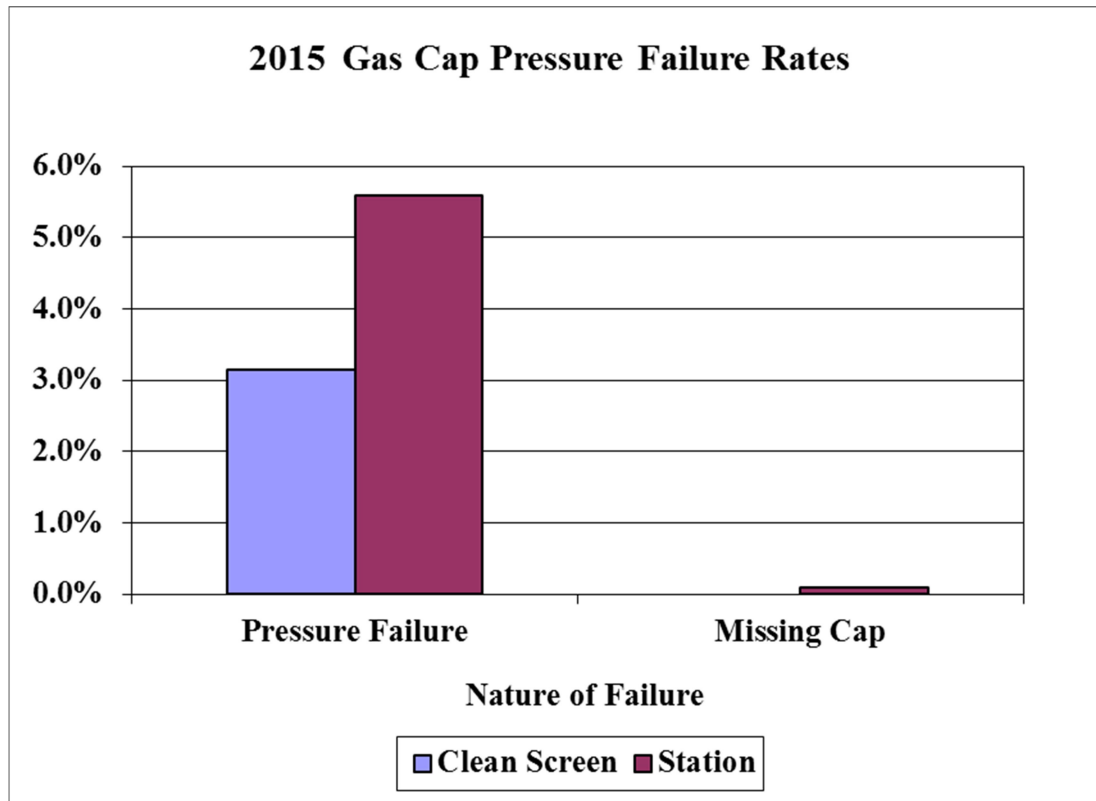
C. Gas Cap Evaporative Emissions

The evaporative emissions test used in the I/M Program is a gas cap pressure test. Leaking gas caps allow evaporated gasoline (HC) to escape from vehicle gas tanks into the atmosphere. The impact of leaking gas caps on the Clean Screen program is only evaluated in this report in terms of the failure rate, not in terms of repairable gas cap emissions reductions⁴.

Figure IV-1 compares the average gas cap failure rate of the Clean Screen audit sample vehicles (3.1%) to the average failure rate of the non-audit vehicles tested at stations (5.7%). The failure rate of vehicles exempted via Clean Screen methods was 44% lower than the failure rate of vehicles receiving a station-based test (See Figure IV-1). A gas cap evaporative leak has to be quite large to be detected by RSD units. Clean screen models were newer than the overall tested fleet.

⁴ Although the gas cap leak rates are measured in the I/M Program, it is not clear that leak rates are directly related to the amount of evaporative HC emissions released from the gas tank. A small pressure leak may have the same effect as a large pressure leak, as long as it is sufficient to release internal gas tank pressure over a period of an hour or so.

Figure IV-1 Gas Cap Pressure Failure Rates



Using the fail rates identified in the audit sample, Table IV-6 shows the projected gas cap failures that would have been found in the exempted clean screen vehicles. These projected gas cap failures are added to the actual gas cap failures identified in initial inspections at the test stations to provide the total possible gas cap failure rate for the program. Vehicle counts in Figure IV-6 are higher than IV-5 because they include gas cap tests on vehicles tested using idle tests as well as those tested using IM240 and OBD. Vehicles with a redeemed Clean Screen notice account for 10.9% of the total possible gas cap failures. Therefore, 89.1% of evaporative gas cap HC emission reductions were retained.

In general, it is desirable to use direct measurements of emissions to evaluate program performance rather than a model. Unlike exhaust emissions that are directly measured using tailpipe tests, however, emissions rates from gas caps cannot easily be directly measured. Emissions rates of vapor leaks are typically determined in a test laboratory by enclosing a vehicle in a sealed compartment and measuring the emissions released into the compartment over time, which is impractical for testing many vehicles. Therefore, the EPA mobile source emissions model, MOVES, was used to estimate the fraction of emissions benefits derived from gas cap inspections.

CDPHE provided results from MOVES 2015 models of the benefits of the I/M program for 2015. The projected average reduction in HC emissions of the area fleet was 0.132 g/mi. This was comprised of 0.121 g/mi resulting from exhaust emissions inspections and 0.011 g/mi from the Gas Cap testing, i.e. evaporative benefits were 8.6% of total HC benefits. The measured I/M exhaust reductions (see section V) were 443.3 tons. Assuming the 0.132 g/mi corresponded to 443.3 tons, the Gas Cap related HC reductions were projected to be 41.6 tons.

These results are shown in Table IV-7. The RapidScreen impact was projected as 4.5 tons or 0.9% of the I/M program reductions.

Table IV-6 Clean Screen Impact on Evaporative HC Emissions

	Initial Tests	Pressure Failure	Missing Cap	Total Fails
RapidScreen Audit	3,717	117 3.1%	- 0.0%	117 3.1%
Projected RapidScreen	195,778	6,163	-	6,163
Station GC Tests	886,275	49,559 5.6%	920 0.1%	50,479 5.7%
Total Program	1,082,053	55,722	920	56,642
RapidScreen Impact	18.1%	11.1%	0.0%	10.9%
Retained Reductions	81.9%	88.9%	100.0%	89.1%

Table IV-7 Gas Cap Related Benefit Tons

		2015 MOVES g/mi HC	I/M 2015 HC tons
MOVES Estimates (from CDPHE)			
I/M Exhaust emission reductions		0.1205	443.3
Projected Gas Cap Evap Emissions reductions		0.0113	41.6
I/M Program total HC reductions		0.1318	485.0
Gas Cap Evap RapidScreen impact	10.9%	0.001	4.5
% of I/M program HC benefit			0.9%

D. Hybrid RSD-LEI vs. 2-hit RSD

Envirotest compared the effectiveness of the ‘Hybrid’ and ‘2-RSD’ screening methods. The Hybrid method uses a single RSD measurement and a low emitter index (LEI) table. The 2-RSD method uses two RSD measurements.

The audit sample of vehicles with IM240 tests contained 2,091 vehicles screened using the 2-RSD method and 1,220 vehicles screened using Hybrid RSD-LEI method. Table IV-8 shows the emissions reductions for these two samples and the average for all vehicles inspected at stations. Figures IV-2 and IV-3 show the average initial emissions and emissions reductions for each sample.

The 2-RSD method audit vehicles had initial emissions that were 44%, 54% and 60% of the overall I/M fleet average for HC and CO and NOx respectively. The equivalent percentages in 2014 were 43%, 53% and 54% respectively.

The Hybrid RSD-LEI method audit vehicles had lower initial emissions that were 34%, 48% and 46% of the I/M fleet average for HC and CO and NOx respectively. The 2014 equivalents were 32%, 46% and 39%.

Average reductions in station tested vehicle emissions were 26.0%, 24.1% and 11.6% for HC, CO and NOx respectively – almost unchanged from the equivalent percentages in 2014 of 25.2%, 24.4% and 11.7%.

Average I/M emissions reductions for the 2-RSD audit vehicles were 1.7%, 1.9% and 1.7% of fleet average initial emissions for HC and CO and NOx respectively. Comparable percentages in 2014 were 2.6%, 1.3% and 0.7%.

Average emissions reductions for the Hybrid RSD-LEI audit vehicles were 2.5%, 4.5% and 1.9% of fleet average initial emissions for HC and CO and NOx respectively. Comparable percentages in 2014 were 0.1%, 0.3% and 0.1% and in 2013 were 0.8%, 2.1% and 1.1%.

It seems likely that looser LEI screen fail rate criteria in combination applying IM240 failure rates to screen OBD models allowed a greater percentage of reductions to pass through the LEI screen. We anticipate this will be partially mitigated when OBD inspection fail rates become incorporated into the LEI.

Table IV-8 Average Emissions per Vehicle

Vehicle Sample	IM240 Tailpipe Emissions			
	Vehicles	HC g/mi	CO g/mi	NOx g/mi
I/M vehicle initial mean emissions		0.223	3.348	0.496
2-RSD Audits	2,091			
Mean Initial		0.098	1.809	0.298
Mean Final		0.094	1.745	0.290
Emissions reduction		0.004	0.064	0.008
% of I/M vehicle initial mean emission		1.7%	1.9%	1.7%
Hybrid Audits	1,220			
Mean Initial		0.075	1.592	0.226
Mean Final		0.070	1.440	0.217
Emissions reduction		0.006	0.152	0.010
% of I/M vehicle initial mean emission		2.5%	4.5%	1.9%
All Station Tests	814,274			
Mean Initial		0.255	3.737	0.550
Mean Final		0.197	2.929	0.492
Emissions reduction		0.058	0.808	0.057
% of I/M vehicle initial mean emission		26.0%	24.1%	11.6%

Figure IV-2 Average Initial IM240 Emissions

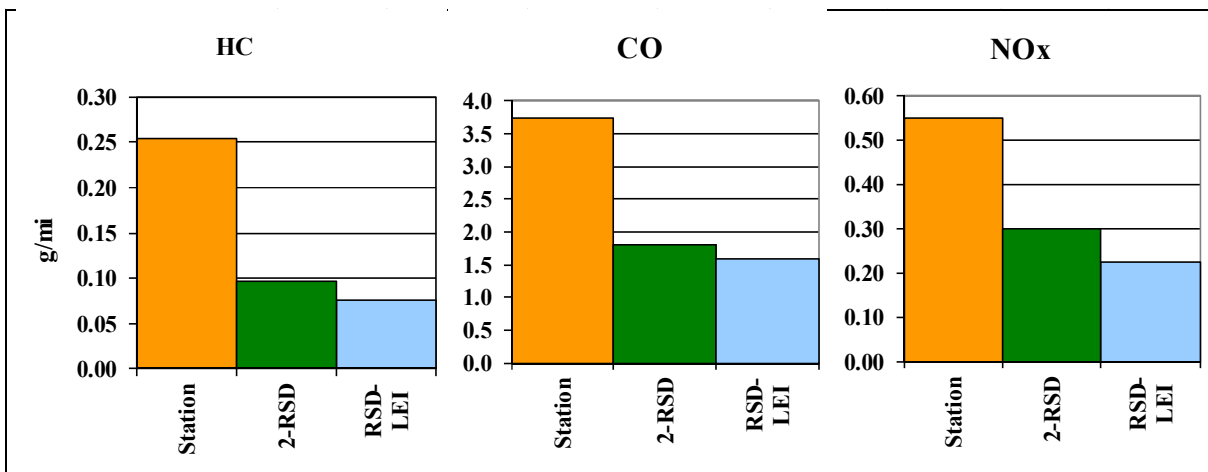
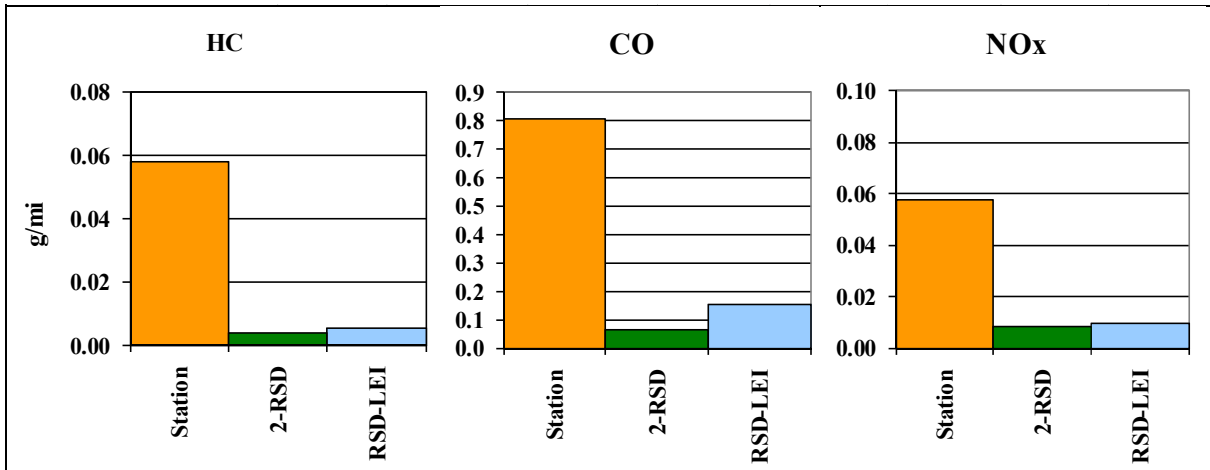


Figure IV-3 Average IM240 Emissions Reductions



V. Estimate of Overall I/M Program Benefits and Clean Screen Impact

Overall I/M program emission reductions derive from two main components:

- Reductions resulting directly from I/M inspections and consequent repairs;
- Reductions from repair activities performed in anticipation of an I/M inspection.

In previous years, it was assumed the vast majority of emissions reductions were directly measurable by comparing the initial and final I/M inspection emissions results, i.e. the first component described above. This report uses the same methodology. However, most vehicles tested were equipped with OBD-II malfunction indicator lights and many repairs of these vehicles are performed in response to warning lights before the initial inspection. The benefits of these repairs are not directly measurable in the program testing.

The Clean Screen dis-benefit can be projected directly from the emissions testing of the audit sample. There may be unmeasured offsetting benefits if the Clean Screen program encourages owners to maintain malfunctioning vehicles sooner than otherwise.

For this report, measured I/M exhaust emissions benefits were projected from the IM240 and Idle emissions tests. In the case of Idle tests, idle test emission concentrations were converted to equivalent IM240 g/mi emissions.

For each model year, the IM240 g/mi emissions values were weighted by the annual vehicle miles traveled to project the emissions inventory for initial and final test and, hence, the direct program benefits.

The following sections project the directly measured tons of emissions and reductions

A. Conversion of Idle Tests to IM240 Equivalent emissions

On-road remote sensing emissions of vehicles inspected at I/M stations have been used to project IM240 equivalent values for Idle test emissions.

The idle test procedure includes a low-speed idle and a high speed idle at 2500rpm. Vehicles model year 1980 and older are required to pass the low-speed idle while 1981 and newer models must pass both the low-speed and the high-speed tests.

Figures V-1 and V-2 show the correlation between Idle tests and on-road HC and CO emissions of the same vehicles. Results are averaged by model year. Average initial and final test emissions were used for vehicles initially failing and retested. Model years were grouped together for 1965-and-older, 1966 to 1970, 1971 to 1975, 1976 to 1981, 1982 to 1985, 1986 to 1990 and 2004-and-newer. Even with these groups, there were less than 100 matching RSD measurements for Passenger vehicles in groups from 1982 to 1998. There were several hundred matching RSD measurements for each truck group. Trend lines were plotted with an intercept of zero to obtain RSD / Idle Test emissions ratios.

Similarly, Figure V-3 shows the correlation between IM240 and on-road emissions. Trend lines were plotted with an intercept of zero for HC and CO emissions to obtain IM240 / RSD emissions ratios. The results are summarized in Tables V-1 and V-2.

Figure V-1 RSD vs. Idle Test Emissions

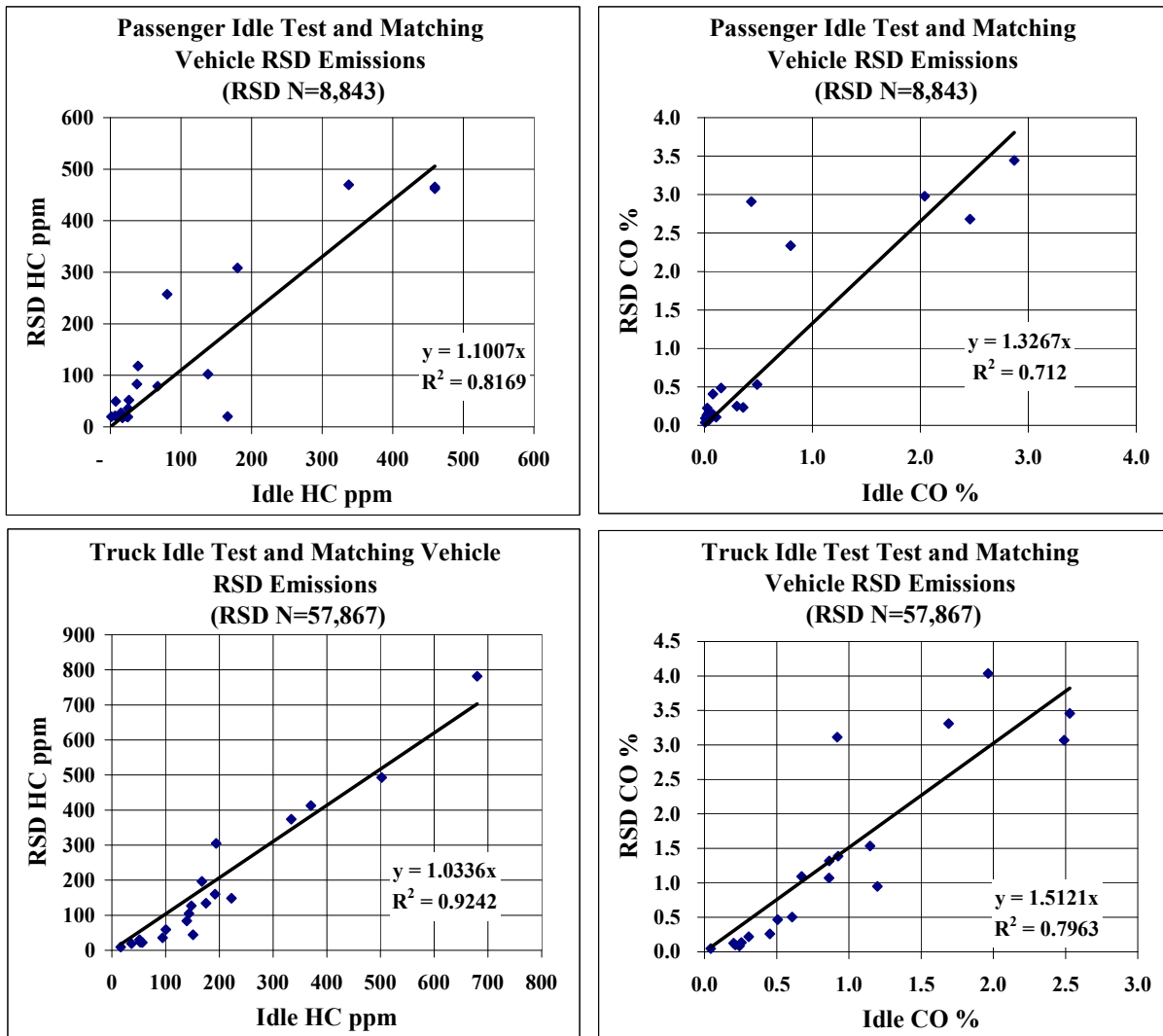


Table V-1 Low Speed Idle to IM240

Low Speed Idle test to IM240 Projection				
Passenger	HC	HC R2	CO	CO R2
RSD / Idle	1.1007	0.81	1.3267	0.71
IM240 / RSD	0.0087	0.98	15.947	0.92
IM240 / Idle	0.0096		21.1569	
Truck	HC	HC R2	CO	CO R2
RSD / Idle	1.0336	0.92	1.5121	0.8
IM240 / RSD	0.0111	0.98	18.765	0.94
IM240 / Idle	0.0115		28.3746	

Figure V-2 RSD vs. 2500 Idle Test Emissions

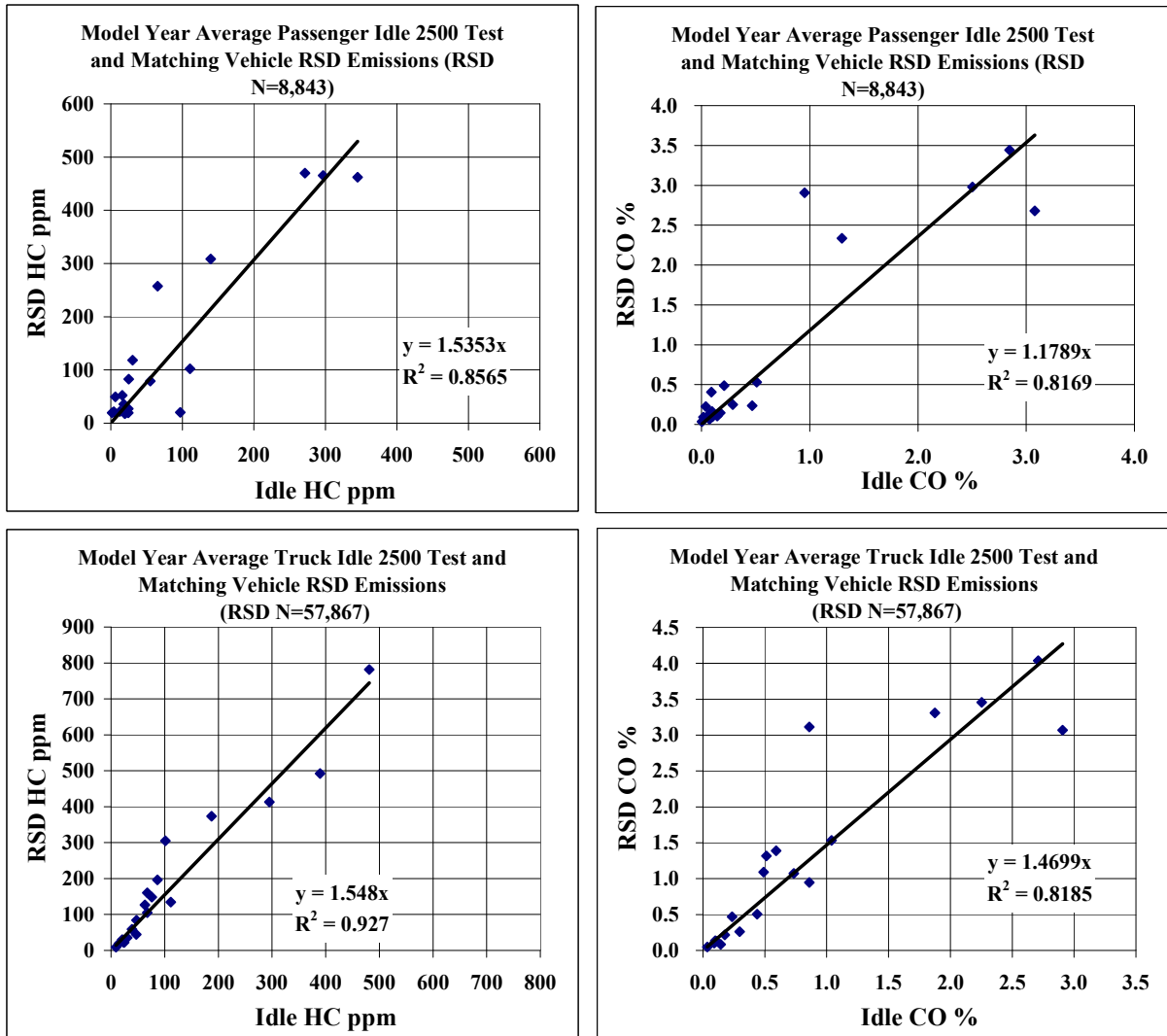
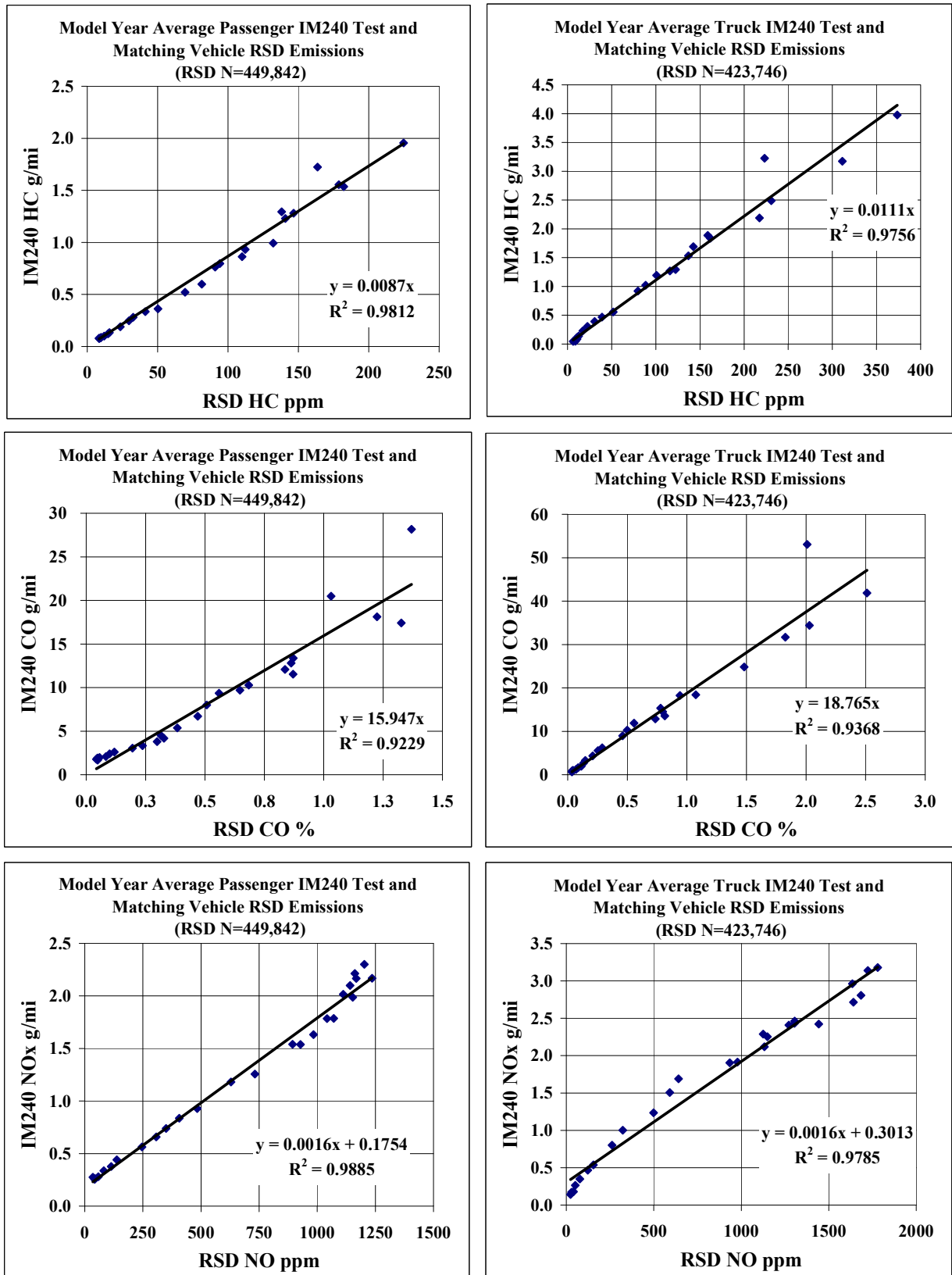


Table V-2 High Speed Idle to IM240

2500 RPM Idle test to IM240 Projection				
Passenger	HC	HC R2	CO	CO R2
RSD / 2500	1.5353	0.86	1.1789	0.82
IM240 / RSD	0.0087	0.98	15.947	0.92
IM240 / 2500	0.0134		18.7999	
Truck	HC	HC R2	CO	CO R2
RSD / 2500	1.548	0.93	1.4699	0.82
IM240 / RSD	0.0111	0.98	18.765	0.94
IM240 / 2500	0.0172		27.5827	

Using the ratios derived above, IM240 g/mi equivalent emissions were projected for the vehicles tested with the idle test procedure. The low speed idle results were used to estimate emissions reductions as all model year vehicles tested at idle were required to pass the low speed idle test.

Figure V-3 RSD vs. IM240 Test Emissions



B. Estimation of OBD Tested Vehicle Emissions

In 2015, a random sample of the general population of vehicles subject to the OBD test was selected for IM240 testing. The IM240 emissions from the sample were used to project the emissions of the general population of models tested using OBD.

Within the random sample, the test result from an OBD perspective (Pass, Fail, Reject) was determined by the Overall result, the Emissions result and the OBD result:

- If the OBD result was null, the vehicle was not considered
- If the vehicle passed emissions but failed for another reason the vehicle failed;
- Otherwise, the result was assumed to be the OBD result

The average initial emissions of the random sample by type, year and OBD result were used to estimate the initial and final emissions of the OBD tested vehicles:

- Initial emissions were set according to the initial result
- Final emissions of repaired vehicles were assumed to be the same as initial pass;
- Final emissions of unresolved vehicles were assumed to be the same as an initial fail;
- Final emissions of vehicles receiving a waiver were assumed to be the same as an initial fail.

The average of 2009, 2010 & newer IM240 random test emissions were used to estimate 2011 & newer model emissions having an inadequate random sample.

C. Annual Mileage Weighting

Because of data entry errors and odometer rollover on older, high mileage vehicles, obtaining estimates of annual mileage from the I/M Program odometer readings for each model year and type of vehicle is not recommended. To avoid these problems, annual mileages for vehicles were taken from the 2008 ERG report on Colorado mileage accumulation rates⁷.

The estimated annual mileages are shown in Table V-3 for LDGVs and LDGTs. In Table VI-3 the mileage accumulation rates for LDGT2, 3 and 4 were weighted together to obtain a single LDGT value. On average, newer model year vehicles are driven more miles annually than older vehicles and, for vehicles less than 15 years old, trucks are driven more than passenger vehicles.

,

Table V-3 Estimated Annual Mileage in 2015

Year	LDGV	LDGT
1985	4,304	4,550
1986	4,304	4,554
1987	4,304	4,562
1988	4,434	4,583
1989	4,481	4,630
1990	4,502	4,668
1991	4,552	4,741
1992	4,780	4,851
1993	5,088	5,019
1994	5,430	5,256
1995	5,672	5,519
1996	6,002	5,824
1997	6,331	6,135
1998	6,653	6,471
1999	6,974	6,940
2000	7,369	7,437
2001	7,764	7,863
2002	8,188	8,345
2003	8,613	8,900
2004	9,032	9,502
2005	9,450	10,087
2006	9,905	10,727
2007	10,360	11,245
2008	10,746	11,817
2009	11,132	12,303
2010	11,870	12,834
2011	12,023	13,215
2012	12,307	13,433
2013	12,357	13,514
2014	11,600	12,428
2015	9,650	8,995

D. Annual Emissions Reductions

Annual tons of emissions were projected for vehicle type and model year by multiplying the numbers of vehicles by annual mileage and average g/mi emission levels. Results were projected for initial tests and final tests to determine the initial and final tons of emissions and, therefore, the tons of reduction. The results are listed in Appendix B for IM240 and Idle tests.

Table V-4 first shows the reductions from the Clean Screen audit tests. Based on the audit tests, the second part of the table projects the potential reductions from the Clean Screen vehicles if all vehicles with redeemed Clean Screen notices had been tested at a station. The third part of the table shows the reductions from the vehicles tested at inspection stations, which includes the Clean Screen audit vehicles. The total potential reductions from the program are the combination of the potential reductions from the Clean Screened vehicles plus the actual reductions from the vehicles tested at stations.

In Table IV-4, Clean Screen effectiveness was expressed without reference to the annual vehicle miles traveled (VMT) by each model year of vehicles. The more complete analysis in Table V-4 shows the Clean Screen program effectiveness when the VMT and Gas Cap⁵ estimates are factored in. During 2015, the Clean Screen program retained 97.3%, 96.9% and 95.5% respectively of potential HC, CO and NOx emission reductions in vehicles subject to testing.

For vehicles initially tested in calendar year 2015, the I/M Program is projected to have eliminated 471.9 tons of HC, 5,791.1 tons of CO and 356.8 tons of NOx for one year of vehicle travel – based on the IM240 driving cycle.

Because the program is biennial, these reductions are approximately half of the reductions that would be measured over a full two-year cycle of the program.

The tons of reductions cited here do not relate directly to the total mobile emissions inventory. The reductions cited are for tailpipe emissions and are in terms of the IM240 driving cycle. State Implementation Plan reductions are based on different driving cycles, are subject to many adjustments for speed, road type, temperature, air conditioning loads, etc., and therefore are larger than the IM240 measured reductions.

As noted earlier, the reductions shown do not include reductions from maintenance actions performed on vehicles before their initial inspection. These may be quite substantial, especially for OBD-II vehicles that turn on the check engine light to alert owners to problems.

⁵ The evaporative emissions have not been adjusted for mileage but the effect of an adjustment would be small. Gas cap failures are more evenly distributed by age than tailpipe failures and only part of the evaporative emissions are running losses dependent on miles traveled.

Table V-4 Estimated Annual Tons of Reduction (IM240 and Idle Tested Vehicles)

Audit Vehicle Reductions (IM240 tons/yr)				
Audit Tests	Unique Vehicles	HC	CO	NO_x
Enhanced IM240 & OBD	3,311	0.14	3.14	0.29
Potential from RS Vehicles (IM240 tons/yr)				
RapidScreen	Unique Vehicles	HC	CO	NO_x
Enhanced Area	195,778	8.5	185.4	17.0
Gas Cap estimate from MOVES		4.5		
Station Reductions (IM240 tons/yr)				
Station I/M Vehicles	Unique Vehicles	HC	CO	NO_x
Enhanced IM240 & OBD	814,274	316.3	4,533.3	356.8
Enhanced Idle*	49,324	118.5	1,257.8	
Gas Cap scaled from MOVES		37.1		
	863,598	471.9	5,791.1	356.8
Total Potential Reductions		485.0	5,976.5	373.8
<i>RapidScreen Exhaust Impact</i>		<i>1.8%</i>	<i>3.1%</i>	<i>4.5%</i>
<i>Rapidscreen Gas Cap Impact</i>		<i>0.9%</i>		
Retained Reductions		97.3%	96.9%	95.5%

* NO_x is not reported for idle tests.

During calendar year 2015, 195,778 vehicles were exempted through Clean Screen, and 863,598 vehicles received a station test. Therefore, 18.5% of the 1,059,376 unique vehicles were Clean Screened.

If the fraction of Clean Screen vehicles had been 30% of vehicles subject to inspection there would have been 317,813 Clean Screens and 741,563 Station tests. Assuming this increase was achieved by increasing on-road fleet coverage rather than by relaxing the Clean Screen standards, the projected emissions retained would have been 95.6%, 95.0% and 92.6% respectively of potential HC, CO and NO_x tailpipe emission reductions.

VI.IM240 Projected Emissions by Model Year

Figures VI-1 through VI-6 show the annual emissions inventories and reductions by model year and vehicle type for the vehicles clean screened and tested at stations in 2015. Emissions are based on the IM240 driving cycle. The projected IM240 equivalent exhaust emissions inventory for the Clean Screen vehicles and Idle tested vehicles are also shown. The biennial testing cycle of the Enhanced area causes the difference between the sizes of the bars for odd model year vehicles vs. even model year vehicles.

Not included in these charts:

- most 2009 and newer models not yet subject to inspection;
- any estimate of pre-inspection emission reductions;
- NOx emissions for 49,329 vehicles tested with the idle test: 1981 and older models 9,233 (19%), 1982 and newer trucks 38,557 (78%), and 1982 & newer passenger vehicles 1,534 (3%).

Vehicles 15 years and older (model year 2000 and older), which are fewer in number and driven fewer miles each year, still contribute many tons of excess emissions in the I/M area – especially old trucks.

Figure VI-1 LDGV HC Reductions and Remaining Emissions

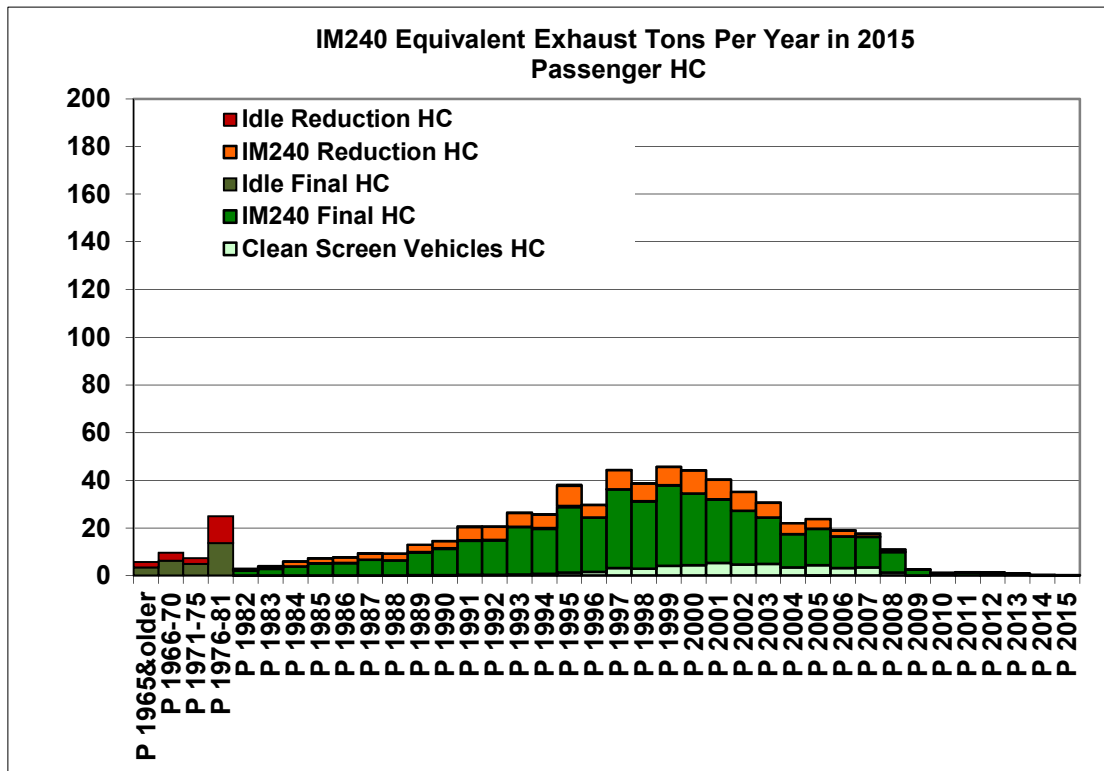


Figure VI-2 LDGT HC Reductions and Remaining Emissions

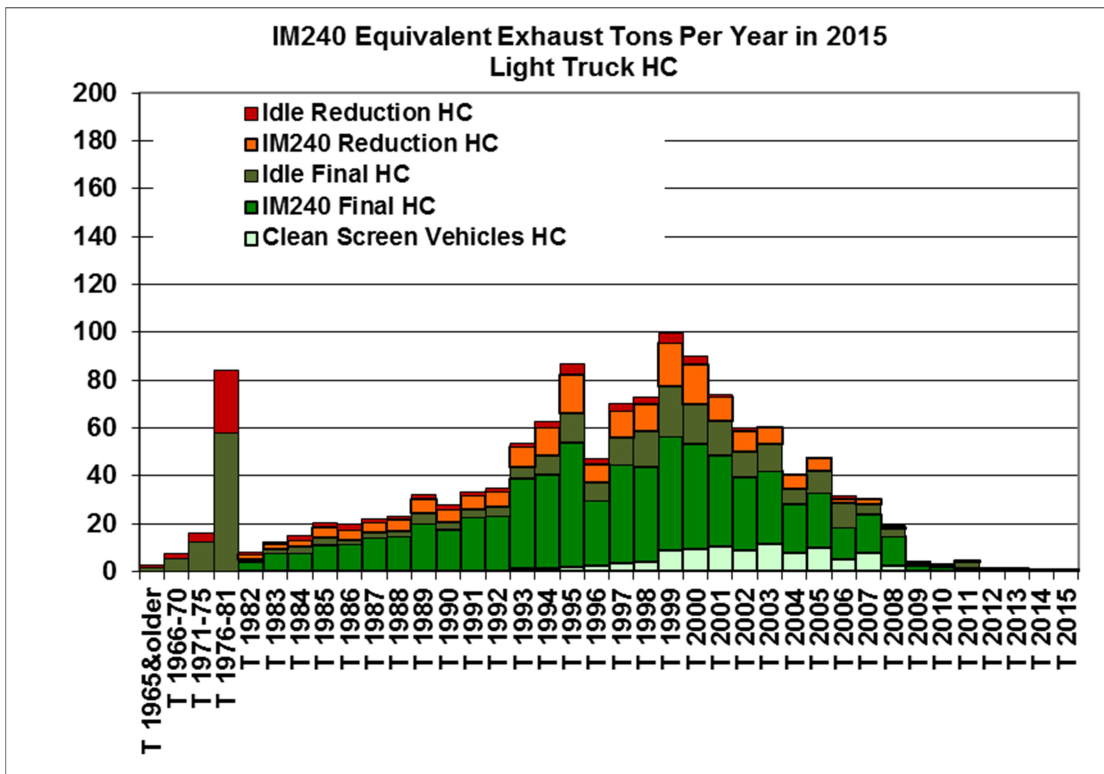


Figure VI-3 LDGV CO Reductions and Remaining Emissions

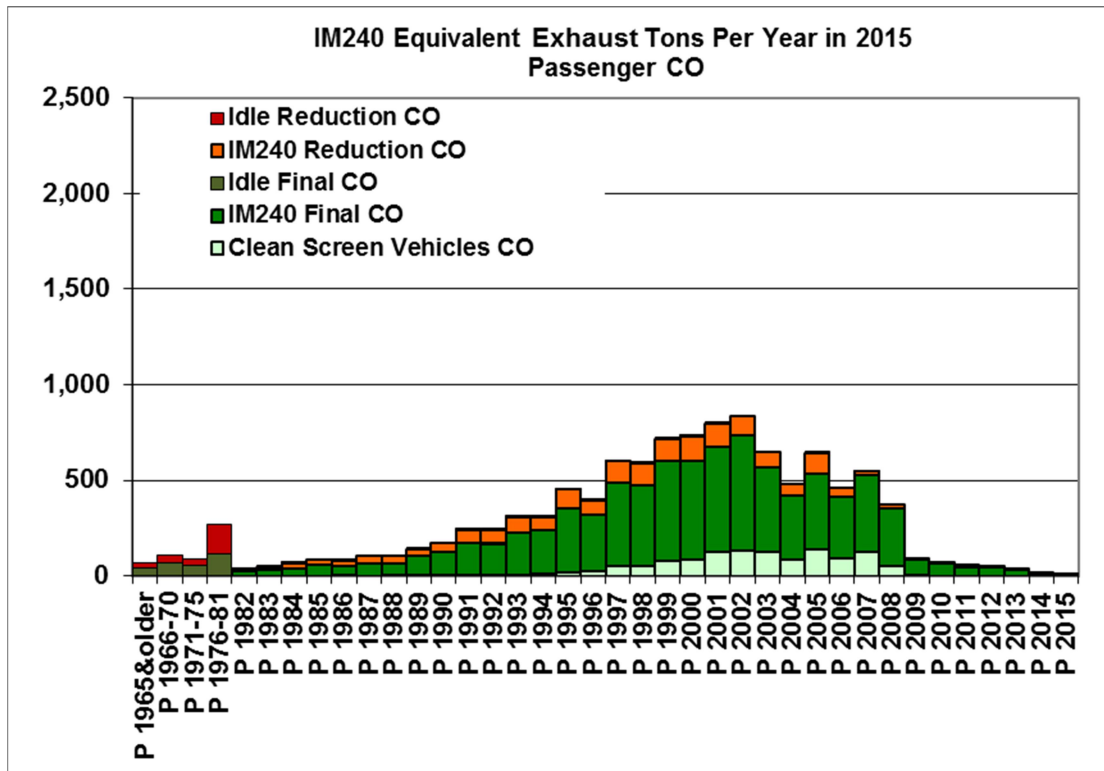


Figure VI-4 LDGT CO Reductions and Remaining Emissions

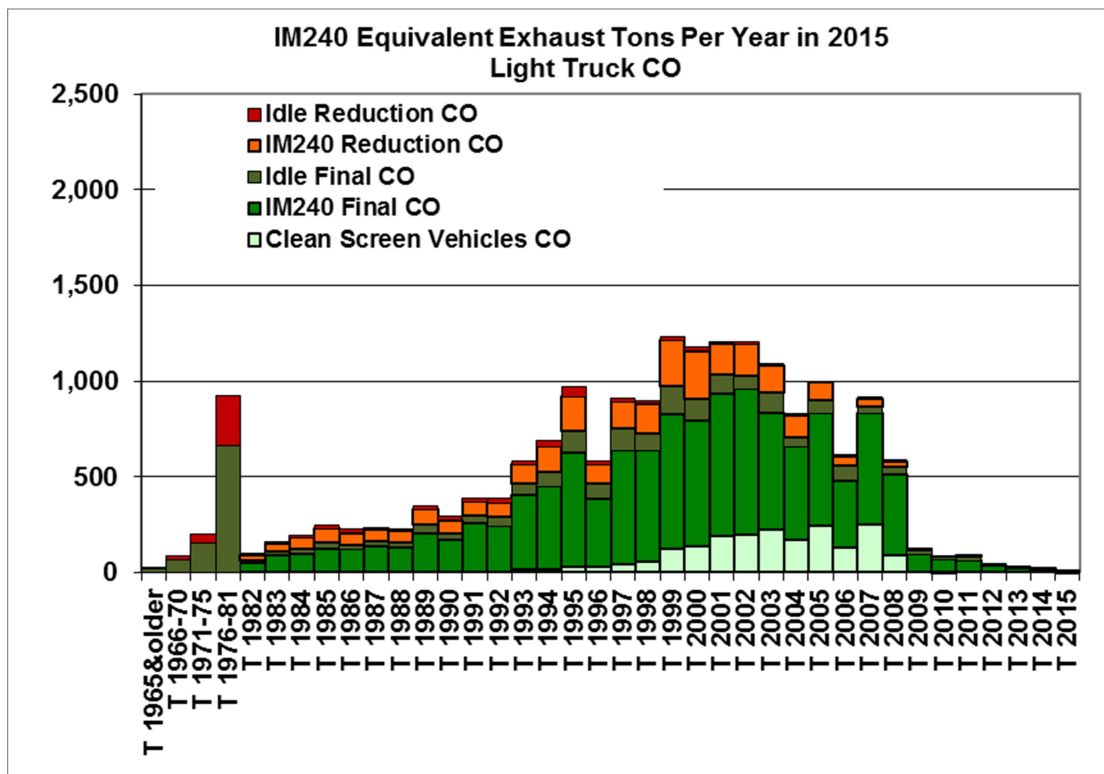


Figure VI-5 LDGV NOx Reductions and Remaining Emissions

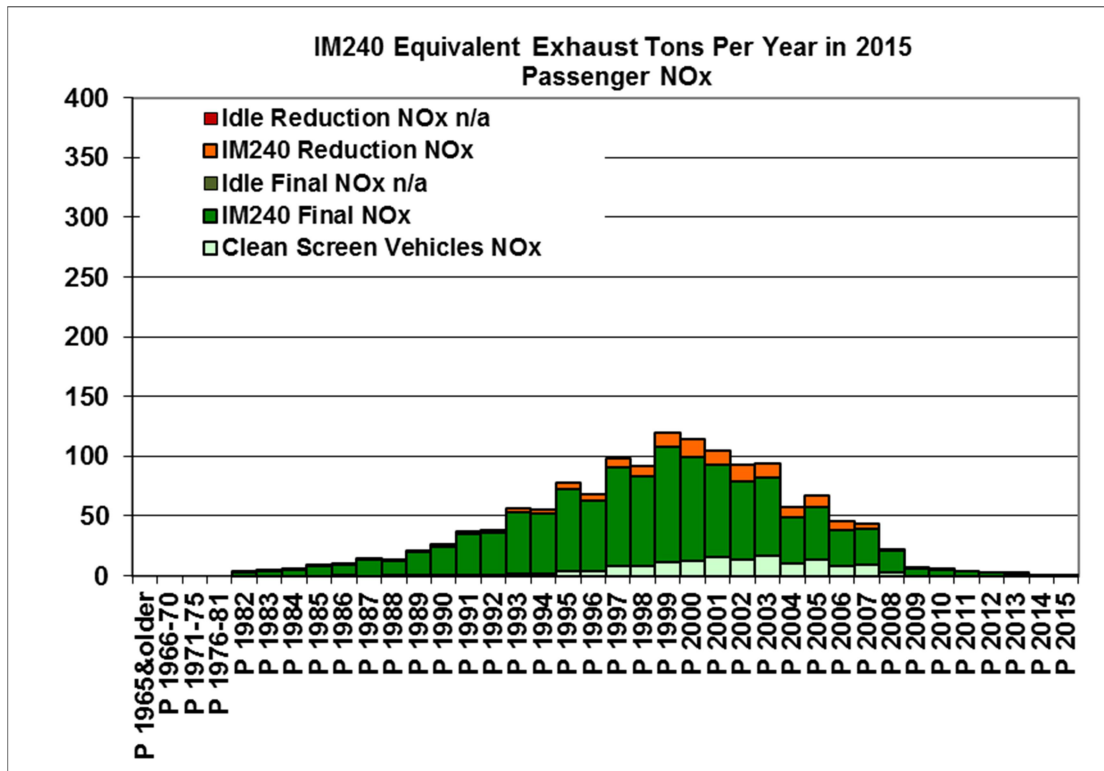
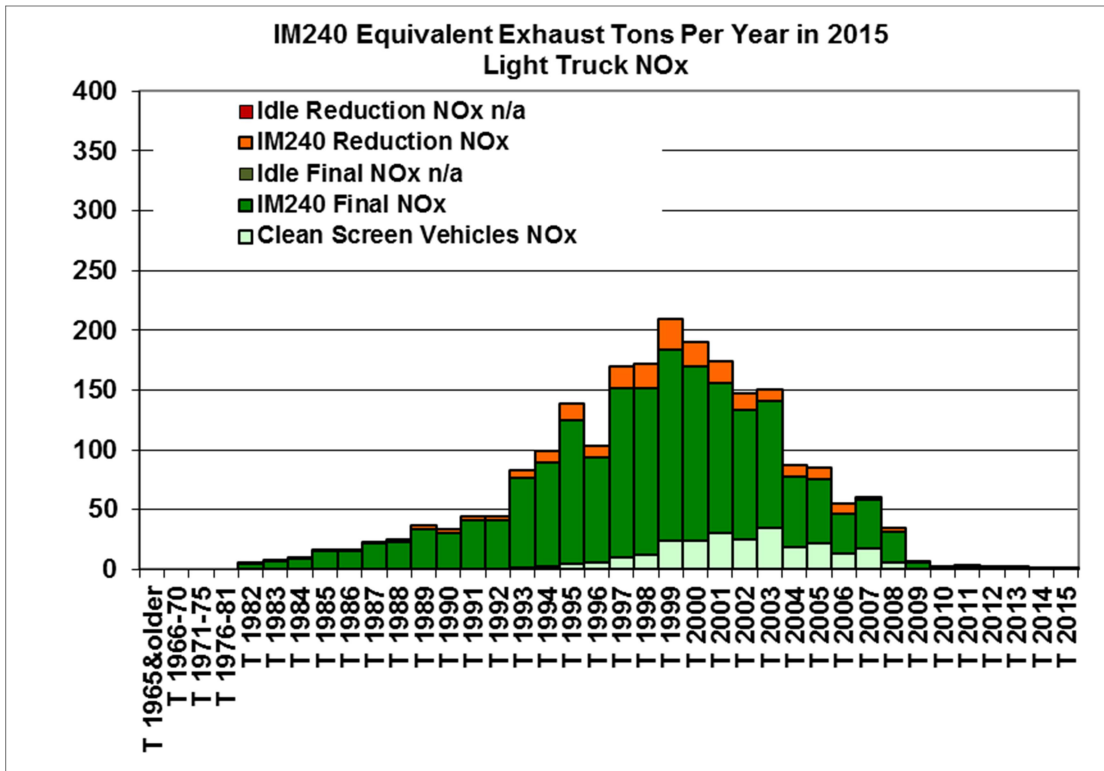


Figure VI-6 LDGT NOx Reductions and Remaining Emissions



VII. RapidScreen Benefits

RapidScreen provided benefits to vehicle owners of \$4.05M through reduced time and expense associated with eliminated inspection station visits. The elimination of station inspections also yielded net savings in emissions, greenhouse gases and 150,000 gallons of gasoline. This section summarizes the operational costs and benefits of the RapidScreen program.

A. Greenhouse Gas and Pollutants from Clean Screen Operations

The following were considered in deriving the net emissions, greenhouse gas and fuel use associated with the RapidScreen program:

- RSD van operations;
- RSD generators;
- RSD unit calibration and audit gases;
- Reductions from eliminated trips to inspection stations.

Table VII-1 summarizes these amounts.

Table VII-1 Reductions in Greenhouse Gases and Pollutants from RapidScreen Operations

Activity	HC t/yr	CO t/yr	NOx t/yr	CO2 t/yr	Fuel gal.
RapidScreen Operations					
RapidScreen operating vehicles (vans, audit trucks, maintenance)	0.224	0.484	0.028	124.8	13,996
Generators	0.063	4.45	0.000	14.1	2,178
Calibration and audit gases	0.005	0.05	0.003	0.5	
Total Rapidscreen operations	0.291	4.99	0.032	139.5	16,174
RapidScreen Vehicle Emission Reductions					
Station trip, waiting & testing	0.528	17.37	1.772	1476.7	165,547
Net benefit (cost)	0.24	12.38	1.740	1337.2	149,372

1. RapidScreen Operating Vehicles

Emissions and fuel usage of older RSD vans, audit trucks and maintenance vehicles associated with the RapidScreen program were developed from the average IM240 emissions of each vehicle from the most recent inspections performed from 2010 through 2015. Idle test emissions were converted to IM240 g/mi using the conversion factors described in Section V. IM240 emissions were scaled up to match MOVES estimates of running emissions vs. IM240 using scaling factors of 1.0 for hydrocarbons, 1.92 for CO and 2.23 for NO_x. For new model vans, the Tier2 standards for the G3500

Express V8 6L gasoline certification values were obtained from the EPA certification database. Odometer changes were pro-rated to provide annual mileages. Fuel use was calculated using EPA city fuel economies for the vehicle models or similar models. CO₂ tons were calculated at the rate of 8.92 x 10⁻³ tons per gallon (<http://www.epa.gov/cleanenergy/energy-resources/refs.html>).

2. Generators

The unmanned RSD 5000 units now run off battery power. For the four traditional vans, typical generator emissions and CO₂ grams over a four minute period were obtained by collecting generator emissions using lane IM240 equipment. Emissions and CO₂ grams were then multiplied by 15 to obtain g/hour and by 20% (4/20) of the Active Collection Van Hours from Table III-1. Fuel gallons were back calculated from CO₂ tons.

3. Calibration and Audit Gases

Calibration and Audit Gas emissions were calculated directly from the use estimates presented in Table VII-2. The liters of calibration and audit gases at 70F and normal pressure were multiplied by the pollutant concentration percentages and by the pollutant mass per liter to obtain tons.

Table VII-2 Calibration and Audit Gas Emissions

RSD VANS	AL Cyls	BL Cyls	CL Cyls	Liters at 70F NP	CO %	CO ₂ %	HC %	NO %	HC PPM	NOX PPM	CO tons	CO ₂ tons	HC tons	NO tons
Calibration	240	30	0	1,028,820	3.00	12.90	0.15	0.15	1500	1500	0.0425	0.2874	0.0033	0.0023
2 Point Audit	80	10		342,940	0.50	14.70	0.04	0.10	400	1000	0.0024	0.1092	0.0003	0.0005
ATP / DOR														
A	12	0		47,916	0.00	15.05	0.00	0.00	0	0	0.0000	0.0156	0.0000	0.0000
F	12	0	16	61,964	5.00	11.55	0.60	0.03	6000	250	0.0043	0.0155	0.0008	0.0000
G	12	0		47,916	0.20	14.91	0.01	0.15	100	1500	0.0001	0.0155	0.0000	0.0001
H	12	0		47,916	0.30	14.84	0.02	0.10	200	1000	0.0002	0.0154	0.0000	0.0001
J	12	0	16	61,964	0.50	14.70	0.04	0.10	400	1000	0.0004	0.0197	0.0001	0.0001
K	12	0		47,916	1.00	14.34	0.05	0.03	500	300	0.0007	0.0149	0.0001	0.0000
L	12	0		47,916	1.50	13.99	0.07	0.01	700	100	0.0010	0.0145	0.0001	0.0000
Q	12	0	16	61,964	3.00	12.92	0.11	0.05	1100	500	0.0026	0.0173	0.0001	0.0000
Total	416	40	48	1,797,232							0.0541	0.5249	0.0048	0.0031

Capacities and g/l	AL Cyls	BL Cyls	CL Cyls		CO %	CO ₂ %	HC %	NO %
Cylinder L @2000psi	29.5	15.7	5.9	Mol. Wt	28	44	44	30
Liters gas at 70F NP	3993	2350	878	g/l	1.3	2.0	2.0	1.3

4. RapidScreen Vehicle Emissions Reductions

The RapidScreen program eliminated the need for 195,778 station inspections that would otherwise require travel, waiting and inspection.

The average round trip to a station was estimated to be 9.5 miles. For every two minutes a car is idling, it uses about the same amount of fuel it takes to go about one mile according to the Consumer Energy Center (<http://www.consumerenergycenter.org/myths/idling.html>). This implies the average waiting

time of 10.4 minutes was equivalent to 5.2 miles of driving. The equivalent of another equivalent 2.2 miles of driving was spent moving through the inspection lane for a total equivalent of 16.9 miles per inspection. Eliminated trip/inspection emissions tons were calculated from the inspection mileage multiplied by the average IM240 g/mi emissions of the RapidScreen audit sample and the number of exempted vehicles. As noted above, IM240 emissions were scaled up to match MOVES estimates of running emissions vs. IM240. Gallons of fuel saved were estimated using an average of 20mpg.

B. RapidScreen Vehicle Owner Savings

Table VII-3 quantifies the RapidScreen benefits to vehicle owners. The average round trip to an inspection station was assumed to take an average of 28.5 minutes (9.5 miles at 20mph). Average wait and test times were 10.5 and 11.3 minutes respectively. The waiting and testing fuel consumption was estimated to be the equivalent of driving another 7.4 miles. Vehicle owner time was assumed to be worth half the Denver area average hourly wage of \$26.18 per hour, or \$13.09 per hour.

Travel savings were calculated at the IRS rate of 57.5c per mile per IRS Notice IR-2014-114, Dec. 10, 2014.

Total savings were \$4.05M or \$20.66 per vehicle.

Table VII-3 RapidScreen Vehicle Owner Savings

Activity	Vehicles	Minutes	Hours	Unit \$	\$'M
Station round trip @ 20mph	195778	28.5	92995	\$ 13.09	\$ 1.22
Testing	195778	11.3	36763	\$ 13.09	\$ 0.48
Waiting	195778	10.4	33880	\$ 13.09	\$ 0.44
Miles					
Driving miles equiv.	195778	16.9		\$ 0.575	\$ 1.90
Total vehicle owner savings					\$ 4.05

VIII. Recommendations

In 2015, several program changes were implemented affecting the vehicles subject to testing and test procedures:

- New models were exempt for seven years vs. four years previously;
- Models 8 to 11 years old were tested by scanning the OBD status with a fallback to IM240 allowed for vehicles with no more than one out of a select group of OBD system monitors not set ready;
- Models over 11 years old continued to be tailpipe tested using IM240 or Idle.

Previously clean screen notices were issued to 30% of subject vehicles due to renew registration. Except for changes made to clean screen criteria, the 2015 program changes reduced this percentage in two ways:

- The percentage of vehicles qualifying for clean screen was highest among the newest three model years are now exempt and the extended new model exemption will reduce current clean screens by at least one third over previous numbers;
- When the LEI is updated with OBD failure rates for 8 to 11 year old vehicles, the percentage passing the screen will decrease dramatically.

2015 was a transitional year. Only minor changes were made to Clean screen criteria by increasing the previous 2% RSD-LEI fail cutpoint to 4%.

One issue that came to light in the development of this report was the absence of tailpipe emissions values for RapidScreen audit vehicles tested using OBD-II. A change has been implemented to trigger an IM240 test for the newer RapidScreen audit vehicles that would normally be tested using OBD-II without a tailpipe test.

Among 2014 data, there were noted a few recent Asian turbo models having high on-road emissions and high rates of tailpipe failures with less than half the tailpipe failures also failing OBD. This may indicate OBD systems were tampered or were not functioning as they should. Exceptional models could be required to pass a tailpipe emissions test as well as OBD. Systematic screening using RSD emissions could be implemented to identify suspect models.

References

¹ “The Colorado Remote Sensing Program January – December 2011”, Envirotech report for the Colorado Department of Public Health and Environment, November 2012

² Colorado Air Quality Control Commission, “Regulation Number 11, Motor Vehicle Emissions Inspection Program”, <http://www.cdphe.state.co.us/regulations/airregs/5CCR1001-13.pdf>

³ Colorado Department Of Public Health and Environment, Air Pollution Control Division, Mobile Sources Section, “Colorado On-road Vehicle Emissions Remote Sensing System (COVERS) Specifications” Amended July 2010

⁴ Klausmeier R., “Technical Note: Estimating Full IM240 Emissions Based on Fast Pass Emission Results”, November 2005

⁵ Wenzel, T. “Evaluation of Arizona’s Enhanced I/M Program”, Presented at the 9th CRC On-Road Vehicle Emissions Workshop. April 1999.

⁶ McClintock, P. “The Denver Remote Sensing Clean Screening Pilot”, Envirotech report for the Colorado Department of Health and Environment, December 1999.

⁷ “Colorado Mileage Accumulation Rates from VID Odometer Readings Draft Report” for CDPHE by Eastern Research Group, Inc. June 30, 2008

Appendix A1 Colorado 2015 Transient Test Emissions Reductions

Unresolved fails remaining in area

33%

Model Year/Type	First Result	Last Result	Vehicles	Fail%	Initial			Final			Reduction %		
					HC	CO	NOX	HC	CO	NOX	HC	CO	NOX
1982	Pass	-	208		1.54	19.00	1.95	1.54	19.00	1.95	0.0%	0.0%	0.0%
P	Fail	Pass	40	15.0%	2.92	45.53	1.92	1.63	20.94	1.94	44.1%	54.0%	-0.9%
	Fail	Unresolv.	18	6.7%	6.52	88.21	1.50	2.28	35.99	0.43	65.0%	59.2%	71.4%
	Fail	Waiver	1	0.4%	3.34	61.88	3.45	4.66	70.49	3.79	-39.6%	-13.9%	-9.8%
Total	Fail%		267	22.1%	2.09	27.80	1.92	1.62	20.63	1.85	22.6%	25.8%	3.6%
1983	Pass	-	330		1.26	12.34	1.88	1.26	12.34	1.88	0.0%	0.0%	0.0%
P	Fail	Pass	68	15.4%	2.67	37.79	1.76	1.37	15.66	1.92	48.5%	58.6%	-8.8%
	Fail	Unresolv.	42	9.5%	4.32	68.26	1.74	1.36	21.78	0.66	68.6%	68.1%	61.9%
	Fail	Waiver	2	0.5%	7.88	35.67	1.85	8.43	47.04	1.29	-6.9%	-31.9%	30.0%
Total	Fail%		442	25.3%	1.79	21.67	1.85	1.32	13.90	1.77	26.6%	35.8%	4.4%
1984	Pass	-	455		1.21	11.25	1.86	1.21	11.25	1.86	0.0%	0.0%	0.0%
P	Fail	Pass	99	16.1%	2.79	37.37	1.95	1.41	13.29	1.87	49.4%	64.4%	4.0%
	Fail	Unresolv.	58	9.4%	6.70	82.72	1.79	1.66	22.19	0.59	75.2%	73.2%	66.8%
	Fail	Waiver	2	0.3%	3.75	112.83	0.76	5.84	171.20	0.39	-55.6%	-51.7%	48.7%
Total	Fail%		614	25.9%	1.99	22.54	1.86	1.30	13.13	1.74	34.8%	41.7%	6.8%
1985	Pass	-	785		1.01	10.64	1.88	1.01	10.64	1.88	0.0%	0.0%	0.0%
P	Fail	Pass	144	14.3%	2.64	30.42	2.06	1.18	10.06	1.98	55.3%	66.9%	3.6%
	Fail	Unresolv.	71	7.1%	3.89	57.98	1.68	1.23	19.12	0.57	68.4%	67.0%	66.2%
	Fail	Waiver	6	0.6%	2.90	82.14	0.83	2.63	88.99	0.83	9.2%	-8.3%	0.4%
Total	Fail%		1,006	22.0%	1.46	17.24	1.88	1.06	11.62	1.79	27.3%	32.6%	4.7%
1986	Pass	-	888		0.88	7.64	1.78	0.88	7.64	1.78	0.0%	0.0%	0.0%
P	Fail	Pass	159	13.9%	2.04	28.41	1.98	1.08	9.19	1.95	47.2%	67.6%	1.7%
	Fail	Unresolv.	96	8.4%	4.58	50.64	1.95	1.35	17.10	0.63	70.5%	66.2%	67.6%
	Fail	Waiver	2	0.2%	3.00	66.37	1.06	1.77	31.37	2.70	41.2%	52.7%	-153.2%
Total	Fail%		1,145	22.4%	1.35	14.23	1.82	0.95	8.69	1.71	30.1%	38.9%	6.2%
1987	Pass	-	1,320		0.80	7.39	1.77	0.80	7.39	1.77	0.0%	0.0%	0.0%
P	Fail	Pass	183	11.4%	2.12	26.49	2.03	0.99	8.13	1.80	53.3%	69.3%	11.3%
	Fail	Unresolv.	106	6.6%	4.59	62.54	1.59	1.25	16.31	0.57	72.8%	73.9%	64.4%
	Fail	Waiver	3	0.2%	3.23	31.31	3.31	0.54	14.25	3.01	83.2%	54.5%	8.9%
Total	Fail%		1,612	18.1%	1.21	13.23	1.79	0.85	8.07	1.70	29.2%	39.0%	5.2%
1988	Pass	-	1,296		0.75	7.91	1.54	0.75	7.91	1.54	0.0%	0.0%	0.0%
P	Fail	Pass	207	12.9%	2.51	26.98	1.93	0.87	8.30	1.61	65.5%	69.2%	16.7%
	Fail	Unresolv.	100	6.2%	3.39	41.77	1.77	1.08	12.50	0.58	68.2%	70.1%	66.9%
	Fail	Waiver	4	0.2%	6.83	115.00	0.92	3.79	38.95	1.00	44.4%	66.1%	-9.0%
Total	Fail%		1,607	19.4%	1.15	12.74	1.61	0.79	8.32	1.49	31.5%	34.7%	7.2%
1989	Pass	-	2,228		0.70	7.74	1.54	0.70	7.74	1.54	0.0%	0.0%	0.0%
P	Fail	Pass	236	9.2%	2.18	24.90	1.86	0.90	8.42	1.73	58.5%	66.2%	7.0%
	Fail	Unresolv.	103	4.0%	4.07	42.59	1.99	1.31	12.99	0.66	68.0%	69.5%	66.9%
	Fail	Waiver	4	0.2%	14.29	78.55	1.39	5.04	55.04	1.03	64.7%	29.9%	26.3%
Total	Fail%		2,571	13.3%	1.00	10.82	1.59	0.75	8.08	1.52	24.3%	25.3%	4.2%
1990	Pass	-	2,774		0.66	7.31	1.54	0.66	7.31	1.54	0.0%	0.0%	0.0%
P	Fail	Pass	302	9.4%	1.83	25.87	1.93	0.78	8.10	1.63	57.6%	68.7%	15.7%
	Fail	Unresolv.	137	4.3%	3.26	35.47	2.42	1.07	11.97	0.79	67.1%	66.2%	67.5%
	Fail	Waiver	2	0.1%	4.91	150.27	0.19	4.65	158.39	0.24	5.3%	-5.4%	-31.1%
Total	Fail%		3,215	13.7%	0.88	10.34	1.61	0.69	7.68	1.51	21.8%	25.8%	6.1%

Appendix A1 Colorado 2015 Transient Test Emissions Reductions

Unresolved fails remaining in area					33%								
Model	First	Last	Vehicles	Fail%	Initial			Final			Reduction %		
Year/Type	Result	Result			HC	CO	NOX	HC	CO	NOX	HC	CO	NOX
1991	Pass	-	4,170		0.55	6.49	1.40	0.55	6.49	1.40	0.0%	0.0%	0.0%
P	Fail	Pass	449	9.3%	1.85	22.75	1.95	0.70	7.39	1.58	62.1%	67.5%	18.9%
	Fail	Unresolv.	217	4.5%	3.71	41.94	1.98	1.11	11.86	0.69	70.1%	71.7%	65.2%
	Fail	Waiver	5	0.1%	1.94	12.58	2.53	1.95	6.81	2.46	-0.1%	45.9%	2.7%
Total	Fail%		4,841	13.9%	0.81	9.59	1.48	0.59	6.82	1.39	27.4%	29.0%	6.2%
1992	Pass	-	4,167		0.52	5.95	1.37	0.52	5.95	1.37	0.0%	0.0%	0.0%
P	Fail	Pass	512	10.4%	1.77	21.62	1.83	0.65	6.30	1.51	63.6%	70.9%	17.5%
	Fail	Unresolv.	242	4.9%	2.87	34.81	2.15	0.96	11.70	0.69	66.6%	66.4%	68.0%
	Fail	Waiver	3	0.1%	4.01	64.27	0.94	3.57	58.39	0.30	11.1%	9.2%	68.4%
Total	Fail%		4,924	15.4%	0.77	9.03	1.46	0.56	6.30	1.35	27.5%	30.3%	7.2%
1993	Pass	-	5,827		0.51	5.51	1.40	0.51	5.51	1.40	0.0%	0.0%	0.0%
P	Fail	Pass	594	8.9%	1.54	22.00	1.92	0.63	6.29	1.57	58.7%	71.4%	18.4%
	Fail	Unresolv.	228	3.4%	3.01	35.51	2.40	0.90	9.90	0.78	70.3%	72.1%	67.6%
	Fail	Waiver	6	0.1%	2.83	43.34	1.18	1.70	36.10	1.28	39.9%	16.7%	-8.5%
Total	Fail%		6,655	12.4%	0.69	8.04	1.48	0.53	5.76	1.39	22.5%	28.4%	5.9%
1994	Pass	-	6,611		0.40	4.92	1.11	0.40	4.92	1.11	0.0%	0.0%	0.0%
P	Fail	Pass	636	8.5%	1.37	15.52	1.71	0.49	5.19	1.24	64.5%	66.5%	27.3%
	Fail	Unresolv.	254	3.4%	2.33	27.64	2.17	0.82	9.06	0.73	64.7%	67.2%	66.4%
	Fail	Waiver	3	0.0%	4.80	36.02	2.31	2.36	21.61	2.93	50.9%	40.0%	-26.6%
Total	Fail%		7,504	11.9%	0.55	6.60	1.19	0.42	5.09	1.11	23.1%	22.9%	7.4%
1995	Pass	-	9,984		0.37	4.56	0.97	0.37	4.56	0.97	0.0%	0.0%	0.0%
P	Fail	Pass	919	8.2%	1.24	14.69	1.64	0.46	4.89	1.14	63.1%	66.7%	30.2%
	Fail	Unresolv.	338	3.0%	2.80	28.34	2.07	0.90	8.34	0.69	67.9%	70.6%	66.6%
	Fail	Waiver	6	0.1%	2.14	25.31	2.23	2.05	18.01	1.54	3.8%	28.9%	30.9%
Total	Fail%		11,247	11.2%	0.51	6.11	1.05	0.39	4.71	0.97	23.6%	23.0%	7.8%
1996	Pass	-	9,918		0.29	3.76	0.79	0.29	3.76	0.79	0.0%	0.0%	0.0%
P	Fail	Pass	848	7.7%	0.76	11.33	1.38	0.34	4.40	0.92	54.5%	61.2%	33.5%
	Fail	Unresolv.	304	2.7%	2.19	27.10	2.10	0.69	8.53	0.68	68.5%	68.5%	67.5%
	Fail	Waiver	8	0.1%	3.86	32.21	1.90	5.35	29.89	2.03	-38.5%	7.2%	-6.9%
Total	Fail%		11,078	10.5%	0.38	5.00	0.87	0.31	3.96	0.80	18.8%	20.8%	8.5%
1997	Pass	-	14,530		0.28	3.72	0.72	0.28	3.72	0.72	0.0%	0.0%	0.0%
P	Fail	Pass	1,272	7.9%	0.81	12.55	1.30	0.33	4.38	0.86	58.9%	65.1%	33.7%
	Fail	Unresolv.	341	2.1%	2.27	22.96	2.11	0.71	7.03	0.68	68.7%	69.4%	67.6%
	Fail	Waiver	4	0.0%	0.57	4.95	3.12	0.61	4.84	3.02	-6.2%	2.3%	3.2%
Total	Fail%		16,147	10.0%	0.36	4.82	0.79	0.29	3.84	0.73	19.5%	20.3%	8.1%
1998	Pass	-	14,572		0.23	3.41	0.62	0.23	3.41	0.62	0.0%	0.0%	0.0%
P	Fail	Pass	1,384	8.5%	0.72	11.63	1.15	0.26	3.82	0.67	63.7%	67.2%	41.6%
	Fail	Unresolv.	390	2.4%	1.42	17.57	1.92	0.46	5.38	0.62	67.5%	69.4%	67.8%
	Fail	Waiver	7	0.0%	0.76	14.97	2.53	0.89	14.49	1.64	-17.1%	3.2%	35.1%
Total	Fail%		16,353	10.9%	0.30	4.45	0.70	0.23	3.50	0.62	20.8%	21.4%	10.4%
1999	Pass	-	19,876		0.19	3.00	0.56	0.19	3.00	0.56	0.0%	0.0%	0.0%
P	Fail	Pass	1,619	7.4%	0.57	8.98	1.15	0.22	3.34	0.64	60.7%	62.8%	44.7%
	Fail	Unresolv.	441	2.0%	1.38	18.21	2.00	0.44	5.86	0.64	67.8%	67.8%	68.1%
	Fail	Waiver	4	0.0%	1.75	13.01	2.70	0.68	4.86	2.23	61.3%	62.7%	17.4%
Total	Fail%		21,940	9.4%	0.24	3.75	0.63	0.20	3.08	0.57	18.3%	17.7%	10.4%

Appendix A1 Colorado 2015 Transient Test Emissions Reductions

Unresolved fails remaining in area					33%								
Model	First	Last	Vehicles	Fail%	Initial			Final			Reduction %		
Year/Type	Result	Result			HC	CO	NOX	HC	CO	NOX	HC	CO	NOX
2000	Pass	-	21,172		0.14	2.58	0.44	0.14	2.58	0.44	0.0%	0.0%	0.0%
P	Fail	Pass	1,696	7.3%	0.52	8.41	1.20	0.20	3.27	0.54	62.2%	61.1%	54.7%
	Fail	Unresolv.	506	2.2%	1.70	18.73	2.13	0.51	5.85	0.67	70.2%	68.8%	68.4%
	Fail	Waiver	6	0.0%	0.71	8.58	2.94	0.38	3.39	4.11	47.1%	60.5%	-39.9%
Total	Fail%		23,380	9.4%	0.21	3.35	0.53	0.16	2.70	0.45	24.0%	19.5%	14.9%
2001	Pass	-	25,886		0.10	2.17	0.31	0.10	2.17	0.31	0.0%	0.0%	0.0%
P	Fail	Pass	1,691	6.1%	0.48	8.24	0.93	0.15	2.73	0.41	69.3%	66.9%	55.9%
	Fail	Unresolv.	339	1.2%	1.57	17.76	2.26	0.52	6.00	0.72	66.8%	66.2%	68.3%
	Fail	Waiver	5	0.0%	0.60	17.62	1.93	0.35	8.90	1.86	42.1%	49.5%	3.6%
Total	Fail%		27,921	7.3%	0.14	2.73	0.37	0.11	2.25	0.32	23.4%	17.5%	13.7%
2002	Pass	-	23,684		0.09	2.52	0.27	0.09	2.52	0.27	0.0%	0.0%	0.0%
P	Fail	Pass	1,749	6.8%	0.46	6.66	0.92	0.13	2.70	0.34	72.1%	59.4%	62.9%
	Fail	Unresolv.	302	1.2%	1.37	17.41	2.22	0.42	5.06	0.69	69.4%	70.9%	69.1%
	Fail	Waiver	1	0.0%	0.30	5.73	2.77	0.12	4.36	2.46	61.1%	23.8%	11.2%
Total	Fail%		25,736	8.0%	0.13	2.98	0.33	0.10	2.56	0.28	25.8%	13.9%	17.2%
2003	Pass	-	28,207		0.06	1.48	0.21	0.06	1.48	0.21	0.0%	0.0%	0.0%
P	Fail	Pass	1,624	5.4%	0.35	4.83	0.78	0.10	1.88	0.28	71.7%	61.1%	63.8%
	Fail	Unresolv.	241	0.8%	1.34	16.26	2.19	0.47	4.83	0.67	65.1%	70.3%	69.5%
	Fail	Waiver	3	0.0%	9.15	39.46	2.11	1.88	57.55	1.41	79.4%	-45.8%	33.3%
Total	Fail%		30,075	6.2%	0.09	1.78	0.26	0.07	1.53	0.22	24.4%	14.0%	15.1%
2004	Pass	-	21,555		0.05	1.33	0.16	0.05	1.33	0.16	0.0%	0.0%	0.0%
P	Fail	Pass	1,255	5.5%	0.34	4.97	0.69	0.10	1.77	0.23	71.2%	64.4%	66.8%
	Fail	Unresolv.	174	0.8%	1.28	13.54	2.31	0.43	4.55	0.72	66.4%	66.4%	68.6%
	Fail	Waiver	3	0.0%	0.83	22.82	1.14	1.13	23.82	1.40	-36.3%	-4.4%	-22.1%
Total	Fail%		22,987	6.2%	0.08	1.62	0.20	0.06	1.38	0.16	25.1%	14.9%	18.6%
2005	Pass	-	3,851		0.05	1.34	0.15	0.05	1.34	0.15	0.0%	0.0%	0.0%
P	Fail	Pass	273	6.5%	0.44	10.18	0.84	0.11	2.07	0.23	75.8%	79.6%	72.0%
	Fail	Unresolv.	48	1.2%	1.33	19.43	2.11	0.40	5.09	0.65	70.1%	73.8%	69.2%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		4,172	7.7%	0.09	2.13	0.22	0.06	1.43	0.16	34.6%	32.7%	25.6%
2006	Pass	-	2,916		0.05	1.38	0.12	0.05	1.38	0.12	0.0%	0.0%	0.0%
P	Fail	Pass	181	5.8%	0.64	10.69	1.21	0.12	2.24	0.21	80.8%	79.1%	82.5%
	Fail	Unresolv.	38	1.2%	1.23	17.86	2.28	0.35	5.36	0.62	71.3%	70.0%	72.6%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		3,135	7.0%	0.10	2.11	0.21	0.06	1.47	0.13	41.7%	30.3%	37.6%
2007	Pass	-	3,070		0.04	1.16	0.10	0.04	1.16	0.10	0.0%	0.0%	0.0%
P	Fail	Pass	108	3.4%	0.36	4.35	0.68	0.10	2.04	0.19	73.4%	53.1%	71.6%
	Fail	Unresolv.	27	0.8%	1.07	14.83	2.06	0.23	4.19	0.53	78.2%	71.7%	74.0%
	Fail	Waiver	1	0.0%	0.70	13.04	2.61	0.79	14.93	2.56	-12.3%	-14.4%	1.9%
Total	Fail%		3,206	4.2%	0.06	1.39	0.13	0.04	1.22	0.10	26.4%	12.0%	22.1%
2008	Pass	-	1,758		0.04	1.31	0.09	0.04	1.31	0.09	0.0%	0.0%	0.0%
P	Fail	Pass	86	4.7%	0.75	10.14	1.39	0.18	2.72	0.24	75.5%	73.2%	82.5%
	Fail	Unresolv.	4	0.2%	1.80	16.56	3.64	0.59	5.59	1.22	67.4%	66.3%	66.4%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		1,848	4.9%	0.08	1.75	0.16	0.05	1.38	0.10	37.1%	21.1%	37.6%

Appendix A1 Colorado 2015 Transient Test Emissions Reductions

Unresolved fails remaining in area					33%								
Model	First	Last	Vehicles	Fail%	Initial			Final			Reduction %		
Year/Type	Result	Result			HC	CO	NOX	HC	CO	NOX	HC	CO	NOX
2009	Pass	-	574		0.03	1.19	0.08	0.03	1.19	0.08	0.0%	0.0%	0.0%
P	Fail	Pass	19	3.2%	0.33	4.35	0.89	0.05	1.32	0.22	83.8%	69.6%	75.2%
	Fail	Unresolv.	3	0.5%	1.89	13.93	3.95	0.62	4.60	1.30	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		596	3.7%	0.05	1.35	0.12	0.04	1.21	0.09	29.8%	10.6%	28.4%
2010	Pass	-	353		0.04	1.42	0.08	0.04	1.42	0.08	0.0%	0.0%	0.0%
P	Fail	Pass	16	4.3%	0.64	13.75	0.82	0.11	2.10	0.11	83.1%	84.7%	86.7%
	Fail	Unresolv.	5	1.3%	0.89	19.24	1.89	0.29	6.35	0.62	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		374	5.6%	0.08	2.18	0.13	0.05	1.51	0.09	39.4%	30.7%	35.1%
2011	Pass	-	279		0.03	1.43	0.08	0.03	1.43	0.08	0.0%	0.0%	0.0%
P	Fail	Pass	7	2.4%	0.29	7.35	0.64	0.08	2.65	0.27	72.7%	64.0%	58.4%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		286	2.4%	0.04	1.57	0.09	0.03	1.46	0.08	12.9%	7.3%	10.2%
2012	Pass	-	220		0.02	1.14	0.06	0.02	1.14	0.06	0.0%	0.0%	0.0%
P	Fail	Pass	3	1.3%	0.01	0.88	0.05	0.01	1.15	0.22	34.6%	-30.5%	-344.4%
	Fail	Unresolv.	4	1.8%	0.93	8.88	1.23	0.34	3.16	0.44	63.0%	64.4%	64.6%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		227	3.1%	0.04	1.27	0.08	0.03	1.17	0.07	25.8%	7.7%	15.2%
2013	Pass	-	129		0.03	0.96	0.08	0.03	0.96	0.08	0.0%	0.0%	0.0%
P	Fail	Pass	3	2.2%	0.02	1.34	0.04	0.01	1.09	0.05	24.7%	18.9%	-2.8%
	Fail	Unresolv.	2	1.5%	1.10	17.29	2.65	0.39	6.92	0.78	64.8%	60.0%	70.5%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		134	3.7%	0.04	1.21	0.11	0.03	1.05	0.09	24.2%	13.3%	24.5%
2014	Pass	-	32		0.02	0.86	0.05	0.02	0.86	0.05	0.0%	0.0%	0.0%
P	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		32	0.0%	0.02	0.86	0.05	0.02	0.86	0.05	0.0%	0.0%	0.0%
2015	Pass	-	12		0.01	0.80	0.06	0.01	0.80	0.06	0.0%	0.0%	0.0%
P	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		12	0.0%	0.01	0.80	0.06	0.01	0.80	0.06	0.0%	0.0%	0.0%
2016	Pass	-	1		0.00	0.20	0.00	0.00	0.20	0.00	0.0%	0.0%	0.0%
P	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		1	0.0%	0.00	0.20	0.00	0.00	0.20	0.00	0.0%	0.0%	0.0%
Total Passenger Vehicles													
All	Pass	-	233,638		0.20	3.02	0.54	0.20	3.02	0.54	0.0%	0.0%	0.0%
P	Fail	Pass	18,382	7.1%	0.83	11.72	1.23	0.32	4.00	0.75	62.2%	65.9%	39.3%
	Fail	Unresolv.	5,179	2.0%	2.30	27.18	2.10	0.72	8.38	0.68	68.6%	69.2%	67.8%
	Fail	Waiver	91	0.0%	3.34	40.75	1.94	2.38	34.56	1.87	28.6%	15.2%	3.7%
Total	Fail%		257,290	9.2%	0.29	4.14	0.62	0.22	3.21	0.56	23.8%	22.5%	10.2%

Appendix A1 Colorado 2015 Transient Test Emissions Reductions

Unresolved fails remaining in area					33%								
Model	First	Last	Vehicles	Fail%	Initial			Final			Reduction %		
Year/Type	Result	Result			HC	CO	NOX	HC	CO	NOX	HC	CO	NOX
1982	Pass	-	214		2.45	30.22	2.87	2.45	30.22	2.87	0.0%	0.0%	0.0%
T	Fail	Pass	79	23.5%	4.77	69.82	2.48	2.51	32.10	2.82	47.3%	54.0%	-13.8%
	Fail	Unresolv.	43	12.8%	7.73	83.26	2.79	2.32	25.95	0.85	70.0%	68.8%	69.7%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		336	36.3%	3.67	46.32	2.77	2.45	30.11	2.60	33.3%	35.0%	6.1%
1983	Pass	-	395		2.87	32.00	2.54	2.87	32.00	2.54	0.0%	0.0%	0.0%
T	Fail	Pass	109	19.2%	4.81	66.83	2.44	2.77	34.99	2.48	42.4%	47.6%	-1.5%
	Fail	Unresolv.	62	10.9%	5.36	101.75	2.34	1.69	29.58	0.81	68.5%	70.9%	65.5%
	Fail	Waiver	1	0.2%	7.08	146.65	1.04	6.02	140.39	1.65	15.1%	4.3%	-57.6%
Total	Fail%		567	30.3%	3.52	46.53	2.50	2.72	32.50	2.34	22.6%	30.1%	6.4%
1984	Pass	-	510		1.96	23.86	2.61	1.96	23.86	2.61	0.0%	0.0%	0.0%
T	Fail	Pass	179	22.9%	3.45	60.22	2.63	2.11	26.91	2.75	38.7%	55.3%	-4.3%
	Fail	Unresolv.	91	11.7%	5.06	88.60	2.53	1.73	29.03	0.84	65.8%	67.2%	66.6%
	Fail	Waiver	1	0.1%	4.05	99.49	0.49	3.02	74.09	0.06	25.4%	25.5%	88.0%
Total	Fail%		781	34.7%	2.66	39.83	2.60	1.97	25.23	2.43	26.1%	36.7%	6.6%
1985	Pass	-	844		1.83	18.55	2.74	1.83	18.55	2.74	0.0%	0.0%	0.0%
T	Fail	Pass	240	19.7%	3.35	46.07	2.77	1.85	21.37	2.77	44.8%	53.6%	0.0%
	Fail	Unresolv.	133	10.9%	5.43	91.10	2.40	1.66	28.21	0.79	69.5%	69.0%	67.2%
	Fail	Waiver	4	0.3%	5.83	99.59	3.67	4.31	81.14	1.53	26.1%	18.5%	58.1%
Total	Fail%		1,221	30.9%	2.53	32.13	2.71	1.82	20.36	2.53	28.1%	36.6%	6.7%
1986	Pass	-	961		1.64	16.83	2.52	1.64	16.83	2.52	0.0%	0.0%	0.0%
T	Fail	Pass	247	18.5%	3.04	41.28	2.76	1.74	18.40	2.71	42.8%	55.4%	1.7%
	Fail	Unresolv.	122	9.2%	5.53	79.21	2.19	1.79	24.97	0.79	67.7%	68.5%	64.0%
	Fail	Waiver	3	0.2%	2.82	112.64	3.33	4.97	138.56	0.62	-76.2%	-23.0%	81.5%
Total	Fail%		1,333	27.9%	2.26	27.28	2.54	1.68	18.14	2.39	25.6%	33.5%	5.6%
1987	Pass	-	1,467		1.47	13.91	2.39	1.47	13.91	2.39	0.0%	0.0%	0.0%
T	Fail	Pass	295	15.6%	2.89	40.11	2.62	1.44	14.34	2.54	50.3%	64.3%	3.0%
	Fail	Unresolv.	126	6.7%	5.05	63.55	2.58	1.55	20.60	0.81	69.4%	67.6%	68.4%
	Fail	Waiver	4	0.2%	2.11	53.46	2.50	3.60	90.20	2.10	-70.6%	-68.7%	16.2%
Total	Fail%		1,892	22.5%	1.93	21.39	2.44	1.47	14.58	2.31	23.7%	31.8%	5.4%
1988	Pass	-	1,669		1.31	11.72	2.17	1.31	11.72	2.17	0.0%	0.0%	0.0%
T	Fail	Pass	330	15.4%	2.49	29.13	2.74	1.36	12.55	2.32	45.5%	56.9%	15.5%
	Fail	Unresolv.	142	6.6%	5.91	63.00	2.70	1.71	17.00	0.91	71.1%	73.0%	66.3%
	Fail	Waiver	2	0.1%	9.20	123.00	2.93	3.51	28.92	3.97	61.8%	76.5%	-35.3%
Total	Fail%		2,143	22.1%	1.80	17.90	2.30	1.34	12.21	2.12	25.4%	31.8%	8.0%
1989	Pass	-	2,520		1.21	12.19	2.12	1.21	12.19	2.12	0.0%	0.0%	0.0%
T	Fail	Pass	459	14.5%	2.79	31.09	2.65	1.30	12.45	2.24	53.3%	59.9%	15.5%
	Fail	Unresolv.	175	5.5%	3.89	56.90	2.83	1.32	19.23	0.91	66.2%	66.2%	68.0%
	Fail	Waiver	3	0.1%	3.79	74.33	2.38	2.83	78.28	2.24	25.4%	-5.3%	6.0%
Total	Fail%		3,157	20.2%	1.59	17.47	2.24	1.23	12.68	2.07	22.7%	27.4%	7.4%
1990	Pass	-	2,190		1.19	11.59	2.18	1.19	11.59	2.18	0.0%	0.0%	0.0%
T	Fail	Pass	435	15.7%	2.61	30.17	2.88	1.30	12.30	2.37	50.3%	59.2%	17.7%
	Fail	Unresolv.	137	5.0%	4.58	50.23	2.93	1.43	15.46	0.93	68.8%	69.2%	68.4%
	Fail	Waiver	5	0.2%	2.79	17.78	3.76	2.36	15.51	3.82	15.5%	12.8%	-1.8%
Total	Fail%		2,767	20.9%	1.58	16.44	2.33	1.22	11.90	2.15	22.9%	27.6%	7.7%

Appendix A1 Colorado 2015 Transient Test Emissions Reductions

Unresolved fails remaining in area					33%								
Model	First	Last	Vehicles	Fail%	Initial			Final			Reduction %		
Year/Type	Result	Result			HC	CO	NOX	HC	CO	NOX	HC	CO	NOX
1991	Pass	-	3,455		0.99	11.32	1.89	0.99	11.32	1.89	0.0%	0.0%	0.0%
T	Fail	Pass	550	13.2%	2.18	25.62	2.47	1.09	11.17	1.93	49.8%	56.4%	21.8%
	Fail	Unresolv.	160	3.8%	4.48	54.72	2.80	1.27	17.43	0.86	71.6%	68.1%	69.1%
	Fail	Waiver	5	0.1%	3.34	36.37	2.61	2.86	52.81	1.65	14.3%	-45.2%	36.6%
Total	Fail%		4,170	17.1%	1.28	14.90	2.00	1.02	11.58	1.86	20.8%	22.3%	7.3%
1992	Pass	-	3,266		1.02	10.81	1.92	1.02	10.81	1.92	0.0%	0.0%	0.0%
T	Fail	Pass	570	14.2%	2.27	25.81	2.45	1.15	11.66	1.98	49.6%	54.8%	19.0%
	Fail	Unresolv.	172	4.3%	4.27	43.72	2.71	1.37	13.86	0.89	68.0%	68.3%	67.3%
	Fail	Waiver	8	0.2%	3.37	39.05	2.15	3.68	33.18	2.20	-9.4%	15.0%	-2.7%
Total	Fail%		4,016	18.7%	1.34	14.41	2.03	1.06	11.11	1.88	21.1%	22.9%	7.1%
1993	Pass	-	5,633		0.99	10.41	2.04	0.99	10.41	2.04	0.0%	0.0%	0.0%
T	Fail	Pass	824	12.3%	2.24	23.89	2.81	1.13	11.20	2.11	49.3%	53.1%	25.0%
	Fail	Unresolv.	228	3.4%	3.97	46.36	3.23	1.26	13.48	1.03	68.2%	70.9%	68.2%
	Fail	Waiver	5	0.1%	6.48	47.24	3.43	2.39	28.56	2.82	63.1%	39.5%	17.8%
Total	Fail%		6,690	15.8%	1.25	13.32	2.17	1.02	10.63	2.01	18.5%	20.2%	7.4%
1994	Pass	-	6,917		0.78	8.65	1.79	0.78	8.65	1.79	0.0%	0.0%	0.0%
T	Fail	Pass	1,234	14.5%	1.87	20.30	2.68	0.87	9.13	1.84	53.5%	55.0%	31.5%
	Fail	Unresolv.	338	4.0%	3.32	37.32	3.21	1.02	11.07	1.03	69.1%	70.3%	67.9%
	Fail	Waiver	14	0.2%	3.47	33.21	3.52	2.46	26.35	2.56	29.1%	20.7%	27.5%
Total	Fail%		8,503	18.7%	1.04	11.52	1.98	0.80	8.85	1.77	22.8%	23.2%	10.7%
1995	Pass	-	9,337		0.72	8.44	1.77	0.72	8.44	1.77	0.0%	0.0%	0.0%
T	Fail	Pass	1,531	13.5%	1.76	19.70	2.68	0.81	8.86	1.82	53.8%	55.0%	32.3%
	Fail	Unresolv.	465	4.1%	3.79	38.20	3.02	1.12	11.95	0.99	70.5%	68.7%	67.2%
	Fail	Waiver	11	0.1%	4.61	56.26	1.58	2.64	41.67	1.13	42.7%	25.9%	28.1%
Total	Fail%		11,344	17.7%	0.99	11.23	1.95	0.75	8.67	1.75	24.1%	22.7%	10.3%
1996	Pass	-	8,709		0.40	5.29	1.33	0.40	5.29	1.33	0.0%	0.0%	0.0%
T	Fail	Pass	1,279	12.4%	0.99	13.60	2.08	0.44	5.63	1.45	55.2%	58.6%	30.2%
	Fail	Unresolv.	282	2.7%	2.42	25.83	3.16	0.76	8.68	1.01	68.8%	66.4%	68.0%
	Fail	Waiver	7	0.1%	2.14	16.79	4.34	1.27	14.05	3.03	40.5%	16.3%	30.2%
Total	Fail%		10,277	15.3%	0.53	6.90	1.47	0.41	5.43	1.33	21.7%	21.2%	9.4%
1997	Pass	-	14,648		0.34	4.97	1.20	0.34	4.97	1.20	0.0%	0.0%	0.0%
T	Fail	Pass	1,970	11.5%	0.89	12.47	2.15	0.38	5.44	1.34	56.9%	56.4%	37.8%
	Fail	Unresolv.	506	3.0%	1.87	20.29	3.20	0.59	6.50	1.00	68.4%	68.0%	68.9%
	Fail	Waiver	14	0.1%	5.34	39.72	2.97	4.54	41.16	3.17	15.1%	-3.6%	-6.8%
Total	Fail%		17,138	14.5%	0.45	6.31	1.37	0.35	5.10	1.22	21.4%	19.2%	11.5%
1998	Pass	-	15,457		0.30	4.44	1.07	0.30	4.44	1.07	0.0%	0.0%	0.0%
T	Fail	Pass	1,981	11.0%	0.82	11.94	2.01	0.34	4.67	1.19	58.4%	60.9%	40.9%
	Fail	Unresolv.	540	3.0%	1.72	19.19	3.16	0.53	6.12	1.01	69.1%	68.1%	68.1%
	Fail	Waiver	9	0.1%	1.45	28.47	3.34	1.21	27.07	3.04	16.2%	4.9%	9.0%
Total	Fail%		17,987	14.1%	0.40	5.72	1.24	0.31	4.52	1.08	22.3%	20.9%	12.6%
1999	Pass	-	21,613		0.23	3.46	0.79	0.23	3.46	0.79	0.0%	0.0%	0.0%
T	Fail	Pass	2,540	10.2%	0.76	10.96	1.76	0.28	3.94	0.95	62.9%	64.1%	46.1%
	Fail	Unresolv.	628	2.5%	1.93	20.05	2.82	0.62	6.48	0.89	67.7%	67.7%	68.6%
	Fail	Waiver	20	0.1%	1.01	13.06	3.47	1.02	11.11	2.86	-0.8%	14.9%	17.6%
Total	Fail%		24,801	12.9%	0.32	4.65	0.94	0.24	3.59	0.81	25.3%	22.9%	14.1%

Appendix A1 Colorado 2015 Transient Test Emissions Reductions

Unresolved fails remaining in area					33%								
Model	First	Last	Vehicles	Fail%	Initial			Final			Reduction %		
Year/Type	Result	Result			HC	CO	NOX	HC	CO	NOX	HC	CO	NOX
2000	Pass	-	20,447		0.20	3.02	0.67	0.20	3.02	0.67	0.0%	0.0%	0.0%
T	Fail	Pass	2,253	9.7%	0.71	10.88	1.51	0.26	3.69	0.87	63.7%	66.1%	42.8%
	Fail	Unresolv.	469	2.0%	1.84	25.52	2.66	0.59	8.02	0.83	68.1%	68.6%	68.6%
	Fail	Waiver	14	0.1%	1.49	32.51	3.46	0.82	15.50	3.25	44.7%	52.3%	6.1%
Total	Fail%		23,183	11.8%	0.28	4.26	0.80	0.21	3.19	0.70	24.8%	25.0%	12.6%
2001	Pass	-	25,894		0.14	2.64	0.46	0.14	2.64	0.46	0.0%	0.0%	0.0%
T	Fail	Pass	2,245	7.9%	0.45	8.03	1.11	0.18	3.23	0.60	59.0%	59.7%	45.6%
	Fail	Unresolv.	339	1.2%	1.48	23.91	2.60	0.41	7.42	0.82	72.4%	69.0%	68.6%
	Fail	Waiver	8	0.0%	1.43	30.31	3.35	0.78	8.20	3.83	45.3%	73.0%	-14.2%
Total	Fail%		28,486	9.1%	0.18	3.33	0.53	0.14	2.75	0.47	19.1%	17.4%	11.4%
2002	Pass	-	23,271		0.11	2.89	0.41	0.11	2.89	0.41	0.0%	0.0%	0.0%
T	Fail	Pass	1,787	7.1%	0.47	10.36	1.08	0.16	3.34	0.55	66.2%	67.8%	49.1%
	Fail	Unresolv.	264	1.0%	1.29	23.60	2.55	0.39	7.19	0.79	69.9%	69.5%	69.0%
	Fail	Waiver	7	0.0%	0.47	18.09	1.85	0.57	24.77	1.51	-21.4%	-36.9%	18.4%
Total	Fail%		25,329	8.1%	0.15	3.64	0.48	0.12	2.97	0.43	20.7%	18.3%	11.6%
2003	Pass	-	29,214		0.09	1.74	0.31	0.09	1.74	0.31	0.0%	0.0%	0.0%
T	Fail	Pass	1,871	6.0%	0.37	7.79	0.80	0.13	2.38	0.43	66.5%	69.4%	46.6%
	Fail	Unresolv.	194	0.6%	1.55	27.12	2.37	0.44	7.89	0.73	71.4%	70.9%	69.1%
	Fail	Waiver	6	0.0%	1.05	31.50	2.17	1.12	32.10	2.24	-6.4%	-1.9%	-3.3%
Total	Fail%		31,285	6.6%	0.11	2.27	0.35	0.09	1.83	0.32	19.1%	19.5%	9.3%
2004	Pass	-	25,782		0.06	1.52	0.18	0.06	1.52	0.18	0.0%	0.0%	0.0%
T	Fail	Pass	1,595	5.8%	0.32	6.96	0.62	0.10	2.24	0.27	70.0%	67.9%	57.3%
	Fail	Unresolv.	135	0.5%	1.52	25.16	2.71	0.36	7.32	0.83	76.1%	70.9%	69.3%
	Fail	Waiver	3	0.0%	0.35	20.13	0.69	0.24	19.97	0.73	31.2%	0.8%	-6.4%
Total	Fail%		27,515	6.3%	0.09	1.95	0.22	0.07	1.59	0.19	21.9%	18.5%	13.5%
2005	Pass	-	4,816		0.07	1.52	0.16	0.07	1.52	0.16	0.0%	0.0%	0.0%
T	Fail	Pass	298	5.8%	0.35	6.49	0.90	0.12	2.24	0.30	64.6%	65.5%	67.1%
	Fail	Unresolv.	44	0.9%	2.58	20.84	2.97	0.45	6.48	0.91	82.7%	68.9%	69.4%
	Fail	Waiver	1	0.0%	0.97	11.11	2.18	0.94	11.57	2.19	3.1%	-4.1%	-0.3%
Total	Fail%		5,159	6.6%	0.11	1.97	0.23	0.08	1.60	0.18	28.6%	18.7%	22.8%
2006	Pass	-	3,276		0.05	1.36	0.14	0.05	1.36	0.14	0.0%	0.0%	0.0%
T	Fail	Pass	200	5.7%	0.35	6.38	0.88	0.09	1.83	0.22	73.4%	71.3%	74.7%
	Fail	Unresolv.	31	0.9%	0.89	11.25	2.73	0.28	3.60	0.87	68.0%	68.0%	68.3%
	Fail	Waiver	1	0.0%	0.84	18.93	2.70	0.91	15.57	2.82	-8.3%	17.8%	-4.2%
Total	Fail%		3,508	6.6%	0.08	1.74	0.20	0.06	1.41	0.15	25.1%	18.9%	26.7%
2007	Pass	-	3,218		0.04	1.16	0.10	0.04	1.16	0.10	0.0%	0.0%	0.0%
T	Fail	Pass	144	4.3%	0.55	6.89	0.53	0.09	2.02	0.20	83.5%	70.7%	62.3%
	Fail	Unresolv.	14	0.4%	0.83	23.84	2.02	0.32	7.72	0.64	61.7%	67.6%	68.1%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		3,376	4.7%	0.07	1.50	0.12	0.04	1.22	0.10	32.9%	18.3%	16.2%
2008	Pass	-	1,877		0.04	1.17	0.08	0.04	1.17	0.08	0.0%	0.0%	0.0%
T	Fail	Pass	118	5.9%	0.26	4.49	0.44	0.07	1.63	0.15	74.9%	63.6%	65.9%
	Fail	Unresolv.	15	0.7%	0.94	28.95	1.35	0.29	8.33	0.42	69.1%	71.2%	69.2%
	Fail	Waiver	1	0.0%	2.10	84.52	1.40	2.10	84.52	1.40	0.0%	0.0%	0.0%
Total	Fail%		2,011	6.7%	0.06	1.62	0.11	0.04	1.29	0.09	27.5%	19.9%	21.1%

Appendix A1 Colorado 2015 Transient Test Emissions Reductions

Unresolved fails remaining in area					33%								
Model	First	Last	Vehicles	Fail%	Initial			Final			Reduction %		
Year/Type	Result	Result			HC	CO	NOX	HC	CO	NOX	HC	CO	NOX
2009	Pass	-	469		0.04	1.15	0.08	0.04	1.15	0.08	0.0%	0.0%	0.0%
T	Fail	Pass	26	5.2%	0.04	1.46	0.15	0.04	1.34	0.14	11.8%	8.1%	10.8%
	Fail	Unresolv.	3	0.6%	0.68	9.30	1.70	0.22	3.07	0.56	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		498	5.8%	0.04	1.21	0.09	0.04	1.17	0.08	7.5%	3.6%	8.4%
2010	Pass	-	341		0.03	1.03	0.06	0.03	1.03	0.06	0.0%	0.0%	0.0%
T	Fail	Pass	15	4.2%	0.03	2.63	0.04	0.02	0.55	0.06	25.6%	79.0%	-40.4%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		356	4.2%	0.03	1.09	0.06	0.03	1.01	0.06	1.0%	8.0%	-1.1%
2011	Pass	-	236		0.03	0.96	0.06	0.03	0.96	0.06	0.0%	0.0%	0.0%
T	Fail	Pass	14	5.6%	0.03	1.09	0.05	0.03	1.48	0.06	1.0%	-35.2%	-25.0%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		250	5.6%	0.03	0.97	0.06	0.03	0.99	0.06	0.0%	-2.2%	-1.1%
2012	Pass	-	106		0.02	0.74	0.05	0.02	0.74	0.05	0.0%	0.0%	0.0%
T	Fail	Pass	2	1.8%	0.91	9.64	2.51	0.18	2.36	0.37	79.9%	75.5%	85.1%
	Fail	Unresolv.	1	0.9%	2.65	225.61	0.00	0.87	74.45	0.00	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		109	2.8%	0.06	2.97	0.09	0.03	1.45	0.05	46.9%	51.2%	43.6%
2013	Pass	-	41		0.03	0.72	0.06	0.03	0.72	0.06	0.0%	0.0%	0.0%
T	Fail	Pass	2	4.5%	0.07	9.35	0.53	0.06	3.29	0.35	9.2%	64.8%	33.4%
	Fail	Unresolv.	1	2.3%	0.49	5.30	2.01	0.15	1.94	0.68	69.9%	63.3%	66.3%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		44	6.8%	0.04	1.22	0.12	0.03	0.87	0.09	20.5%	28.8%	30.9%
2014	Pass	-	16		0.02	0.54	0.04	0.02	0.54	0.04	0.0%	0.0%	0.0%
T	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		16	0.0%	0.02	0.54	0.04	0.02	0.54	0.04	0.0%	0.0%	0.0%
2015	Pass	-	9		0.02	0.40	0.04	0.02	0.40	0.04	0.0%	0.0%	0.0%
T	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		9	0.0%	0.02	0.40	0.04	0.02	0.40	0.04	0.0%	0.0%	0.0%
2016	Pass	-	1		0.01	0.50	0.04	0.01	0.50	0.04	0.0%	0.0%	0.0%
T	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		1	0.0%	0.01	0.50	0.04	0.01	0.50	0.04	0.0%	0.0%	0.0%
Total Trucks													
All	Pass	-	238,819		0.31	4.18	0.80	0.31	4.18	0.80	0.0%	0.0%	0.0%
T	Fail	Pass	25,422	9.4%	1.10	15.04	1.78	0.50	6.11	1.17	54.5%	59.3%	34.0%
	Fail	Unresolv.	5,860	2.2%	2.85	35.58	2.85	0.88	11.08	0.91	69.2%	68.8%	68.2%
	Fail	Waiver	157	0.1%	2.80	37.88	2.95	2.16	32.78	2.54	23.0%	13.5%	13.8%
Total	Fail%		270,258	11.6%	0.44	5.91	0.94	0.34	4.53	0.84	22.7%	23.3%	10.6%
Fleet Total													
All	Pass	-	472,457		0.25	3.61	0.67	0.25	3.61	0.67	0.0%	0.0%	0.0%
All	Fail	Pass	43,804	8.3%	0.99	13.65	1.55	0.42	5.23	0.99	57.2%	61.7%	35.8%
	Fail	Unresolv.	11,039	2.1%	2.59	31.64	2.50	0.80	9.82	0.80	69.0%	69.0%	68.0%
	Fail	Waiver	248	0.0%	3.00	38.94	2.58	2.24	33.43	2.30	25.3%	14.1%	11.0%
Total	Fail%		527,548	10.4%	0.37	5.05	0.78	0.28	3.89	0.70	23.2%	23.0%	10.4%

Colorado 2015 OBD Test Estimated Reductions

Unresolved fails remaining in area					0.33								
Model Year/Type	First Result	Last Result	Vehicles	Fail%	HC	Initial CO	NOX	HC	Final CO	NOX	Reduction %		
											HC	CO	NOX
1996	Pass	-	63		0.36	3.5	0.96	0.36	3.5	0.96	0.0%	0.0%	0.0%
P	Fail	Pass	6	6.8%	0.77	7.0	1.34	0.36	3.5	0.96	53.8%	49.8%	28.4%
	Fail	Unresolv.	19	21.6%	0.77	7.0	1.34	0.25	2.3	0.44	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		88	28.4%	0.47	4.5	1.07	0.33	3.3	0.85	29.5%	27.8%	20.6%
1997	Pass	-	76		0.37	3.3	0.64	0.37	3.3	0.64	0.0%	0.0%	0.0%
P	Fail	Pass	4	4.4%	1.13	22.0	0.81	0.37	3.3	0.64	67.6%	84.9%	21.2%
	Fail	Unresolv.	11	12.1%	1.13	22.0	0.81	0.37	7.3	0.27	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		91	16.5%	0.49	6.4	0.66	0.37	3.8	0.59	25.4%	40.6%	11.0%
1998	Pass	-	63		0.29	3.1	0.64	0.29	3.1	0.64	0.0%	0.0%	0.0%
P	Fail	Pass	14	14.4%	0.37	5.0	0.79	0.29	3.1	0.64	20.3%	38.5%	19.7%
	Fail	Unresolv.	20	20.6%	0.37	5.0	0.79	0.12	1.7	0.26	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		97	35.1%	0.32	3.8	0.69	0.26	2.8	0.56	19.3%	25.8%	19.1%
1999	Pass	-	130		0.32	2.6	0.65	0.32	2.6	0.65	0.0%	0.0%	0.0%
P	Fail	Pass	21	12.0%	0.91	15.3	1.09	0.32	2.6	0.65	65.3%	82.8%	40.0%
	Fail	Unresolv.	24	13.7%	0.91	15.3	1.09	0.30	5.0	0.36	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		175	25.7%	0.47	5.9	0.76	0.31	3.0	0.61	33.0%	49.7%	19.9%
2000	Pass	-	176		0.26	2.7	0.49	0.26	2.7	0.49	0.0%	0.0%	0.0%
P	Fail	Pass	26	11.4%	0.73	8.5	0.99	0.26	2.7	0.49	64.2%	68.1%	50.6%
	Fail	Unresolv.	26	11.4%	0.73	8.5	0.99	0.24	2.8	0.33	67.0%	67.0%	67.0%
	Fail	Waiver	1	0.4%	0.73	8.5	0.99	0.73	8.5	0.99	0.0%	0.0%	0.0%
Total	Fail%		229	23.1%	0.37	4.1	0.60	0.26	2.8	0.47	29.4%	32.2%	21.9%
2001	Pass	-	438		0.16	2.7	0.29	0.16	2.7	0.29	0.0%	0.0%	0.0%
P	Fail	Pass	42	8.2%	0.82	15.9	0.60	0.16	2.7	0.29	80.4%	83.2%	51.7%
	Fail	Unresolv.	31	6.1%	0.82	15.9	0.60	0.27	5.2	0.20	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		511	14.3%	0.26	4.5	0.34	0.17	2.8	0.29	34.3%	38.0%	14.9%
2002	Pass	-	572		0.05	1.7	0.19	0.05	1.7	0.19	0.0%	0.0%	0.0%
P	Fail	Pass	37	5.7%	0.26	3.4	0.52	0.05	1.7	0.19	82.8%	50.3%	62.9%
	Fail	Unresolv.	35	5.4%	0.26	3.4	0.52	0.09	1.1	0.17	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		644	11.2%	0.07	1.9	0.23	0.05	1.7	0.19	31.7%	11.8%	16.5%
2003	Pass	-	727		0.08	1.4	0.23	0.08	1.4	0.23	0.0%	0.0%	0.0%
P	Fail	Pass	107	12.1%	0.12	3.5	0.72	0.08	1.4	0.23	33.4%	61.0%	68.4%
	Fail	Unresolv.	47	5.3%	0.12	3.5	0.72	0.04	1.2	0.24	67.0%	67.0%	67.0%
	Fail	Waiver	4	0.5%	0.12	3.5	0.72	0.12	3.5	0.72	0.0%	0.0%	0.0%
Total	Fail%		885	17.9%	0.08	1.7	0.31	0.08	1.4	0.23	10.5%	21.9%	27.0%
2004	Pass	-	1,153		0.06	1.4	0.14	0.06	1.4	0.14	0.0%	0.0%	0.0%
P	Fail	Pass	69	5.5%	0.17	3.9	0.29	0.06	1.4	0.14	66.8%	65.8%	51.3%
	Fail	Unresolv.	43	3.4%	0.17	3.9	0.29	0.06	1.3	0.10	67.0%	67.0%	67.0%
	Fail	Waiver	1	0.1%	0.17	3.9	0.29	0.17	3.9	0.29	0.0%	0.0%	0.0%
Total	Fail%		1,266	8.9%	0.07	1.6	0.16	0.06	1.4	0.14	15.1%	14.6%	9.5%
2005	Pass	-	26,869		0.04	1.1	0.11	0.04	1.1	0.11	0.0%	0.0%	0.0%
P	Fail	Pass	2,493	8.3%	0.12	3.4	0.34	0.04	1.1	0.11	65.6%	69.2%	66.7%
	Fail	Unresolv.	788	2.6%	0.12	3.4	0.34	0.04	1.1	0.11	67.0%	67.0%	67.0%
	Fail	Waiver	19	0.1%	0.12	3.4	0.34	0.12	3.4	0.34	0.0%	0.0%	0.0%
Total	Fail%		30,169	10.9%	0.05	1.3	0.14	0.04	1.1	0.12	17.3%	19.5%	17.9%
2006	Pass	-	21,937		0.04	1.0	0.10	0.04	1.0	0.10	0.0%	0.0%	0.0%
P	Fail	Pass	1,688	7.0%	0.08	1.8	0.27	0.04	1.0	0.10	45.6%	43.1%	63.2%
	Fail	Unresolv.	561	2.3%	0.08	1.8	0.27	0.03	0.6	0.09	67.0%	67.0%	67.0%
	Fail	Waiver	18	0.1%	0.08	1.8	0.27	0.08	1.8	0.27	0.0%	0.0%	0.0%
Total	Fail%		24,204	9.4%	0.05	1.1	0.11	0.04	1.0	0.10	8.1%	7.5%	13.9%

Colorado 2015 OBD Test Estimated Reductions

Unresolved fails remaining in area					0.33								
Model Year/Type	First Result	Last Result	Vehicles	Fail%	HC	Initial CO	NOX	HC	Final CO	NOX	Reduction %		
											HC	CO	NOX
2007 P	Pass	-	30,634		0.03	1.0	0.07	0.03	1.0	0.07	0.0%	0.0%	0.0%
	Fail	Pass	1,435	4.4%	0.06	1.6	0.23	0.03	1.0	0.07	51.9%	40.2%	69.5%
	Fail	Unresolv.	380	1.2%	0.06	1.6	0.23	0.02	0.5	0.08	67.0%	67.0%	67.0%
	Fail	Waiver	8	0.0%	0.06	1.6	0.23	0.06	1.6	0.23	0.0%	0.0%	0.0%
Total	Fail%		32,457	5.6%	0.03	1.0	0.08	0.03	1.0	0.07	6.0%	4.1%	11.2%
2008 P	Pass	-	21,030		0.03	1.0	0.06	0.03	1.0	0.06	0.0%	0.0%	0.0%
	Fail	Pass	934	4.2%	0.06	1.8	0.05	0.03	1.0	0.06	48.6%	42.8%	-24.1%
	Fail	Unresolv.	248	1.1%	0.06	1.8	0.05	0.02	0.6	0.02	67.0%	67.0%	67.0%
	Fail	Waiver	1	0.0%	0.06	1.8	0.05	0.06	1.8	0.05	0.0%	0.0%	0.0%
Total	Fail%		22,213	5.3%	0.03	1.1	0.06	0.03	1.0	0.06	5.2%	4.3%	-0.2%
2009 P	Pass	-	5,979		0.03	0.9	0.07	0.03	0.9	0.07	0.0%	0.0%	0.0%
	Fail	Pass	237	3.8%	0.01	1.8	0.03	0.03	0.9	0.07	-147.2%	47.6%	-118.1%
	Fail	Unresolv.	73	1.2%	0.01	1.8	0.03	0.00	0.6	0.01	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		6,289	4.9%	0.03	1.0	0.07	0.03	0.9	0.07	-2.0%	4.7%	-1.7%
2010 P	Pass	-	4,246		0.01	0.9	0.08	0.01	0.9	0.08	0.0%	0.0%	0.0%
	Fail	Pass	119	2.7%	0.01	1.6	0.01	0.01	0.9	0.08	-13.7%	40.0%	-699.9%
	Fail	Unresolv.	46	1.0%	0.01	1.6	0.01	0.00	0.5	0.00	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		4,411	3.7%	0.01	1.0	0.08	0.01	0.9	0.08	0.3%	2.9%	-2.4%
2011 P	Pass	-	3,208		0.03	1.0	0.07	0.03	1.0	0.07	0.0%	0.0%	0.0%
	Fail	Pass	72	2.2%	0.01	1.7	0.02	0.03	1.0	0.07	-115.2%	43.5%	-198.3%
	Fail	Unresolv.	31	0.9%	0.01	1.7	0.02	0.00	0.6	0.01	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		3,311	3.1%	0.02	1.0	0.07	0.03	1.0	0.07	-0.9%	2.7%	-1.3%
2012 P	Pass	-	2,901		0.03	1.0	0.07	0.03	1.0	0.07	0.0%	0.0%	0.0%
	Fail	Pass	67	2.2%	0.01	1.7	0.02	0.03	1.0	0.07	-115.2%	43.5%	-198.3%
	Fail	Unresolv.	20	0.7%	0.01	1.7	0.02	0.00	0.6	0.01	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		2,988	2.9%	0.02	1.0	0.07	0.03	1.0	0.07	-1.0%	2.5%	-1.4%
2013 P	Pass	-	1,897		0.03	1.0	0.07	0.03	1.0	0.07	0.0%	0.0%	0.0%
	Fail	Pass	53	2.7%	0.01	1.7	0.02	0.03	1.0	0.07	-115.2%	43.5%	-198.3%
	Fail	Unresolv.	12	0.6%	0.01	1.7	0.02	0.00	0.6	0.01	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		1,962	3.3%	0.02	1.0	0.07	0.03	1.0	0.07	-1.3%	2.7%	-1.7%
2014 P	Pass	-	951		0.03	1.0	0.07	0.03	1.0	0.07	0.0%	0.0%	0.0%
	Fail	Pass	11	1.1%	0.01	1.7	0.02	0.03	1.0	0.07	-115.2%	43.5%	-198.3%
	Fail	Unresolv.	3	0.3%	0.01	1.7	0.02	0.00	0.6	0.01	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		965	1.5%	0.03	1.0	0.07	0.03	1.0	0.07	-0.5%	1.2%	-0.7%
2015 P	Pass	-	240		0.03	1.0	0.07	0.03	1.0	0.07	0.0%	0.0%	0.0%
	Fail	Pass	1	0.4%	0.01	1.7	0.02	0.03	1.0	0.07	-115.2%	43.5%	-198.3%
	Fail	Unresolv.	2	0.8%	0.01	1.7	0.02	0.00	0.6	0.01	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		243	1.2%	0.03	1.0	0.07	0.03	1.0	0.07	0.0%	1.3%	-0.1%
2016 P	Pass	-	5		0.03	1.0	0.07	0.03	1.0	0.07	0.0%	0.0%	0.0%
	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	1	16.7%	0.01	1.7	0.02	0.00	0.6	0.01	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		6	16.7%	0.02	1.1	0.06	0.02	0.9	0.06	5.7%	17.5%	4.2%
Total Passenger Vehicles													
All	Pass	-	123,295		0.04	1.0	0.09	0.04	1.0	0.09	0.0%	0.0%	0.0%
P	Fail	Pass	7,436	5.6%	0.09	2.5	0.26	0.04	1.1	0.10	57.0%	58.0%	60.9%
	Fail	Unresolv.	2,421	1.8%	0.12	2.9	0.29	0.04	1.0	0.10	67.0%	67.0%	67.0%
	Fail	Waiver	52	0.0%	0.11	2.7	0.33	0.11	2.7	0.33	0.0%	0.0%	0.0%
Total	Fail%		133,204	7.4%	0.04	1.1	0.10	0.04	1.0	0.09	11.1%	10.2%	12.1%

Colorado 2015 OBD Test Estimated Reductions

Unresolved fails remaining in area					0.33								
Model Year/Type	First Result	Last Result	Vehicles	Fail%	HC	Initial CO	NOX	HC	Final CO	NOX	Reduction %		
											HC	CO	NOX
1996	Pass	-	22		0.17	5.4	0.66	0.17	5.4	0.66	0.0%	0.0%	0.0%
T	Fail	Pass	5	14.7%	7.87	15.2	2.08	0.17	5.4	0.66	97.8%	64.2%	68.0%
	Fail	Unresolv.	6	17.6%	7.87	15.2	2.08	2.60	5.0	0.69	67.0%	67.0%	67.0%
	Fail	Waiver	1	2.9%	7.87	15.2	2.08	7.87	15.2	2.08	0.0%	0.0%	0.0%
Total	Fail%		34	35.3%	2.89	8.9	1.16	0.82	5.6	0.71	71.4%	36.4%	39.0%
1997	Pass	-	93		0.25	3.1	0.87	0.25	3.1	0.87	0.0%	0.0%	0.0%
T	Fail	Pass	9	7.6%	0.35	5.8	1.48	0.25	3.1	0.87	28.1%	47.4%	41.5%
	Fail	Unresolv.	17	14.3%	0.35	5.8	1.48	0.12	1.9	0.49	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		119	21.8%	0.27	3.7	1.00	0.23	2.9	0.81	15.0%	20.9%	18.8%
1998	Pass	-	83		0.36	4.0	0.95	0.36	4.0	0.95	0.0%	0.0%	0.0%
T	Fail	Pass	13	11.5%	1.65	10.8	2.02	0.36	4.0	0.95	78.0%	63.2%	52.7%
	Fail	Unresolv.	16	14.2%	1.65	10.8	2.02	0.54	3.6	0.67	67.0%	67.0%	67.0%
	Fail	Waiver	1	0.9%	1.65	10.8	2.02	1.65	10.8	2.02	0.0%	0.0%	0.0%
Total	Fail%		113	26.5%	0.70	5.8	1.24	0.40	4.0	0.92	43.2%	31.3%	25.4%
1999	Pass	-	842		0.18	2.5	0.88	0.18	2.5	0.88	0.0%	0.0%	0.0%
T	Fail	Pass	153	14.1%	1.63	25.0	0.90	0.18	2.5	0.88	88.8%	89.9%	2.8%
	Fail	Unresolv.	89	8.2%	1.63	25.0	0.90	0.54	8.2	0.30	67.0%	67.0%	67.0%
	Fail	Waiver	4	0.4%	1.63	25.0	0.90	1.63	25.0	0.90	0.0%	0.0%	0.0%
Total	Fail%		1,088	22.6%	0.51	7.6	0.88	0.22	3.1	0.83	57.5%	59.6%	6.0%
2000	Pass	-	1,183		0.29	3.9	1.07	0.29	3.9	1.07	0.0%	0.0%	0.0%
T	Fail	Pass	257	16.2%	1.40	19.2	1.16	0.29	3.9	1.07	79.6%	79.9%	7.4%
	Fail	Unresolv.	144	9.1%	1.40	19.2	1.16	0.46	6.3	0.38	67.0%	67.0%	67.0%
	Fail	Waiver	5	0.3%	1.40	19.2	1.16	1.40	19.2	1.16	0.0%	0.0%	0.0%
Total	Fail%		1,589	25.6%	0.57	7.8	1.10	0.31	4.1	1.01	46.5%	46.9%	7.7%
2001	Pass	-	1,803		0.13	3.2	0.47	0.13	3.2	0.47	0.0%	0.0%	0.0%
T	Fail	Pass	368	15.8%	0.56	7.4	1.07	0.13	3.2	0.47	76.1%	57.2%	56.1%
	Fail	Unresolv.	151	6.5%	0.56	7.4	1.07	0.19	2.4	0.35	67.0%	67.0%	67.0%
	Fail	Waiver	5	0.2%	0.56	7.4	1.07	0.56	7.4	1.07	0.0%	0.0%	0.0%
Total	Fail%		2,327	22.5%	0.23	4.1	0.60	0.14	3.1	0.46	39.9%	24.0%	23.4%
2002	Pass	-	1,640		0.15	3.5	0.47	0.15	3.5	0.47	0.0%	0.0%	0.0%
T	Fail	Pass	379	17.5%	0.53	5.7	0.50	0.15	3.5	0.47	71.3%	38.8%	7.3%
	Fail	Unresolv.	143	6.6%	0.53	5.7	0.50	0.18	1.9	0.17	67.0%	67.0%	67.0%
	Fail	Waiver	6	0.3%	0.53	5.7	0.50	0.53	5.7	0.50	0.0%	0.0%	0.0%
Total	Fail%		2,168	24.4%	0.25	4.0	0.47	0.16	3.4	0.45	36.7%	15.8%	6.0%
2003	Pass	-	2,054		0.10	2.0	0.37	0.10	2.0	0.37	0.0%	0.0%	0.0%
T	Fail	Pass	356	14.1%	0.13	3.6	0.26	0.10	2.0	0.37	27.5%	44.3%	-45.5%
	Fail	Unresolv.	121	4.8%	0.13	3.6	0.26	0.04	1.2	0.08	67.0%	67.0%	67.0%
	Fail	Waiver	2	0.1%	0.13	3.6	0.26	0.13	3.6	0.26	0.0%	0.0%	0.0%
Total	Fail%		2,533	18.9%	0.10	2.3	0.35	0.09	2.0	0.36	9.1%	14.7%	-2.3%
2004	Pass	-	1,664		0.07	1.6	0.17	0.07	1.6	0.17	0.0%	0.0%	0.0%
T	Fail	Pass	267	13.3%	0.20	5.0	0.39	0.07	1.6	0.17	66.5%	67.8%	56.1%
	Fail	Unresolv.	78	3.9%	0.20	5.0	0.39	0.07	1.6	0.13	67.0%	67.0%	67.0%
	Fail	Waiver	2	0.1%	0.20	5.0	0.39	0.20	5.0	0.39	0.0%	0.0%	0.0%
Total	Fail%		2,011	17.3%	0.09	2.2	0.21	0.07	1.6	0.17	25.4%	26.4%	18.8%
2005	Pass	-	30,057		0.05	1.3	0.12	0.05	1.3	0.12	0.0%	0.0%	0.0%
T	Fail	Pass	2,493	7.5%	0.14	3.3	0.28	0.05	1.3	0.12	65.6%	59.4%	57.9%
	Fail	Unresolv.	690	2.1%	0.14	3.3	0.28	0.05	1.1	0.09	67.0%	67.0%	67.0%
	Fail	Waiver	26	0.1%	0.14	3.3	0.28	0.14	3.3	0.28	0.0%	0.0%	0.0%
Total	Fail%		33,266	9.6%	0.06	1.5	0.13	0.05	1.3	0.12	15.5%	12.6%	12.0%
2006	Pass	-	23,655		0.04	1.0	0.09	0.04	1.0	0.09	0.0%	0.0%	0.0%
T	Fail	Pass	1,753	6.8%	0.07	2.4	0.36	0.04	1.0	0.09	51.9%	59.3%	75.7%
	Fail	Unresolv.	452	1.7%	0.07	2.4	0.36	0.02	0.8	0.12	67.0%	67.0%	67.0%
	Fail	Waiver	10	0.0%	0.07	2.4	0.36	0.07	2.4	0.36	0.0%	0.0%	0.0%
Total	Fail%		25,870	8.6%	0.04	1.1	0.11	0.04	1.0	0.09	8.9%	11.3%	20.5%

Colorado 2015 OBD Test Estimated Reductions

Unresolved fails remaining in area					0.33								
Model Year/Type	First Result	Last Result	Vehicles	Fail%	HC	Initial CO	NOX	HC	Final CO	NOX	Reduction %		
											HC	CO	NOX
2007 T	Pass	-	34,255		0.03	1.2	0.08	0.03	1.2	0.08	0.0%	0.0%	0.0%
	Fail	Pass	2,028	5.5%	0.06	2.2	0.12	0.03	1.2	0.08	48.4%	47.0%	34.4%
	Fail	Unresolv.	414	1.1%	0.06	2.2	0.12	0.02	0.7	0.04	67.0%	67.0%	67.0%
	Fail	Waiver	9	0.0%	0.06	2.2	0.12	0.06	2.2	0.12	0.0%	0.0%	0.0%
Total	Fail%		36,706	6.7%	0.03	1.2	0.08	0.03	1.2	0.08	6.3%	6.0%	3.9%
2008 T	Pass	-	24,988		0.03	1.1	0.07	0.03	1.1	0.07	0.0%	0.0%	0.0%
	Fail	Pass	1,385	5.2%	0.05	2.1	0.15	0.03	1.1	0.07	40.6%	47.2%	53.8%
	Fail	Unresolv.	203	0.8%	0.05	2.1	0.15	0.02	0.7	0.05	67.0%	67.0%	67.0%
	Fail	Waiver	6	0.0%	0.05	2.1	0.15	0.05	2.1	0.15	0.0%	0.0%	0.0%
Total	Fail%		26,582	6.0%	0.03	1.2	0.07	0.03	1.1	0.07	4.2%	5.3%	6.7%
2009 T	Pass	-	5,176		0.03	1.2	0.06	0.03	1.2	0.06	0.0%	0.0%	0.0%
	Fail	Pass	264	4.8%	0.03	1.2	0.06	0.03	1.2	0.06	5.3%	1.0%	-1.8%
	Fail	Unresolv.	53	1.0%	0.03	1.2	0.06	0.01	0.4	0.02	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		5,493	5.8%	0.03	1.2	0.06	0.03	1.2	0.06	0.9%	0.7%	0.6%
2010 T	Pass	-	4,593		0.02	1.0	0.03	0.02	1.0	0.03	0.0%	0.0%	0.0%
	Fail	Pass	208	4.3%	0.08	0.7	0.01	0.02	1.0	0.03	68.5%	-35.6%	-130.5%
	Fail	Unresolv.	28	0.6%	0.08	0.7	0.01	0.02	0.2	0.00	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		4,829	4.9%	0.03	0.9	0.03	0.02	1.0	0.03	9.6%	-0.9%	-2.3%
2011 T	Pass	-	3,563		0.03	1.1	0.05	0.03	1.1	0.05	0.0%	0.0%	0.0%
	Fail	Pass	130	3.5%	0.04	1.0	0.05	0.03	1.1	0.05	42.4%	-7.0%	-8.5%
	Fail	Unresolv.	26	0.7%	0.04	1.0	0.05	0.01	0.3	0.02	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		3,719	4.2%	0.03	1.1	0.05	0.03	1.1	0.05	3.3%	0.2%	0.2%
2012 T	Pass	-	2,218		0.03	1.1	0.05	0.03	1.1	0.05	0.0%	0.0%	0.0%
	Fail	Pass	50	2.2%	0.04	1.0	0.05	0.03	1.1	0.05	42.4%	-7.0%	-8.5%
	Fail	Unresolv.	5	0.2%	0.04	1.0	0.05	0.01	0.3	0.02	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		2,273	2.4%	0.03	1.1	0.05	0.03	1.1	0.05	1.8%	0.0%	0.0%
2013 T	Pass	-	1,411		0.03	1.1	0.05	0.03	1.1	0.05	0.0%	0.0%	0.0%
	Fail	Pass	26	1.8%	0.04	1.0	0.05	0.03	1.1	0.05	42.4%	-7.0%	-8.5%
	Fail	Unresolv.	8	0.6%	0.04	1.0	0.05	0.01	0.3	0.02	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		1,445	2.4%	0.03	1.1	0.05	0.03	1.1	0.05	1.9%	0.2%	0.2%
2014 T	Pass	-	939		0.03	1.1	0.05	0.03	1.1	0.05	0.0%	0.0%	0.0%
	Fail	Pass	14	1.5%	0.04	1.0	0.05	0.03	1.1	0.05	42.4%	-7.0%	-8.5%
	Fail	Unresolv.	5	0.5%	0.04	1.0	0.05	0.01	0.3	0.02	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		958	2.0%	0.03	1.1	0.05	0.03	1.1	0.05	1.7%	0.2%	0.2%
2015 T	Pass	-	371		0.03	1.1	0.05	0.03	1.1	0.05	0.0%	0.0%	0.0%
	Fail	Pass	1	0.3%	0.04	1.0	0.05	0.03	1.1	0.05	42.4%	-7.0%	-8.5%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		372	0.3%	0.03	1.1	0.05	0.03	1.1	0.05	0.2%	0.0%	0.0%
2016 T	Pass	-	24		0.03	1.1	0.05	0.03	1.1	0.05	0.0%	0.0%	0.0%
	Fail	Pass	2	7.4%	0.04	1.0	0.05	0.03	1.1	0.05	42.4%	-7.0%	-8.5%
	Fail	Unresolv.	1	3.7%	0.04	1.0	0.05	0.01	0.3	0.02	67.0%	67.0%	67.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		27	11.1%	0.03	1.1	0.05	0.03	1.1	0.05	9.0%	1.8%	1.7%
Total Trucks													
All T	Pass	-	140,634		0.04	1.3	0.11	0.04	1.3	0.11	0.0%	0.0%	0.0%
	Fail	Pass	10,161	6.6%	0.19	3.6	0.30	0.06	1.5	0.17	69.5%	60.0%	44.7%
	Fail	Unresolv.	2,650	1.7%	0.30	4.9	0.40	0.10	1.6	0.13	67.0%	67.0%	67.0%
	Fail	Waiver	77	0.1%	0.46	5.9	0.47	0.46	5.9	0.47	0.0%	0.0%	0.0%
Total	Fail%		153,522	8.4%	0.06	1.5	0.13	0.05	1.3	0.12	21.1%	13.6%	10.4%

Colorado 2015 OBD Test Estimated Reductions

Unresolved fails remaining in area					0.33						Reduction %		
Model Year/Type	First Result	Last Result	Vehicles	Fail%	HC	Initial CO	NOX	HC	Final CO	NOX	HC	CO	NOX
Fleet Total													
All	Pass	-	263,929		0.04	1.2	0.10	0.04	1.2	0.10	0.0%	0.0%	0.0%
All	Fail	Pass	17,597	6.1%	0.15	3.2	0.28	0.05	1.3	0.14	66.1%	59.3%	50.9%
	Fail	Unresolv.	5,071	1.8%	0.22	4.0	0.35	0.07	1.3	0.11	67.0%	67.0%	67.0%
	Fail	Waiver	129	0.0%	0.31	4.6	0.41	0.31	4.6	0.41	0.0%	0.0%	0.0%
Total	Fail%		286,726	8.0%	0.05	1.3	0.12	0.04	1.2	0.10	17.3%	12.2%	11.1%

Appendix A2 Colorado 2015 Clean Screen Audit IM240 & OBD Test Emissions Reductions

Unresolved fails remaining in area					100%								
Model	First	Last	Vehicles	Fail%	Initial			Final			Reduction %		
Year/Type	Result	Result			HC	CO	NOX	HC	CO	NOX	HC	CO	NOX
1982	Pass	-	0		-	-	-	-	-	-	-	-	-
P	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
1983	Pass	-	0		-	-	-	-	-	-	-	-	-
P	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
1984	Pass	-	0		-	-	-	-	-	-	-	-	-
P	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
1985	Pass	-	0		-	-	-	-	-	-	-	-	-
P	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
1986	Pass	-	0		-	-	-	-	-	-	-	-	-
P	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
1987	Pass	-	2		0.41	3.69	1.57	0.41	3.69	1.57	0.0%	0.0%	0.0%
P	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		2	0.0%	0.41	3.69	1.57	0.41	3.69	1.57	0.0%	0.0%	0.0%
1988	Pass	-	2		0.61	9.72	0.96	0.61	9.72	0.96	0.0%	0.0%	0.0%
P	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		2	0.0%	0.61	9.72	0.96	0.61	9.72	0.96	0.0%	0.0%	0.0%
1989	Pass	-	4		0.59	6.66	1.69	0.59	6.66	1.69	0.0%	0.0%	0.0%
P	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		4	0.0%	0.59	6.66	1.69	0.59	6.66	1.69	0.0%	0.0%	0.0%
1990	Pass	-	3		0.45	7.72	1.14	0.45	7.72	1.14	0.0%	0.0%	0.0%
P	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		3	0.0%	0.45	7.72	1.14	0.45	7.72	1.14	0.0%	0.0%	0.0%

Appendix A2 Colorado 2015 Clean Screen Audit IM240 & OBD Test Emissions Reductions

Unresolved fails remaining in area					100%								
Model	First	Last	Vehicles	Fail%	Initial			Final			Reduction %		
Year/Type	Result	Result			HC	CO	NOX	HC	CO	NOX	HC	CO	NOX
1991	Pass	-	0		-	-	-	-	-	-	-	-	-
P	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
1992	Pass	-	2		0.22	3.46	0.73	0.22	3.46	0.73	0.0%	0.0%	0.0%
P	Fail	Pass	1	33.3%	0.23	5.82	2.01	0.15	2.57	2.14	37.3%	55.9%	-6.4%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		3	33.3%	0.23	4.25	1.16	0.20	3.16	1.20	12.8%	25.5%	-3.7%
1993	Pass	-	3		0.37	5.59	1.46	0.37	5.59	1.46	0.0%	0.0%	0.0%
P	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		3	0.0%	0.37	5.59	1.46	0.37	5.59	1.46	0.0%	0.0%	0.0%
1994	Pass	-	6		0.18	2.80	0.73	0.18	2.80	0.73	0.0%	0.0%	0.0%
P	Fail	Pass	1	14.3%	0.52	4.66	1.70	0.29	3.01	1.17	43.5%	35.4%	31.2%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		7	14.3%	0.23	3.06	0.87	0.19	2.83	0.79	14.3%	7.7%	8.8%
1995	Pass	-	8		0.21	2.53	0.59	0.21	2.53	0.59	0.0%	0.0%	0.0%
P	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		8	0.0%	0.21	2.53	0.59	0.21	2.53	0.59	0.0%	0.0%	0.0%
1996	Pass	-	6		0.28	2.67	0.71	0.28	2.67	0.71	0.0%	0.0%	0.0%
P	Fail	Pass	1	14.3%	0.22	2.67	0.47	0.12	1.91	0.53	46.5%	28.6%	-13.3%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		7	14.3%	0.27	2.67	0.67	0.26	2.56	0.68	5.3%	4.1%	-1.3%
1997	Pass	-	31		0.32	3.12	0.69	0.32	3.12	0.69	0.0%	0.0%	0.0%
P	Fail	Pass	1	3.1%	0.00	4.02	2.06	0.16	6.41	1.94	#DIV/0!	-59.3%	5.8%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		32	3.1%	0.31	3.15	0.73	0.31	3.22	0.73	-1.6%	-2.4%	0.5%
1998	Pass	-	27		0.18	2.64	0.55	0.18	2.64	0.55	0.0%	0.0%	0.0%
P	Fail	Pass	3	10.0%	0.53	6.69	1.58	0.46	3.89	0.66	12.6%	41.8%	58.3%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		30	10.0%	0.22	3.05	0.65	0.21	2.77	0.56	3.1%	9.2%	14.1%
1999	Pass	-	68		0.17	2.59	0.52	0.17	2.59	0.52	0.0%	0.0%	0.0%
P	Fail	Pass	4	5.6%	0.96	37.07	0.88	0.05	1.70	0.25	94.7%	95.4%	71.6%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		72	5.6%	0.22	4.50	0.54	0.17	2.54	0.51	23.4%	43.6%	6.5%

Appendix A2 Colorado 2015 Clean Screen Audit IM240 & OBD Test Emissions Reductions

Unresolved fails remaining in area					100%								
Model	First	Last	Vehicles	Fail%	Initial			Final			Reduction %		
Year/Type	Result	Result			HC	CO	NOX	HC	CO	NOX	HC	CO	NOX
2000 P	Pass	-	67		0.11	2.45	0.39	0.11	2.45	0.39	0.0%	0.0%	0.0%
	Fail	Pass	2	2.9%	0.38	23.23	0.43	0.18	3.85	0.41	53.3%	83.4%	2.8%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		69	2.9%	0.12	3.05	0.39	0.11	2.49	0.39	4.9%	18.4%	0.1%
2001 P	Pass	-	93		0.07	1.68	0.27	0.07	1.68	0.27	0.0%	0.0%	0.0%
	Fail	Pass	5	5.1%	0.05	2.16	1.10	0.06	0.90	0.14	-18.1%	58.4%	87.4%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		98	5.1%	0.07	1.70	0.31	0.07	1.64	0.26	-0.7%	3.8%	15.7%
2002 P	Pass	-	93		0.07	2.45	0.27	0.07	2.45	0.27	0.0%	0.0%	0.0%
	Fail	Pass	9	8.8%	0.19	6.40	0.60	0.05	1.74	0.13	76.4%	72.8%	77.9%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		102	8.8%	0.08	2.80	0.30	0.07	2.38	0.26	15.4%	14.7%	13.8%
2003 P	Pass	-	166		0.06	1.42	0.25	0.06	1.42	0.25	0.0%	0.0%	0.0%
	Fail	Pass	4	2.4%	0.12	6.02	0.13	0.05	0.93	0.18	57.7%	84.6%	-43.5%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		170	2.4%	0.06	1.53	0.25	0.06	1.41	0.25	2.5%	7.8%	-0.5%
2004 P	Pass	-	111		0.04	1.10	0.13	0.04	1.10	0.13	0.0%	0.0%	0.0%
	Fail	Pass	4	3.5%	0.07	1.33	0.15	0.05	1.32	0.15	24.8%	1.0%	-5.9%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		115	3.5%	0.04	1.11	0.13	0.04	1.11	0.13	1.4%	0.0%	-0.2%
2005 P	Pass	-	183		0.03	0.90	0.10	0.03	0.90	0.10	0.0%	0.0%	0.0%
	Fail	Pass	15	7.6%	0.06	1.48	0.17	0.03	0.90	0.10	48.3%	39.0%	39.8%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		198	7.6%	0.04	0.95	0.11	0.03	0.90	0.10	6.6%	4.6%	4.8%
2006 P	Pass	-	104		0.04	1.15	0.09	0.04	1.15	0.09	0.0%	0.0%	0.0%
	Fail	Pass	11	9.5%	0.06	1.60	0.13	0.04	1.15	0.09	34.6%	27.9%	30.2%
	Fail	Unresolv.	1	0.9%	0.06	1.60	0.13	0.06	1.60	0.13	0.0%	0.0%	0.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		116	10.3%	0.04	1.20	0.10	0.04	1.16	0.09	4.8%	3.5%	3.9%
2007 P	Pass	-	186		0.03	0.91	0.09	0.03	0.91	0.09	0.0%	0.0%	0.0%
	Fail	Pass	4	2.1%	0.04	1.56	0.16	0.03	0.91	0.09	21.5%	41.4%	45.3%
	Fail	Unresolv.	1	0.5%	0.04	1.56	0.16	0.04	1.56	0.16	0.0%	0.0%	0.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		191	2.6%	0.03	0.93	0.09	0.03	0.92	0.09	0.6%	1.5%	1.7%
2008 P	Pass	-	62		0.03	1.03	0.08	0.03	1.03	0.08	0.0%	0.0%	0.0%
	Fail	Pass	1	1.6%	0.03	1.61	0.07	0.03	1.03	0.08	-7.4%	36.3%	-6.3%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		63	1.6%	0.03	1.04	0.08	0.03	1.03	0.08	-0.1%	0.9%	-0.1%

Appendix A2 Colorado 2015 Clean Screen Audit IM240 & OBD Test Emissions Reductions

Unresolved fails remaining in area

100%

Model Year/Type	First Result	Last Result	Vehicles	Fail%	Initial			Final			Reduction %		
					HC	CO	NOX	HC	CO	NOX	HC	CO	NOX
2009 P	Pass	-	0		-	-	-	-	-	-	-	-	-
	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
2010 P	Pass	-	0		-	-	-	-	-	-	-	-	-
	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
2011 P	Pass	-	0		-	-	-	-	-	-	-	-	-
	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
2012 P	Pass	-	0		-	-	-	-	-	-	-	-	-
	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
2013 P	Pass	-	0		-	-	-	-	-	-	-	-	-
	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
Total Passenger Vehicles													
All	Pass	-	1,227		0.07	1.57	0.24	0.07	1.57	0.24	0.0%	0.0%	0.0%
P	Fail	Pass	66	5.1%	0.18	5.72	0.49	0.07	1.52	0.24	58.7%	73.5%	50.7%
	Fail	Unresolv.	2	0.2%	0.05	1.58	0.15	0.05	1.58	0.15	0.0%	0.0%	0.0%
	Fail	Waiver	0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00			
Total	Fail%		1,295	5.3%	0.08	1.78	0.25	0.07	1.56	0.24	6.6%	12.0%	5.1%

Appendix A2 Colorado 2015 Clean Screen Audit IM240 & OBD Test Emissions Reductions

Unresolved fails remaining in area

					100%								
Model	First	Last	Vehicles	Fail%	Initial			Final			Reduction %		
Year/Type	Result	Result			HC	CO	NOX	HC	CO	NOX	HC	CO	NOX
1982	Pass	-	0		-	-	-	-	-	-	-	-	-
T	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
1983	Pass	-	0		-	-	-	-	-	-	-	-	-
T	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
1984	Pass	-	0		-	-	-	-	-	-	-	-	-
T	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
1985	Pass	-	0		-	-	-	-	-	-	-	-	-
T	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
1986	Pass	-	0		-	-	-	-	-	-	-	-	-
T	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
1987	Pass	-	0		-	-	-	-	-	-	-	-	-
T	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
1988	Pass	-	0		-	-	-	-	-	-	-	-	-
T	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
1989	Pass	-	1		0.28	6.41	1.38	0.28	6.41	1.38	0.0%	0.0%	0.0%
T	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		1	0.0%	0.28	6.41	1.38	0.28	6.41	1.38	0.0%	0.0%	0.0%
1990	Pass	-	1		0.79	10.22	1.52	0.79	10.22	1.52	0.0%	0.0%	0.0%
T	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		1	0.0%	0.79	10.22	1.52	0.79	10.22	1.52	0.0%	0.0%	0.0%

Appendix A2 Colorado 2015 Clean Screen Audit IM240 & OBD Test Emissions Reductions

Unresolved fails remaining in area

					100%								
Model	First	Last	Vehicles	Fail%	Initial			Final			Reduction %		
Year/Type	Result	Result			HC	CO	NOX	HC	CO	NOX	HC	CO	NOX
1991	Pass	-	2		0.69	7.83	1.43	0.69	7.83	1.43	0.0%	0.0%	0.0%
T	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		2	0.0%	0.69	7.83	1.43	0.69	7.83	1.43	0.0%	0.0%	0.0%
1992	Pass	-	0		-	-	-	-	-	-	-	-	-
T	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
1993	Pass	-	2		1.43	15.70	2.34	1.43	15.70	2.34	0.0%	0.0%	0.0%
T	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		2	0.0%	1.43	15.70	2.34	1.43	15.70	2.34	0.0%	0.0%	0.0%
1994	Pass	-	4		0.41	6.71	1.14	0.41	6.71	1.14	0.0%	0.0%	0.0%
T	Fail	Pass	1	20.0%	1.92	27.69	1.54	0.92	18.53	1.36	52.4%	33.1%	11.7%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		5	20.0%	0.71	10.90	1.22	0.51	9.07	1.19	28.3%	16.8%	2.9%
1995	Pass	-	16		0.66	8.57	1.36	0.66	8.57	1.36	0.0%	0.0%	0.0%
T	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		16	0.0%	0.66	8.57	1.36	0.66	8.57	1.36	0.0%	0.0%	0.0%
1996	Pass	-	16		0.34	4.59	1.21	0.34	4.59	1.21	0.0%	0.0%	0.0%
T	Fail	Pass	2	10.5%	0.08	2.75	2.23	0.22	7.90	1.64	-177.6%	-187.1%	26.4%
	Fail	Unresolv.	1	5.3%	1.59	19.91	2.79	1.59	19.91	2.79	0.0%	0.0%	0.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		19	15.8%	0.37	5.20	1.40	0.39	5.75	1.34	-3.9%	-10.4%	4.4%
1997	Pass	-	31		0.38	4.66	1.10	0.38	4.66	1.10	0.0%	0.0%	0.0%
T	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		31	0.0%	0.38	4.66	1.10	0.38	4.66	1.10	0.0%	0.0%	0.0%
1998	Pass	-	20		0.40	3.81	1.16	0.40	3.81	1.16	0.0%	0.0%	0.0%
T	Fail	Pass	2	8.7%	0.64	3.96	1.55	0.37	5.22	0.97	42.8%	-31.9%	37.2%
	Fail	Unresolv.	1	4.3%	0.24	11.72	2.84	0.24	11.72	2.84	0.0%	0.0%	0.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		23	13.0%	0.41	4.16	1.27	0.39	4.27	1.22	5.8%	-2.6%	3.9%
1999	Pass	-	61		0.19	2.79	0.63	0.19	2.79	0.63	0.0%	0.0%	0.0%
T	Fail	Pass	10	14.1%	0.88	6.00	1.66	0.38	3.57	1.13	56.6%	40.5%	31.9%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		71	14.1%	0.28	3.24	0.78	0.21	2.90	0.70	24.7%	10.6%	9.6%

Appendix A2 Colorado 2015 Clean Screen Audit IM240 & OBD Test Emissions Reductions

Unresolved fails remaining in area					100%								
Model	First	Last	Vehicles	Fail%	Initial			Final			Reduction %		
Year/Type	Result	Result			HC	CO	NOX	HC	CO	NOX	HC	CO	NOX
2000	Pass	-	77		0.17	2.39	0.59	0.17	2.39	0.59	0.0%	0.0%	0.0%
T	Fail	Pass	7	8.3%	0.20	4.11	0.77	0.14	2.43	0.58	29.5%	40.9%	24.6%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		84	8.3%	0.17	2.53	0.60	0.17	2.39	0.59	2.8%	5.5%	2.6%
2001	Pass	-	152		0.13	2.42	0.44	0.13	2.42	0.44	0.0%	0.0%	0.0%
T	Fail	Pass	10	6.2%	0.33	4.66	1.03	0.20	2.72	0.67	38.3%	41.5%	34.2%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		162	6.2%	0.15	2.56	0.48	0.14	2.44	0.46	5.4%	4.7%	4.5%
2002	Pass	-	103		0.12	2.73	0.42	0.12	2.73	0.42	0.0%	0.0%	0.0%
T	Fail	Pass	2	1.9%	0.04	2.44	0.16	0.04	1.31	0.37	-6.5%	46.3%	-140.0%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		105	1.9%	0.12	2.72	0.42	0.12	2.70	0.42	0.0%	0.8%	-1.0%
2003	Pass	-	255		0.08	1.47	0.30	0.08	1.47	0.30	0.0%	0.0%	0.0%
T	Fail	Pass	19	6.9%	0.12	2.13	0.23	0.09	1.93	0.24	26.8%	9.3%	-3.2%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		274	6.9%	0.08	1.52	0.29	0.08	1.50	0.29	2.8%	0.9%	-0.2%
2004	Pass	-	162		0.06	1.19	0.17	0.06	1.19	0.17	0.0%	0.0%	0.0%
T	Fail	Pass	4	2.4%	0.15	1.79	1.18	0.13	1.44	0.55	15.2%	19.6%	53.0%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		166	2.4%	0.06	1.21	0.20	0.06	1.20	0.18	0.9%	0.7%	7.6%
2005	Pass	-	321		0.05	1.06	0.12	0.05	1.06	0.12	0.0%	0.0%	0.0%
T	Fail	Pass	20	5.8%	0.09	1.53	0.20	0.05	1.06	0.12	44.0%	31.0%	43.3%
	Fail	Unresolv.	5	1.4%	0.09	1.53	0.20	0.09	1.53	0.20	0.0%	0.0%	0.0%
	Fail	Waiver	1	0.3%	0.09	1.53	0.20	0.09	1.53	0.20	0.0%	0.0%	0.0%
Total	Fail%		347	7.5%	0.05	1.09	0.12	0.05	1.07	0.12	4.3%	2.5%	4.2%
2006	Pass	-	188		0.04	1.02	0.10	0.04	1.02	0.10	0.0%	0.0%	0.0%
T	Fail	Pass	16	7.8%	0.10	1.99	0.15	0.04	1.02	0.10	61.3%	48.6%	29.0%
	Fail	Unresolv.	1	0.5%	0.10	1.99	0.15	0.10	1.99	0.15	0.0%	0.0%	0.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		205	8.3%	0.05	1.10	0.11	0.04	1.03	0.10	10.9%	6.8%	3.1%
2007	Pass	-	352		0.03	0.93	0.09	0.03	0.93	0.09	0.0%	0.0%	0.0%
T	Fail	Pass	17	4.6%	0.03	1.12	0.10	0.03	0.93	0.09	1.9%	17.2%	10.5%
	Fail	Unresolv.	3	0.8%	0.03	1.12	0.10	0.03	1.12	0.10	0.0%	0.0%	0.0%
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		372	5.4%	0.03	0.94	0.09	0.03	0.93	0.09	0.1%	0.9%	0.5%
2008	Pass	-	122		0.03	0.84	0.08	0.03	0.84	0.08	0.0%	0.0%	0.0%
T	Fail	Pass	8	6.2%	0.03	1.11	0.08	0.03	0.84	0.08	1.1%	24.4%	-5.0%
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		130	6.2%	0.03	0.86	0.08	0.03	0.84	0.08	0.1%	1.9%	-0.3%

Appendix A2 Colorado 2015 Clean Screen Audit IM240 & OBD Test Emissions Reductions

Unresolved fails remaining in area

100%

Model Year/Type	First Result	Last Result	Vehicles	Fail%	Initial			Final			Reduction %		
					HC	CO	NOX	HC	CO	NOX	HC	CO	NOX
2009 T	Pass	-	0		-	-	-	-	-	-	-	-	-
	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
2010 T	Pass	-	0		-	-	-	-	-	-	-	-	-
	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
2011 T	Pass	-	0		-	-	-	-	-	-	-	-	-
	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
2012 T	Pass	-	0		-	-	-	-	-	-	-	-	-
	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
2013 T	Pass	-	0		-	-	-	-	-	-	-	-	-
	Fail	Pass	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Unresolv.	0	0.0%	-	-	-	-	-	-	-	-	-
	Fail	Waiver	0	0.0%	-	-	-	-	-	-	-	-	-
Total	Fail%		0	0.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.0%	0.0%	0.0%
Total Trucks													
All	Pass	-	1,886		0.09	1.62	0.27	0.09	1.62	0.27	0.0%	0.0%	0.0%
T	Fail	Pass	118	5.9%	0.20	2.71	0.51	0.11	1.95	0.36	43.4%	28.1%	28.8%
	Fail	Unresolv.	11	0.5%	0.23	4.06	0.65	0.23	4.06	0.65	0.0%	0.0%	0.0%
	Fail	Waiver	1	0.0%	0.09	1.53	0.20	0.09	1.53	0.20	0.0%	0.0%	0.0%
Total	Fail%		2,016	6.4%	0.10	1.70	0.29	0.09	1.65	0.28	5.4%	2.6%	3.0%
Fleet Total													
All	Pass	-	3,113		0.08	1.60	0.26	0.08	1.60	0.26	0.0%	0.0%	0.0%
All	Fail	Pass	184	5.6%	0.19	3.79	0.50	0.10	1.79	0.32	48.4%	52.7%	36.5%
	Fail	Unresolv.	13	0.4%	0.20	3.68	0.57	0.20	3.68	0.57	0.0%	0.0%	0.0%
	Fail	Waiver	1	0.0%	0.09	1.53	0.20	0.09	1.53	0.20	0.0%	0.0%	0.0%
Total	Fail%		3,311	6.0%	0.09	1.73	0.27	0.08	1.62	0.26	5.8%	6.4%	3.7%

Appendix B Colorado 2015
Enhanced IM240 and OBD Test Reduction Tons

Type	Annual Miles	Unique Vehicles	Initial Tons/Yr			Final Tons/Yr			Reduction Tons/Yr		
			HC	CO	NOx	HC	CO	NOx	HC	CO	NOx
P 1982	4,304	267	2.6	35.2	2.4	2.0	26.1	2.3	0.6	9.1	0.1
P 1983	4,304	442	3.8	45.4	3.9	2.8	29.2	3.7	1.0	16.3	0.2
P 1984	4,304	614	5.8	65.7	5.4	3.8	38.3	5.1	2.0	27.4	0.4
P 1985	4,304	1,006	7.0	82.3	9.0	5.1	55.5	8.6	1.9	26.8	0.4
P 1986	4,304	1,145	7.4	77.3	9.9	5.1	47.2	9.3	2.2	30.1	0.6
P 1987	4,304	1,612	9.2	101.2	13.7	6.5	61.7	13.0	2.7	39.4	0.7
P 1988	4,434	1,607	9.1	100.0	12.6	6.2	65.3	11.7	2.9	34.7	0.9
P 1989	4,481	2,571	12.6	137.4	20.1	9.6	102.7	19.3	3.1	34.7	0.8
P 1990	4,502	3,215	14.1	165.1	25.7	11.0	122.5	24.1	3.1	42.5	1.6
P 1991	4,552	4,841	19.7	233.0	35.9	14.3	165.6	33.7	5.4	67.5	2.2
P 1992	4,780	4,924	19.9	234.3	37.8	14.5	163.4	35.0	5.5	70.9	2.7
P 1993	5,088	6,655	25.6	300.2	55.2	19.9	214.9	51.9	5.8	85.3	3.2
P 1994	5,430	7,504	24.6	296.4	53.6	18.9	228.6	49.7	5.7	67.8	4.0
P 1995	5,672	11,247	36.0	429.9	74.1	27.5	331.0	68.3	8.5	98.9	5.8
P 1996	6,002	11,166	28.1	369.2	64.5	22.8	292.1	59.0	5.3	77.1	5.6
P 1997	6,331	16,238	41.1	547.8	89.9	33.1	435.7	82.6	8.0	112.1	7.3
P 1998	6,653	16,450	35.7	536.3	83.9	28.3	421.3	75.2	7.4	114.9	8.7
P 1999	6,974	22,115	41.6	640.2	107.4	33.8	524.0	96.1	7.7	116.1	11.3
P 2000	7,369	23,609	39.7	644.5	102.0	30.2	518.1	86.8	9.6	126.4	15.2
P 2001	7,764	28,432	34.9	672.1	89.3	26.6	550.3	77.1	8.3	121.8	12.3
P 2002	8,188	26,380	30.5	702.6	78.9	22.6	605.1	65.4	7.9	97.4	13.6
P 2003	8,613	30,960	25.6	523.0	76.9	19.5	448.6	65.0	6.2	74.4	11.9
P 2004	9,032	24,253	18.7	391.7	47.9	14.1	333.3	39.2	4.6	58.4	8.7
P 2005	9,450	34,341	19.3	503.9	53.6	15.2	393.6	43.3	4.0	110.4	10.3
P 2006	9,905	27,339	15.7	367.9	37.1	13.3	324.0	30.2	2.4	44.0	6.8
P 2007	10,360	35,663	14.2	423.1	34.3	12.9	401.7	29.9	1.3	21.5	4.4
P 2008	10,746	24,061	9.6	319.6	19.1	8.5	299.5	17.8	1.0	20.1	1.2
P 2009	11,132	6,885	2.5	85.5	6.2	2.4	80.9	6.0	0.1	4.6	0.2
P 2010	11,870	4,785	1.2	66.6	5.2	1.0	61.7	5.1	0.2	4.9	0.1
P 2011	12,023	3,597	1.2	49.2	3.4	1.2	47.6	3.4	0.0	1.6	0.0
P 2012	12,307	3,215	1.1	43.8	3.0	1.1	42.5	3.0	0.0	1.3	0.0
P 2013	12,357	2,096	0.7	28.6	2.0	0.7	27.6	2.0	0.0	1.0	0.0
P 2014	11,600	997	0.3	12.4	0.9	0.3	12.2	0.9	0.0	0.1	0.0
P 2015	9,650	255	0.1	2.6	0.2	0.1	2.6	0.2	0.0	0.0	0.0
P Total		390,487	559.3	9234.0	1265.2	435.0	7474.3	1123.9	124.3	1759.7	141.3
T 1982	4,550	336	6.2	78.1	4.7	4.1	50.7	4.4	2.1	27.3	0.3
T 1983	4,550	567	10.0	132.3	7.1	7.7	92.4	6.7	2.3	39.9	0.5
T 1984	4,550	781	10.4	156.0	10.2	7.7	98.8	9.5	2.7	57.2	0.7
T 1985	4,550	1,221	15.5	196.7	16.6	11.2	124.7	15.5	4.4	72.0	1.1
T 1986	4,554	1,333	15.1	182.6	17.0	11.3	121.4	16.0	3.9	61.2	1.0
T 1987	4,562	1,892	18.4	203.5	23.2	14.0	138.8	21.9	4.3	64.7	1.2
T 1988	4,583	2,143	19.5	193.8	24.9	14.5	132.2	22.9	5.0	61.6	2.0
T 1989	4,630	3,157	25.6	281.5	36.1	19.8	204.3	33.4	5.8	77.2	2.7
T 1990	4,668	2,767	22.6	234.0	33.1	17.4	169.5	30.6	5.2	64.5	2.5
T 1991	4,741	4,170	27.9	324.7	43.7	22.1	252.4	40.5	5.8	72.3	3.2
T 1992	4,851	4,016	28.8	309.4	43.5	22.7	238.6	40.4	6.1	70.8	3.1
T 1993	5,019	6,690	46.4	493.1	80.5	37.8	393.3	74.5	8.6	99.8	6.0
T 1994	5,256	8,503	51.3	567.6	97.4	39.6	435.8	87.0	11.7	131.8	10.4
T 1995	5,519	11,344	68.5	774.7	134.4	51.9	598.6	120.5	16.5	176.1	13.9
T 1996	5,824	10,311	35.5	457.1	97.4	27.5	359.8	88.2	8.0	97.3	9.2
T 1997	6,135	17,257	52.5	734.4	160.0	41.3	593.0	141.5	11.2	141.4	18.5
T 1998	6,471	18,100	51.6	738.3	159.7	40.0	583.7	139.5	11.6	154.6	20.2
T 1999	6,940	25,889	65.7	946.2	185.8	47.7	706.6	160.3	18.0	239.6	25.6
T 2000	7,437	24,772	60.9	910.3	165.5	44.2	660.7	145.4	16.7	249.6	20.1
T 2001	7,863	30,813	48.4	904.2	143.8	38.2	741.0	125.9	10.2	163.2	17.9
T 2002	8,345	27,497	39.8	927.9	121.6	30.8	760.4	108.0	9.0	167.5	13.6
T 2003	8,900	33,818	37.4	754.4	116.1	30.5	610.1	106.3	6.9	144.3	9.8
T 2004	9,502	29,526	26.7	607.6	68.2	20.8	491.3	58.8	5.9	116.2	9.4
T 2005	10,087	38,425	27.8	680.4	62.6	22.7	587.7	53.7	5.1	92.8	8.9
T 2006	10,727	29,378	15.2	403.0	42.1	13.3	351.8	33.0	1.9	51.1	9.1
T 2007	11,245	40,082	18.5	627.3	43.5	16.6	582.1	41.1	1.9	45.2	2.3
T 2008	11,817	28,593	12.8	455.4	28.7	11.9	424.9	26.4	0.9	30.5	2.4
T 2009	12,303	5,991	2.4	95.1	5.3	2.3	94.2	5.2	0.0	0.9	0.1
T 2010	12,834	5,185	1.9	69.9	2.5	1.8	70.0	2.6	0.2	-0.1	-0.1
T 2011	13,215	3,969	1.6	62.5	2.9	1.5	62.4	2.9	0.0	0.0	0.0
T 2012	13,433	2,382	1.0	41.5	1.8	0.9	39.0	1.8	0.1	2.5	0.1
T 2013	13,514	1,489	0.6	24.3	1.2	0.6	24.0	1.1	0.0	0.3	0.0
T 2014	12,428	974	0.3	14.4	0.7	0.3	14.4	0.7	0.0	0.0	0.0
T 2015	8,995	381	0.1	4.1	0.2	0.1	4.1	0.2	0.0	0.0	0.0
T Total		423,752	866.8	13586.1	1981.8	674.8	10812.5	1766.3	192.0	2773.6	215.5
Total		814,239	1426.2	22820.1	3247.0	1109.8	18286.8	2890.2	316.3	4533.3	356.8

Appendix B - Colorado 2015
RapidScreen Audit IM240 and OBD Test Reduction Tons

Type	Annual Miles	Unique Vehicles	Initial Tons/Yr			Final Tons/Yr			Reduction Tons/Yr		
			HC	CO	NOx	HC	CO	NOx	HC	CO	NOx
P 1982	4,304	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P 1983	4,304	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P 1984	4,304	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P 1985	4,304	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P 1986	4,304	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P 1987	4,304	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P 1988	4,434	2	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
P 1989	4,481	4	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
P 1990	4,502	3	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
P 1991	4,552	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P 1992	4,780	3	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
P 1993	5,088	3	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
P 1994	5,430	7	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
P 1995	5,672	8	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
P 1996	6,002	7	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
P 1997	6,331	32	0.1	0.7	0.2	0.1	0.7	0.2	0.0	0.0	0.0
P 1998	6,653	30	0.0	0.7	0.1	0.0	0.6	0.1	0.0	0.1	0.0
P 1999	6,974	72	0.1	2.5	0.3	0.1	1.4	0.3	0.0	1.1	0.0
P 2000	7,369	69	0.1	1.7	0.2	0.1	1.4	0.2	0.0	0.3	0.0
P 2001	7,764	98	0.1	1.4	0.3	0.1	1.4	0.2	0.0	0.1	0.0
P 2002	8,188	102	0.1	2.6	0.3	0.1	2.2	0.2	0.0	0.4	0.0
P 2003	8,613	170	0.1	2.5	0.4	0.1	2.3	0.4	0.0	0.2	0.0
P 2004	9,032	115	0.0	1.3	0.2	0.0	1.3	0.2	0.0	0.0	0.0
P 2005	9,450	198	0.1	2.0	0.2	0.1	1.9	0.2	0.0	0.1	0.0
P 2006	9,905	116	0.0	1.5	0.1	0.0	1.5	0.1	0.0	0.1	0.0
P 2007	10,360	191	0.1	2.0	0.2	0.1	2.0	0.2	0.0	0.0	0.0
P 2008	10,746	63	0.0	0.8	0.1	0.0	0.8	0.1	0.0	0.0	0.0
P 2009	11,132	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P 2010	11,870	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P 2011	12,023	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P Total		1,295	0.9	20.5	2.7	0.8	18.2	2.6	0.1	2.3	0.1
T 1982	4,550	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
T 1983	4,550	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
T 1984	4,550	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
T 1985	4,550	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
T 1986	4,554	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
T 1987	4,562	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
T 1988	4,583	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
T 1989	4,630	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
T 1990	4,668	1	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
T 1991	4,741	2	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
T 1992	4,851	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
T 1993	5,019	2	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0
T 1994	5,256	5	0.0	0.3	0.0	0.0	0.3	0.0	0.0	0.1	0.0
T 1995	5,519	16	0.1	0.8	0.1	0.1	0.8	0.1	0.0	0.0	0.0
T 1996	5,824	19	0.0	0.6	0.2	0.0	0.7	0.2	0.0	-0.1	0.0
T 1997	6,135	31	0.1	1.0	0.2	0.1	1.0	0.2	0.0	0.0	0.0
T 1998	6,471	23	0.1	0.7	0.2	0.1	0.7	0.2	0.0	0.0	0.0
T 1999	6,940	71	0.2	1.8	0.4	0.1	1.6	0.4	0.0	0.2	0.0
T 2000	7,437	84	0.1	1.7	0.4	0.1	1.6	0.4	0.0	0.1	0.0
T 2001	7,863	162	0.2	3.6	0.7	0.2	3.4	0.6	0.0	0.2	0.0
T 2002	8,345	105	0.1	2.6	0.4	0.1	2.6	0.4	0.0	0.0	0.0
T 2003	8,900	274	0.2	4.1	0.8	0.2	4.0	0.8	0.0	0.0	0.0
T 2004	9,502	166	0.1	2.1	0.3	0.1	2.1	0.3	0.0	0.0	0.0
T 2005	10,087	347	0.2	4.2	0.5	0.2	4.1	0.4	0.0	0.1	0.0
T 2006	10,727	205	0.1	2.7	0.3	0.1	2.5	0.3	0.0	0.2	0.0
T 2007	11,245	372	0.2	4.3	0.4	0.1	4.3	0.4	0.0	0.0	0.0
T 2008	11,817	130	0.1	1.5	0.1	0.1	1.4	0.1	0.0	0.0	0.0
T 2009	12,303	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
T 2010	12,834	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
T 2011	13,215	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
T Total		2,016	1.7	32.4	5.2	1.6	31.5	5.0	0.1	0.8	0.1
Total		3,311	2.6	52.9	7.9	2.4	49.7	7.6	0.1	3.1	0.3