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Eastern Research Group, Inc.

Mobile Source Observation Data (MSOD) Database Update Phase III

Final Report

Revision 1

Prepared for:

U.S. Environmental Protection Agency

August 31, 2003

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Mobile Source Observation Data (MSOD) Database Update

FINAL REPORT
REVISION 1

EPA Contract No. 68-C-00-112
Work Assignment No. 3-08

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1.0 Introduction

The United States Environmental Protection Agency (EPA) is in the process of creating a new mobile source emissions modeling system entitled the Multi-Scale Motor Vehicle and Equipment Emission System (MOVES). This new model will generate emissions factors in units of grams per second. This is a marked difference from previous models, such as MOBILE6, which were based on factors in grams per mile. Much of the new factor development will be based on the vehicle testing information contained within EPA's Mobile Source Observation Database (MSOD).

The process of acquiring emission tests of special studies and I/M programs to populate them into the MSOD database consists of 3 steps.

1. EPA issues a list of the potential data sources to ERG.

2. ERG contacts the data sources for any available data. After receiving the raw emissions data from the data sources, ERG will process the data into an MSOD loadable format and submit the data to EPA.

3. EPA staff will then perform the last step of quality assurance and load the data into the MSOD database. Any errors observed in the last phase of the process will be submitted to ERG for investigation and correction.

This report documents the third phase of the project which addressed the missing data, missing supporting documents, the correction of the vehicle-testing data that was submitted under WA No. 3-06, and submission of additional tables. For documentation on data collected in the first and second phase, the reader should refer to ERG Final Report Revision 1 submitted on December 08,2002 and April 14, 2003. Any missing data or missing supporting documents that do not exist or are unavailable are documented and discussed. Over the course of this project it became necessary to make minor modifications to the MSOD input table format. ERG had prior approval from EPA before any changes were made and each of these changes is discussed in full in this report.

2.0 Special Studies

2.1 Overview

In the past twelve months, ERG has contacted several labs throughout the United States and Canada that perform vehicle emissions testing for a variety of different purposes and studies. While many of the studies were confidential, there was still a wide range of data that could be made available for public release. All publicly available data that contained second-by-second emissions testing was examined for possible inclusion into the MSOD. ERG then produced large amounts of data to be loaded into the MSOD. Primary quality assurance was applied to all of the previously submitted data. Table 2-1 shows a summary of the data received from the special studies. Once the data has passed the primary QA check, the data will be submitted to EPA for a more detailed QA check. Results from the EPA QA check were provided to ERG for further investigation to resolve any data errors and/or acquire any additional information.

In this work assignment, ERG worked with EPA to address the missing data, missing supporting documents, the correction of the vehicle-testing data that was submitted under WA No. 3-06, and submittal of additional tables. Table 2-2 through Table 2-4 represent a list of the missing data, missing supporting documents, and data error issues. Details of the acquired missing data, missing supporting documents and data corrections will be described as follows.

In order to capture as much of this data as possible, it was necessary to add additional fields onto the MSOD input tables. All additions were agreed upon by EPA and ERG staff before any changes were made. These additions are outlined in Table 2.5.

Many of the fields in the MSOD are restricted to contain only those values that appear within a reference table for that particular field. These reference tables are intended to be expanded, as needed, when new data is added to the MSOD. Many additions were made to take into account the wide variety of data being added in this. The additional reference values appear in Table 2.6 and Table 2.7.

Table 2-1: Population of Special Studies

Source Description	No. of Tests	No. of Vehicles
California Air Resources Board (UCC96)	51	42
University of California CE-CERT (NCHRP)	878	344
University of California CE-CERT (NH3)	54	39
Coordinating Research Council (CRC_S_LDV1)	510	12
North Carolina State University	787	7
Coordinating Research Council (AQIRP)	4,696	85
California Air Resources Board (N2O)	64	41
University of California CE-CERT (HDD)	312	8
Coordinating Research Council (E55)	701	25
Environment Canada	71	4
New York IPA	24,889	9,942
West Virginia University	2,350	462
Texas Department of Transportation	126	10
Grand Total	35,489	11,021

Table 2-2: Special Study - Required Additional Data

Data Source	Study	Additional Data Required	Contact Person
CRC	Coordinating Research Council (CRC) study in 2002 on Heavy-duty Vehicle Chassis Dynamometer Testing for Emissions Inventory. /E55_59	WVU conversion algorithm from dynamometer hp to speed. Temperature, humidity, barometric pressure and distance for bag_in level.	Ralph D. Nine (304) 293-3111 ext.2463 Ralp.Nine@mail.wvu.edu
CRC	Coordinating Research Council (CRC) Auto/Oil Air Quality Improvement Research Program (early 1990's) / AQIRP.	Test Weight for dyniob_in table	Robert Gorse (734) 429-3700 rgorse1234@aol.com
CARB	California Air Resources Board (CARB) development of Unified Correction cycles (UCC) in 1996/ UCC96.	Temperature, humidity, barometric pressure and fuel economy for bag_in and dynob_in level.	Mark Carlock macrlock@arb.ca.gov
CARB	California Air Resources Board (CARB) 16th Vehicle Surveillance Program with N2O bag data.	Dynamometer coefficient for dynob_in table	Mark Carlock macrlock@arb.ca.gov
CE-CERT	University of California Riverside College of Engineering Center for Environmental Research and Technology (CE-CERT) Emissions of Ammonia fro Light-duty vehicles/ NH3	Temperature, humidity, barometric pressure and fuel economy for bag_in level. Second by second emission of THC and NOx for time_in table	Dr. Matthew Barth (909) 781-5782 barth@cert.ucr.edu
CE-CERT	University of California Riverside College of Engineering Center for Environmental Research and Technology (CE-CERT) NCHRP 25-11 Comprehensive Modal Emission Model and Vehicle Emissions Database, Version 2.02.	Fuel economy for dynob_in and bag_in tables	Dr. Matthew Barth (909) 781-5782 barth@cert.ucr.edu
NYIPA/ NYIPA2002	The New York State Instrumentation/Protocol Assessment Study which compares the standard IM240 test procedure and instrumentation with the New York Transient Emissions Short Test (NYTEST)	Dynamometer Coefficients	Celia Shih (518) 402-8337 cxshih@gw.dec.state.ny.us
WVU_1 – WVU_4	West Virginia University testing of Heavy Duty Vehicles Using Their Portable Dynamometer (1-4).	Test weight, road_hp, dyno coefficients for dynob_in table	Ralph D. Nine (304) 293-3111 ext.2463 Ralp.Nine@mail.wvu.edu
Environnement Canada (EC)	Environment Canada's study on the Effects of Aged Catalysts and Cold Ambient Temperatures on Nitrous Oxide Emissions.	Test weight for dynob_in table Second by second measurement of speed for time_in table	Mr. Peter Barton (613) 990-3723 Barton.peter@etc.ec.qc.ca

Table 2-3: Special Study - Required Supporting Document

Data Source	Study	Contact Person	Additional Supporting Document Required
WVU_1 - WVU_4	West Virginia University testing of Heavy Duty Vehicles Using Their Portable Dynamometer (1-4).	Ralph D. Nine (304) 293-3111 ext.2463 Ralp.Nine@mail.wvu.edu	Definition of all test procedures and all schedule procedures using in WVU study.
CRC	Coordinating Research Council (CRC) study in 2002 on Heavy-duty Vehicle Chassis Dynamometer Testing for Emissions Inventory. /E55_59	Ralph D. Nine (304) 293-3111 ext.2463 Ralp.Nine@mail.wvu.edu	Definition of test procedure and schedule for CARBI, CARBR, CARBC, CARBT and AC508
CRC	Coordinating Research Council (CRC) Auto/Oil Air Quality Improvement Research Program (early 1990's) / AQIRP.	Robert Gorse (734) 429-3700 rgorse1234@aol.com	Definition of test procedure and schedule for FTP4S
CARB	California Air Resources Board (CARB) development of Unified Correction cycles (UCC) in 1996/ UCC96.	Mark Carlock macrlock@arb.ca.gov	Definition of test procedure and schedule for UCC**.
CARB	California Air Resources Board (CARB) 16th Vehicle Surveillance Program with N2O bag data.	Mark Carlock macrlock@arb.ca.gov	Definition of test procedure for EC, MUC and LA92
CE-CERT	University of California Riverside College of Engineering Center for Environmental Research and Technology (CE-CERT) NCHRP 25-11 Comprehensive Modal Emission Model and Vehicle Emissions Database, Version 2.02.	Dr. Matthew Barth (909) 781-5782 barth@cert.ucr.edu	Definition of test procedure for FTPCC
Texas Department of Transportation (TxDOT)	Truck study - new fuels/power/FE	Sandeep Kishan (512) 407-1830 sandeep.kishan@erg.com	Definition of test Procedure SADT, TADT, GRADA and LOADE

Table 2-4: Special Study - Required Investigation and Correction

Data Source	Study	Investigation and Correction Items
WVU_1 - WVU_4	West Virginia University testing of Heavy Duty Vehicles Using Their Portable Dynamometer (1-4)	Resolve all negative emissions in time_in table.
NYIPA/ NYIPA2002	The New York State Instrumentation/Protocol Assessment Study which compares the standard IM240 test procedure and instrumentation with the New York Transient Emissions Short Test (NYTEST)	Resolve errors of humidity and barometers from dynob_in and bag_in table.
CRC_E55	Coordinating Research Council (CRC) study in 2002 on Heavy-duty Vehicle Chassis Dynamometer Testing for Emissions Inventory. /E55_59	Confirmation on idle tests for the records that appear to have missing emissions in bag level. Update time_in table with recently reported speed.
CRC_S_LDV1	Coordinating Research Council (CRC) study in 1997 to determine the effects of sulfur levels in fuel on vehicles.	Resolve the incorrect test phase in time_in table.
CRC_AQIRP	Coordinating Research Council (CRC) Auto/Oil Air Quality Improvement Research Program (early 1990's) / AQIRP.	Resolve on primary key violations and update of test weight in dynob_in table
CECERT_NCHRP	University of California Riverside College of Engineering Center for Environmental Research and Technology (CE-CERT) NCHRP 25-11 Comprehensive Modal Emission Model and Vehicle Emissions Database, Version 2.02.	Resolve the over upper bound or under lower bound conflict for humidity, in dynob_in table and time in time_in table Resolve the wide range of dynosec in time_in table for FTP, US06 and MEC test cycles.
CECERT_NH3	University of California Riverside College of Engineering Center for Environmental Research and Technology (CE-CERT) Emissions of Ammonia fro Light-duty vehicles.	Resolve on primary key violations and update of ambient conditions
Environnement Canada (EC)	1994 N2O Emissions from Light Duty Vehicles - Phase I	Resolve errors of humidity and barometer s from dynob_in and bag_in table. Resolve on primary key violations.
TXDOT_UT	Texas Department of Transportation and the University of Texas study in 2002-03 on the use of new fuels in heavy-duty diesel vehicles	Resolve the incorrect test phase in time_in table and over upper bound or under lower bound conflict for humidity in dynob_in table.
NCSU_TARF	North Carolina State University conducted an experiment to determine the emission savings that could be achieved through better traffic management	Add additional variables in time_in table
CARB_N2O	California Air Resources Board (CARB) 16th Vehicle Surveillance Program with N2O bag data.	Update dynob_in table with reported test weight
CARB_UCC96	California Air Resources Board (CARB) Development of Unified Correction cycles (UCC) in 1996	Update test_proc and sched_id with proper name and recalculate emission in dynob_in and bag_in tables.

Table 2-5: New fields Added to MSOD Import Tables

WA_ID	Table	Name	Type	Description	Units
NYIPA	DYNOB_IN	Epa_ref	Character()	EPA Reference Number	
CECERT_NCHRP, CARB_UCC96	SCHED_PT	Sched_ph	Number(3)	Schedule Phase	
CECERT_NCHRP	SCHED_PT	Sched_ph_nm	Character(15)	Schedule Phase Name	
TXDOT_UT, ETC_N2O, CARB_UCC96	LTIME_IN	DF	Number()	Dilution Factor	
WVU2-WVU4	LTIME_IN	Tot_hp	Number()	Total Power	hp
WVU2-WVU4, CRCE55	LTIME_IN	Torq1	Number()	Hub1 Torque	FtLb
WVU2-WVU4, CRCE55	LTIME_IN	Torq2	Number()	Hub2 Torque	FtLb
WVU2-WVU4, CRCE55	LTIME_IN	Power1	Number()	Hub1 Power	hp
WVU2-WVU4, CRCE55	LTIME_IN	Power2	Number()	Hub2 Power	hp
WVU2-WVU4, CRCE55	LTIME_IN	Espeed1	Number()	Hub1 Speed	rpm
WVU2-WVU4, CRCE55	LTIME_IN	Espeed2	Number()	Hub2 Speed	rpm
CRCE55	LTIME_IN	Pa1sp	Number()	PA1Speed	RPM
CRCE55	LTIME_IN	Pa1tq	Number()	PA1TQ	FtLb
CRCE55	LTIME_IN	Pa2sp	Number()	PA2Speed	RPM
CRCE55	LTIME_IN	Pa2tq	Number()	PA2TQ	FtLb
CRCE55	LTIME_IN	Espeed	Number()	Engine Speed	ADC
CRCE55	LTIME_IN	Cytemp1	Number()	CycloneTemperature1	DegF
CRCE55	LTIME_IN	Cytemp2	Number()	CycloneTemperature2	DegF
CRCE55	LTIME_IN	Cytemp3	Number()	CycloneTemperature3	DegF
CRCE55	LTIME_IN	Drytemp	Number()	DryBulb Temperature	DegF
CRCE55	LTIME_IN	Exhtemp	Number()	Exhaust Temperature	DegF
CRCE55	LTIME_IN	Fltemp	Number()	Filter Face Temperature	DegF
CRCE55	LTIME_IN	Pmfback	Number()	PM Feed Back	SCFM
CRCE55	LTIME_IN	Sptemp	Number()	Sample Plane Temperature	DegF
CRCE55	LTIME_IN	VenPress	Number()	Venturi Pressure	psf
CRCE55	LTIME_IN	Ventemp	Number()	Venturi Temperature	DegC
CRCE55	LTIME_IN	Wettemp	Number()	WetBulb Temperature	DegF
CRCE55	LTIME_IN	Pmconc	Number()	Teom Mass Concentration	mg/m3

Table 2-6. Additional Reference Values - Measurement Types

WA_ID	Meas_id	Description	Units
ETC_N2O, TXDOT_UT, CARB_UCC96, CRC_S_LDV1	CO_BKG_PPM	Ambient Concentration of CO in ppm	ppm
ETC_N2O, TXDOT_UT, CARB_UCC96, CRC_S_LDV1	CO2_BKG_%	Ambient Concentration of CO2 in percent	percent
ETC_N2O, TXDOT_UT, CARB_UCC96, CRC_S_LDV1	NO_BKG_PPM	Ambient Concentration of NO in ppm	ppm
ETC_N2O	NO2_BKGPPM	Ambient Concentration of NO2 in ppm	ppm
ETC_N2O	N2O_BKGPPM	Ambient Concentration of N2O in ppm	ppm
ETC_N2O	DIL_N2O	Total N2O in ppm by volume as measured after mixed with dilution air	ppm
ETC_N2O	DIL_NO2	Total NO2 in ppm by volume as measured after mixed with dilution air	ppm
ETC_N2O	DIL_NO	Total NO in ppm by volume as measured after mixed with dilution air	ppm
TXDOT_UT, CARB_UCC96, CRC_S_LDV1	NOx_BKG_PPM	Ambient Concentration of NOx in ppm	ppm
TXDOT_UT, CARB_UCC96, CRC_S_LDV1	HC_BKG_PPM	Ambient Concentration of HC in ppm	ppm
CRC_S_LDV1	CH4_BKG_PPM	Ambient Concentration of CH4 in ppm	ppm

Table 2-7: Additional Reference Values- Driving Schedules

WA_ID	ID	Name
CARB_UCC96	UCC15	Unified Correction Cycle 15
CARB_UCC96	UCC20	Unified Correction Cycle 20
CARB_UCC96	UCC25	Unified Correction Cycle 25
CARB_UCC96	UCC30	Unified Correction Cycle 30
CARB_UCC96	UCC35	Unified Correction Cycle 35
CARB_UCC96	UCC40	Unified Correction Cycle 40
CARB_UCC96	UCC45	Unified Correction Cycle 45
CARB_UCC96	UCC50	Unified Correction Cycle 50
CARB_UCC96	UCC55	Unified Correction Cycle 55
CECERT_NCHRP	MECV5	Modal Emission Cycle test created by CE-CERT Version5
CECERT_NCHRP	MECV6	Modal Emission Cycle test created by CE-CERT Version6
CECERT_NCHRP	SMECV6	Special Modal Emission Cycle test created by CE-CERT Version6 (no AC Hill)
CECERT_NCHRP	MECV7	Modal Emission Cycle test created by CE-CERT Version7
CECERT_NCHRP	SMECV7	Special Modal Emission Cycle test created by CE-CERT Version7 (no AC Hill)
CRC_AQIRP	FTPR5	FTP with fourth bag of EPA REP05
CRC_E55_59	AC5080	Acceleration 50 km/r and 80 km/hr
CRC_E55_59	CARB-C	Creep Portion of CARB HHDDT cycle
CRC_E55_59	CARB-T	Transient Portion of CARB HHDDT cycle
CRC_E55_59	CARB-R	Cruise Portion of CARB HHDDT cycle
TXDOT_UT	SADT	Single Axle Dump Truck Cycle developed by ERG
TXDOT_UT	TADT	Tandem Axle Dump Truck Cycle developed by ERG
TXDOT_UT	GRADA	Telescoping Boom Excavator Cycle developed by ERG
TXDOT_UT	LOADE	Wheeled Loader Cycle developed by ERG
WVU1-WVU4	KERN	KERN Cycle
WVU1-WVU4	NYBUS	New York Bus
WVU1-WVU4	CBD	
WVU1-WVU4	TESTD	Test D
WVU1-WVU4	14C	Modified CBD
WVU1-WVU4	14R	Modified and routized CBD
WVU1-WVU4	2-5MIL	Routinized WVU-5P run 2 times
WVU1-WVU4	2CHSVR	Routinized CSHVC run 2 times
WVU1-WVU4	2TESTD	Double Test D with Warmup (TEST_D2W)
WVU1-WVU4	3CBD	CBD run 3 times
WVU1-WVU4	5MILE	Routinized WVU-5P
WVU1-WVU4	ALT1	
WVU1-WVU4	ALT2	
WVU1-WVU4	ART	
WVU1-WVU4	CARB-C	Creep Portion of CARB HHDDT cycle
WVU1-WVU4	CARB-R	Creep Portion of CARB HHDDT cycle
WVU1-WVU4	CARB-T	Transient Portion of CARB HHDDT cycle
WVU1-WVU4	CBD-RT	Routinized CBD
WVU1-WVU4	CSCYC	
WVU1-WVU4	CSHVR	Routinized CSHVC
WVU1-WVU4	DRT	Test D Route
WVU1-WVU4	NYCC	New York Composite Cycle (NY-Comp)

WA_ID	ID	Name
WVU1-WVU4	NYGT2	Double length New York Garbage Truck Cycle
WVU1-WVU4	NYGTC3	NYGTC run 3 times
WVU1-WVU4	NYTRK	New York Truck Cycle
WVU1-WVU4	OCRTC2	OCRTC run 2 times
WVU1-WVU4	VFAC	Viking Freight Adhoc Cycle (VIKING_W)

Additional Table

In phase one and two, we processed and imported data collected by several labs for the MSOD. However, in addition to tailpipe emissions in mass, the data also included tailpipe emission in concentration, which did not conform to the standard MSOD dynamometer test tables and were, therefore, originally left out of the database. Upon further consideration, EPA determined that the tailpipe emission concentration data should be loaded into a newly design dynamometer test table and related to tailpipe emissions in mass by test ID (CTR_TST_ID).

Once the data was reviewed and determined to be desirable for importation into the MSOD, it had to be formatted and processed to match the MSOD data structure and methodology. As with the tailpipe emission mass data, several modifications were made to the emission concentration data for proper population into the newly designed MSOD table. The primary modifications are discussed below.

Table 2-8: Population of Special Studies for Ltime_in Table

Source Description	No.of Tests	No.of Vehicles
California Air Resources Board (UCC96)	51	42
Coordinating Research Council (CRC_S_LDV1)	510	12
Coordinating Research Council (E55)	701	25
Environment Canada	71	4
West Virginia University	2,350	462
Texas Department of Transportation	126	10
Grand Total	3,809	555

2.2 California Air Resources Board

2.2.1 California Air Resources Board (CARB) 16th Vehicle Surveillance Program (CARB_N2O)

As part of its 16th Surveillance Program, the California Air Resources Board (CARB) collected N_2O bag data. There are 64 emission tests, which were performed on 41 unique vehicles for CARB_N2O study. For details on the study, a summary, and vehicle information, the reader should refer to the final report for phase two. THC, NOX, CO, and CO2 were measured by standard instrumentation. N2O was measured by FTIR

Missing Data:

Second by second emission data.

Test weight for Dynob_in table.

Data source was contacted and confirmed that there was no second by second emission values for 16th Surveillance Program.

Test weight was submitted with the raw data in the beginning. Due to our technical problem, the test weights were not populated out properly. The Dynob_in table was update with test weight in this phase of the project.

Missing Supporting Document:

None

Data Errors:

None

Additional Table:

None

The complete programs used to read in and modify the data can be found in Appendix B.

Contact:
Mark Carlock
California Air Resources Board
mcarlock@arb.ca.gov

2.2.2 California Air Resources Board (CARB) Development of Unified Correction Cycles (UCC) in 1996 (CARB_UCC96)

As part of the CARB development of the Emission Factor (EMFAC) model, adjustments to EPA's Unified Cycle (UC) were made. These adjustments, entitled Unified Correction Cycles (UCC), are based off of route specific driving data representative of driving within the Los Angeles area in 1992. CARB then updated the UCC's in 1996 to account for changes in driving patterns. After developing 8 new driving cycles, they conducted an emissions testing program to generate new factors for their EMFAC model.

For this emissions testing program, they recruited approximately 81 vehicles from the general fleet population and tested them using the 8 new UCCs, an FTP test, and a UC test. Only a portion of the testing data was available for inclusion into the MSOD. Each vehicle's fuel tank was emptied and refilled with Phase I summertime gasoline fuel prior to preconditioning and testing. Second by second data was collected for the UCC and UC tests only. For details on the CARB Development of Unified Correction cycles (UCC) in 1996 study, a summary, and vehicle information, the reader should refer to the final report for phase one.

Missing Data:

Ambient conditions and fuel economy Dynob_in table

Data source was contacted and confirmed that ambient conditions and fuel economy are not available for this study.

Missing Supporting Document:

Drive schedule and test procedure

Data source was contacted and submitted drive schedule and test procedure to ERG.

All test schedules were populated and submitted to EPA in Sched_pt table.

Data Errors:

After receiving the correct titles for COLD and UNIFIED cycles from data source, ERG reprocessed Dynob_in, Bag_in, and Time_in tables with the correct titles (COLD as FTP and UNIFIED as LA92) and recalculated values for Bag_in table.

Additional Table:

Ltime_in

The primary modifications and available fields are discussed below.

- The ctr_tst_id were assigned to be the same values as in the time_in table.
- Following variables were filled with measured values from the raw data.

  Dynosec - Elapse time on dynamometer test in second
  Cvs_flow - Constant volume sample in standard cubic feet per second

Dil_thc	- Total hydrocarbon in ppm by volume after mixed with dilution air
Dil_co	- Carbon monoxide in ppm by volume after mixed with dilution air
Dil_co2	- Carbon dioxide in percent by volume after mixed with dilution air
Dil_nox	- Nitrogen oxide in percent by volume after mixed with dilution air
Df	- Dilution Factor

- Back ground concentration of measured pollutants at the beginning of each test were populated into the tmeas_in table.

The complete programs used to read in and modify the data can be found in Appendix B.

Contact:
Jeff Long
Phone: (626) 450-6140
California Air Resources Board; Analysis Section
9528 Telstar Ave.
El Monte, CA 91731 USA
E-mail: jlong@arb.ca.gov

2.3 Coordinating Research Council (CRC)

2.3.1 CRC Project E-47 Sulfur Reversibility Program (CRC_S_LDV1)

The Coordinating Research Council (CRC) conducted a study in 1997 to determine the effects of sulfur levels in fuel on vehicles. They used approximately 12 vehicles. Each vehicle was first tested with approximately 10,000 miles on the odometer. The catalysts were then rapidly aged to the equivalent of over 100,000 miles and retested. To investigate the effects of sulfur, they varied the amount of sulfur in two base fuels by adding the Auto/Oil 3-component sulfur mixture. They used Federal RFG base fuel with 40, 100, 150, 330, and 600 ppm sulfur as well as California Phase 2 RFG with 40 and 150 ppm sulfur. For details on the CRC Project E-47 Sulfur Reversibility Program study, a summary, and vehicle information, the reader should refer to the final report for phase one.

Missing Data:

None

Missing Supporting Document:

None

Data Errors:

After discovering the uncorrected test phase in Time_in table, the SAS program was edited to overcome these errors. The update Time_in table was submitted to EPA with proper values for the test phase.

Additional Table:

Ltime_in

The primary modifications and available fields are discussed below.

- The ctr_tst_id were assigned to be the same values as in the time_in table.
- Following variables were filled with measured values from the raw data.

  Dynosec - Elapse time on dynamometer test in second
  Lab_baro - Barometric pressure for each second in inch of mercury
  Tp_vol - Tailpipe volume in standard cubic feet per second
  Dil_vol - Dilution air in standard cubic feet per second
  Tp_thc - Total hydrocarbon in ppm by volume as measured at tailpipe
  Tp_co - Carbon monoxide in ppm by volume as measured at tailpipe
  Tp_co2 - Carbon dioxide in percent by volume as measured at tailpipe
  Dil_co2 - Carbon dioxide in percent by volume after mixed with dilution air
  Tp_nox - Nitrogen oxide in percent by volume as measured at tailpipe
- Background concentrations of measured pollutants before testing was startedwere populated into the tmeas_in table.

The complete programs used to read in and modify the data can be found in Appendix C.

Contacts:
Mr. Brent Bailey.
Phone: 678-795-0506
Coordinating Research Council
E-mail: bkbailey@crcao.com

2.3.2 CRC Project E-55 Heavy-duty Vehicle Chassis Dynamometer Testing (CRC_E55)

The Coordinating Research Council organized a study through West Virginia University (WVU) entitled "Heavy-Duty Vehicle Chassis Dynamometer Testing for Emission Inventory." The goal of this project was to quantify regulated emissions and certain unregulated species from heavy heavy-duty diesel trucks (HHDDT) in the State of California. There is some doubt that

engine certification data is sufficient to accurately estimate the inventory of nitrous oxides (NOx) and particulate matter (PM) in the environment due to these heavy-duty vehicles. Therefore, WVU used a transportable chassis dynamometer to test 25 heavy-duty diesel trucks with the Urban Driving Dynamometer Schedule, the AC50/80 cycle, and the CARB HHDDT cycle, in both loaded and unloaded situations. For details on the CRC Project E-55 Heavy-duty Vehicle Chassis Dynamometer Testing, a summary, and vehicle information, the reader should refer to the final report for phase two.

Missing Data:

Measured speeds of second by second testing are missing.

Data source was contacted and re-submitted raw data with measured speed values. ERG updated the Time_in table with measured speed values.

Missing Supporting Document:

All schedule points are missing.

Data source was contacted and submitted schedule points for all available test schedules.

Data Errors:

Primary key violations for Dynob_in, Time_in and Bag_in tables.

The error was caused by a technical problem in the SAS program. The SAS code has been modified to correct this error. The updated tables of Dynob_in, Time_in, Rmeas_in, Bmeas_in, Bag_in and Tmeas_in were created and submitted to EPA

Additional Table:

Ltime_in

The primary modifications and available fields are discussed below.

- The ctr_tst_id were assigned to be the same values as in the time_in table.
- Following variables were filled with measured values from the raw data.

Dynosec	- Elapse time on dynamometer test in second
Torq1	-Hub1 torque in FtLb
Torq2	-Hub2 torque in FtLb
Power1	-Hub1 power in hp

Power2	-Hub2 power in hp
Espeed1	-Hub1 speed in rpm
Espeed2	-Hub2 speed in rpm
Pa1sp	-PA1speed in rpm
Pa1tq	-PA1 torque in FtLb
Pa2sp	-PA2 speed in rpm
Pa2tq	-PA2 torque in FtLb
Espeed	-Engine speed in ADC
Cytemp1	-Cyclone temperature1 in Fahrenheit
Cytemp2	-Cyclone temperature2 in Fahrenheit
Cytemp3	-Cyclone temperature3 in Fahrenheit
Drytemp	-Drybulb temperature in Fahrenheit
Exhtemp	-Exhaust temperature in Fahrenheit
Flftemp	-Filter face temperature in Fahrenheit
Pmfback	-PM feedback in SCFM
Sptemp	-Sample plane temperature in Fahrenheit
VenPress	-Venturi pressure in pound per square foot
Ventemp	-Venturi temperature in degree Celsius
Wettemp	-Wetbulb temperature in Fahrenheit
Pmconc	-Teom mass concentration in mg/m3

The complete programs used to read in and modify the data can be found in Appendix C.

Contacts:
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2.3.3 CRC Auto/Oil Air Quality Improvement Research Program (CRC_AQIRP)

The Auto/Oil Air Quality Improvement Research Program (AQIRP) was conducted in two stages and was a major effort intended to assess the air quality effects of using reformulated gasolines and alternative fuels in light-duty motor vehicles. The program involved the collaboration of Ford, General Motors, Chrysler and fourteen oil companies. In Phase I, 28 fuels and 53 vehicles were tested. In Phase II, testing was extended to an additional 71 fuels and 32 vehicles. Most of the tests were included in the data we received; however, outliers were separated from the bulk of the data and we did not include them. All tests conducted used FTP with emissions data being collected every second. Unfortunately, for most of the tests only bag and modal data was retained for public release. Given its time and resource constraints and the fact that the study is ten years old, ERG conducted a thorough search to try to locate the missing

second by second data but was unsuccessful. For the Offcycle subset of tests, the only subset where second by second data was retained, the tests also included an extended test procedure with a fourth bag. In addition to the standard emissions data, measurements for over 150 species were taken from the exhaust and have been included in the data to be loaded into the MSOD. For details on the CRC Auto/Oil Air Quality Improvement Research Program study, a summary, and vehicle information, the reader should refer to the final report for phase two.

Missing Data:

Test weight for Dynob_in table.

Test weight was submitted with the raw data in the beginning. Due to a technical problem, the test weights were not populated properly. The Dynob_in table was updated with test weight in this phase of the project.

Missing Supporting Document:

None

Data Errors:

Primary key violations for Dynob_in, Time_in and Bag_in tables.

The error was caused by unknown tests that were submitted on second by second emission measurements without any test summary. Another cause of error was duplicated records in the raw data. The SAS code has been modified to overcome these violations by removing all unknown tests and duplicated records. The update tables of Dynob_in, Time_in, Rmeas_in, Bmeas_in, Bag_in and Tmeas_in were created and submitted to EPA.

Additional Table:

None

The complete programs used to read in and modify the data can be found in Appendix C.

Contacts:
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Retired from FORD

2.4 Environment Canada (ETC_N2O)

The Environmental Technology Centre (ETC) at Environment Canada has been conducting a wide range of vehicle testing for many years on both heavy- and light-duty vehicles and has been collecting second by second data during the vast majority of thesetests. For phase two of the MSOD project, we were able to obtain a portion of the data generated during Environment Canada's study on the "Effects of Aged Catalysts and Cold Ambient Temperatures on Nitrous Oxide Emissions." The study tested 10 "in-use" vehicles and 4 new vehicles, but at this time only data from the new vehicles has been made available to ERG. The tests conducted were FTP and in some cases IM240 with second by second emissions data being captured for CO, CO2, NO, NO2, and N2O. Summer and winter grade unleaded fuels were used for all tests depending on the test temperature. For details on the study, a summary, and vehicle information, the reader should refer to the final report for phase two. All second by second data was measured using FTIR.

Missing Data:

None

Missing Supporting Document:

None

Data Errors:

Humidity and temperature are out of bounds in Dynob_in and Bag_in tables.

Primary key violations for Dynob_in, Time_in and Bag_in tables.

Extreme fuel economy values, emission summary for 3 tests in Dynob_in and Bag_in tables

Humidity and temperature errors were caused by an inconsistency in the raw data format. Additional SAS code has been developed to re-read raw data in and export them out in an MSOD loadable format.

Primary key problem was caused by a technical problem in the SAS program. The SAS code has been modified to correct this error. The updated tables of Dynob_in, Time_in, Rmeas_in, Bmeas_in, Bag_in and Tmeas_in were created and submitted to EPA

After verifying the raw data, it is shown that these extreme values existed in the original data. Data source has been contacted for this error. Due to the conversion program from the ETC lab, the extreme values for these three tests were set to be null.

Additional Table:

Ltime_in

The primary modifications and available fields are discussed below.

- The ctr_tst_id were assigned to be the same values as in the time_in table.
- Following variables were filled with measured values from the raw data.

Dynosec	- Elapse time on dynamometer test in second
Cvs_flow	- Constant volume sample in standard cubic feet per second
Dil_co	- Carbon monoxide in ppm by volume after mixed with dilution air
Dil_co2	- Carbon dioxide in percent by volume after mixed with dilution air
Df	- Dilution Factor
Dil_n2o	-Total N2O in ppm by volume as measured after mixed with dilution air (rmeas_in)
Dil_no2	-Total NO2 in ppm by volume as measured after mixed with dilution air (rmeas_in)
Dil_no	-Total NO in ppm by volume as measured after mixed with dilution air (rmeas_in)

- Background concentrations of measured pollutants before the start of each bag were populated into the bmeas_in table.

The complete programs used to read in and modify the data can be found in Appendix E.

Contacts:
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Environment Canada
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2.5 New York Instrument Protocol Assessment (NYIPA, NYIPA2002)

New York State runs a decentralized inspection and maintenance (I/M) program that does not use the EPA standard IM240 protocol, but instead uses a New York Transient Emissions Short Test (NYTEST) testing program and equipment. To support this substitution in testing programs, New York has been performing a comparison study between the NYTEST and the

IM240 emissions test. This study is entitled *Evaluation of Simultaneous Emissions Test Data Derived From the NYTEST Instrumentation/Protocol Assessment Pilot Study*. The study is referred to as the IPA. This study began as a pilot study in 1998 and has been carried on yearly ever since. In phase one of the MSOD project we populated data from the pilot study through the 2001 year study. In phase two we included the recently available 2002 year study.

During the IPA study, vehicles are simultaneously tested using both the NYTEST and IM240 equipment. The composite results are then analyzed for equivalency. All tests were performed by TESTCOM contractors at one testing facility. The vehicles used during the testing were recruited from the general vehicle fleet population and followed the distribution of fleet age. Tank fuel (gasoline) was used for all vehicles. Second by second data has been made available for all years of the IPA program for the IM240 testing. For details on the New York Instrument Protocol Assessment program and summary and vehicle information, the reader should refer to the final report for phase two. Only the data measured with the standard I/M240 instrumentation was reported to EPA.

Missing Data:

Missing dynamometer coefficient

Data source was contacted and confirmed that dynamometer coefficients are not available for this study. However, data source provided ERG with EPA reference number instead which can be used to look up the dynamometer setting on ESLT . The EPA reference numbers were updated in the Dynob_in table as EPA_REF filed.

Missing Supporting Document:

None

Data Errors:

Humidity and barometric pressure are out of bounds in Dynob_in and Bag_in tables.

Humidity errors were caused by an incorrect conversion equation from relative humidity to be absolute humidity in the unit of grain of water per pound of dry air. The SAS code has been modified to correct this problem and export the data to an MSOD loadable format.

Barometric pressure errors were caused by an incorrect conversion. Raw data were reported in the unit of inch of mercury while the data format identified the unit as kPa. The SAS code has been modified to correct and export the data to an MSOD loadable format.

Additional Table:

None

The complete program used to read in and modify the data can be found in Appendix F.

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2.6 North Carolina University (NCSU_TRAF)

In 2001, Dr. Christopher Frey from the Department of Civil Engineering at North Carolina State University headed a team to investigate the emissions reductions that could be achieved through improvement in traffic management. They used the portable exhaust gas analyzer, OEM-2100™ from Clean Air Technologies International, Inc., to collect on-road vehicle emissions. This instrumentation was attached to a small number of vehicles that were then repeatedly driven on predefined routes.

Two main sites were used for this study; Chapel Hill Road and Walnut Street in North Carolina. A small number of drivers were used to ensure repeatability in the driving behavior. Regular unleaded gasoline was used for all vehicle runs and no further fuel information is available from the study. For details on the study and summary and vehicle information, the reader should refer to the final report for phase one.

Missing Data:

Exhaust flow

Exhaust flow was submitted with the raw data. However, due to different terminology that was used, it resulted in none-exporting of exhaust flow. After discussions with the EPA project manager, the correct variable was determined. The SAS code has been modified and this additional data was exported to the Ttime_in table.

Missing Supporting Document:

None

Data Errors:

Humidity values are out of bounds in the Ttime_in table.

Humidity errors were caused by an incorrect conversion equation from relative humidity to be absolute humidity in the unit of grain of water per pound of dry air. The SAS code has been modified to correct this problem and the data was exported to the MSOD loadable format.

Additional Table:

None

The complete programs used to read in and modify the data can be found in Appendix G.

Contacts:
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2.7 University of California CE-CERT

Researchers at the University of California College of Engineering-Center for Environmental Research and Technology (CECERT) have been conducting a variety of vehicle test programs for several years.

2.7.1 Comprehensive Modal Emissions Model (NCHRP)

In August 1995, the CECERT at the University of California-Riverside, along with researchers from the University of Michigan and Lawrence Berkeley National Laboratory, began a four-year research project to develop a *Comprehensive Modal Emissions Model (CMEM)*, sponsored by the National Cooperative Highway Research Program (NCHRP, Project 25-11). The overall objective of the research project was to develop and verify a modal emissions model that accurately reflects light-duty vehicle (LDV, i.e., cars and small trucks) emissions produced as a function of the vehicle's operating mode. The model is comprehensive in the sense that it is able to predict emissions for a wide variety of LDVs in various states of condition (e.g., properly functioning, deteriorated, malfunctioning). The model is now complete and capable of predicting second-by-second tailpipe emissions and fuel consumption for a wide range of

vehicle/technology categories. In creating CMEM, over 350 vehicles were extensively tested on a chassis dynamometer, where second-by-second measurements were made of both engine-out and tailpipe emissions of carbon monoxide (CO), hydrocarbons (HC), oxides of nitrogen (NOx), and carbon dioxide (CO2).

The vehicles used in this study were typically tested with three test cycles: 3-bag FTP, US06 cycle (bag 4 of the supplemental FTP), and a second by second emissions cycle developed by CECERT entitled the Modal Emission Cycle (MEC). The MEC was designed to cover a range of driving modes including steady-state cruise, accelerations, decelerations, and idle. All vehicles were recruited out of the general vehicle population and whatever gasoline they had in their tanks was used during testing. For details on the NCHRP study and summary and vehicle information, the reader should refer to the final report for phase one.

Missing Data:

Missing fuel economy and Dynamometer Setting

Data source was contacted and confirmed that fuel economy is not available for this study. However, data source suggested ERG calculate the data from the carbon balance method. After consulting the EPA project manager, we decided not to calculate these data, because there were no reported fuel properties for the test program.

Data source was contacted and confirmed that dynamometer coefficients are not available for this study.

Missing Supporting Document:

MEC schedule point is missing.

Data source was contacted and submitted MEC schedule point.

Data Errors:

Humidity values are out of bounds in Dynob_in and Bag_in tables.

Dynosecs are out of bound for a few tests.

Humidity errors were caused by an incorrect conversion equation from relative humidity to be absolute humidity in the unit of grain of water per pound of dry air. The SAS code has been modified to correct this problem and export the data to an MSOD loadable format.

After contacting the data source for the out of bound dynosecs in the Time_in table, we were informed that the data were out of bounds because some of the tests were terminated before the cycle was completed. Any test with an incomplete cycle was added a prefix of "I" in front of the original values in the test_proc for the Dynob_in table.

Additional Table:

None

The complete programs used to read in and modify the data can be found in Appendix H.

Contacts:
Dr. Matthew Barth
Director of Transportation Systems & Vehicle Technology Research Laboratory
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2.7.2 CE-CERT Emission of Ammonia for Light-Duty Vehicle (CECERT_NH3)

In 2001, CE-CERT conducted a study to examine the factors that influence ammonia emissions from light-duty cars and trucks. During this study they tested 39 vehicles on the FTP driving cycle. All of these tests were performed with whatever gasoline was in the vehicle tank at the time that the vehicle was procured. During each test they recorded the standard exhaust measurements along with utilizing Fourier transform infrared spectroscopy to measure the ammonia emissions. They also performed additional testing on five vehicles using the US06, the New York City Cycle (NYCC), and a high-speed freeway cycle in order to determine the effects of driving patterns on ammonia emissions. Finally, two vehicles were tested using gasoline with 30 and then 330 ppmw sulfur levels to investigate the effects of fuel sulfur levels. For details on the study and summary and vehicle information, the reader should refer to the final report for phase one.

Missing Data:

Missing ambient conditions, THC, and NOx for second by second emissions.

Data source was contacted and re-submitted raw data with ambient values. ERG updated the Dynob_in and Bag_in tables with the ambient conditions.

Data source was contacted and confirmed that second by second emissions for THC and NOx are not available for this study.

Missing Supporting Document:

FWY schedule point is missing.

Data source was contacted and submitted FWY schedule point.

Data Errors:

None

Additional Table:

None

The complete programs used to read in and modify the data can be found in Appendix H.

Contacts:
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2.7.3 CE-CERT Heavy Duty Diesel Emissions (CECERT_HDD)

The CE-CERT Heavy Duty Diesel Truck study is an on-going study and has been released to EPA and ERG under condition that it remains confidential. The emissions data that ERG was able to procure is on-road tests of 8 vehicles throughout southern California. All vehicles were tested with diesel fuel. For details on the study and summary and vehicle information, the reader should refer to the final report for phase one.

Missing Data:

None

Missing Supporting Document:

None

Data Errors:

None

Additional Table:

None

Contacts:
Dr. Matthew Barth
Director of Transportation Systems & Vehicle Technology Research Laboratory
Phone: 909-781-5782
E-mail: barth@cert.ucr.edu

2.8 University of Texas (TXDOT_UT)

The University of Texas at Austin conducted a study for the Texas Department of Transportation (TxDOT) on the use of new fuels in heavy-duty diesel vehicles. The primary purpose of the study was to evaluate new fuels with regard to changes in emissions, maximum power, and fuel economy. Second-by-second activity data was collected on two single axle dump trucks (four weeks total), two tandem axle dump trucks (four weeks total), a telescoping boom excavator (one week), and a wheeled loader (one week) during their normal work activity. The activity data was used to build chassis dynamometer test cycles for the single axle and tandem axle dump trucks and to build engine dynamometer test cycles for the excavator and loader. The chassis and engine test cycles were then used to generate second-by-second HC, CO, and NOx emissions data for eight dump trucks and for two diesel engines, respectively. The fuels used during the testing included two low sulfur diesel fuels, a high sulfur diesel fuel, and PuriNOx diesel fuel.

For details on the study and summary and vehicle information, the reader should refer to the final report for phase two.

Missing Data:

Twenty tests (from 126) have missing CO and CO2 values for Time_in table

Data source was contacted and confirmed that CO and CO2 values are not available for these 20 tests.

Missing Supporting Document:

All schedule points are missing.

Data source was contacted and submitted schedule points for all available test schedules.

Data Errors:

Humidity values are out of bounds in Dynob_in and Bag_in tables.

Test phase and start time of Time_in table were not properly assigned.

Humidity errors were caused by an incorrect conversion equation from relative humidity to be absolute humidity in the unit of grain of water per pound of dry air. The SAS code has been modified to correct this problem and export the data to an MSOD loadable format.

The SAS code has been edited to export the proper test phase and dynosec for the Time_in table.

Additional Table:

Ltime_in

The primary modifications and available fields are discussed below.

- The ctr_tst_id were assigned to be the same values as in the time_in table.
- Following variables were filled with measured values from the raw data.

Dynosec	- Elapse time on dynamometer test in second
Cvs_flow	- Constant volume sample in standard cubic feet per second
Dil_thc	- Total hydrocarbon in ppm by volume after mixed with dilution air
Dil_co	- Carbon monoxide in ppm by volume after mixed with dilution air
Dil_co2	- Carbon dioxide in percent by volume after mixed with dilution air
Dil_nox	- Nitrogen oxide in percent by volume after mixed with dilution air
Df	- Dilution Factor

- Back ground concentration of measured pollutants at the beginning of each test were populated into tmeas_in table.

The complete programs used to read in and modify the data can be found in Appendix I.

Contacts:
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2.9 West Virginia University (WVU_1 – WVU_4)

In 1992, West Virginia University (WVU) developed two transportable chassis dynamometer laboratories for testing heavy-duty vehicles. Each dynamometer is set up on a flat-bed trailer and is designed to allow a heavy-duty truck or bus to be driven onto it and tested. The rollers of the dynamometer are free rotating and are not used to absorb any load. Instead, power is taken directly from the drive wheels through an adapter coupled to a flywheel, which simulates inertial load, and eddy current power absorbers, which simulate road load. The exhaust gas is ducted to a dilution tunnel and from there sample pipes bring the exhaust into the analyzers.

WVU has used this equipment to conduct numerous studies for both private and public organizations. In phase one and two, EPA was able to procure some of the test data from 13 different test sites. However, this still does not constitute all the data that WVU has collected so that WVU remains a source for possible future collection. It should also be noted here that while all data has been received according to test site, WVU has been unable to suggest how each site may be associated with a specific test report. For details on the study and summary and vehicle information, the reader should refer to the final report for phase one and phase two.

Missing Data:

Test weight, Road_hp and Dyno coefficients for Dynob_in table

Test weight was submitted with the raw data. Due to a technical problem, the test weights were not populated out properly. The Dynob_in table was updated with test weight in this phase of the project.

Data source was contacted and confirmed that Road_hp and Dyno coefficients are not available for this study.

Missing Supporting Document:

All schedule points are missing.

Data source was contacted and submitted schedule points for all available test schedules.

Data Errors:

EPA discovered negative emissions in one of the WVU datasets and requested that ERG populate all WVU with raw values.

The SAS code has been modified to export these values. The update tables of Time_in were created and submitted to EPA

Additional Table:

Ltime_in

The primary modifications and available fields are discussed below.

- The ctr_tst_id were assigned to be the same values as in time_in table.
- Following variables were filled with measured values from the raw data.

Dynosec	- Elapse time on dynamometer test in second
Tot_hp	-Total power in hp unit
Torq1	-Hub1 torque in FtLb
Torq2	-Hub2 torque in FtLb
Power1	-Hub1 power in hp
Power2	-Hub2 power in hp
Espeed1	-Hub1 speed in rpm
Espeed2	-Hub2 speed in rpm

The complete program used to read in and modify the data can be found in Appendix J.

Contacts:
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3.0 Inspection and Maintenance Programs

3.1 Overview

Test data from three inspection and maintenance (I/M) programs were highlighted for collection and inclusion into the MSOD. The selected programs were the Arizona Car Care program (AZ_IM_0201), British Columbia AirCare program (BC_IM_0101), and the Colorado Air Care program (CO_IM_9901). All three programs use centralized testing facilities operated by a primary contractor with tests administered by trained technicians. Each program allows clean vehicles to "fast pass" the emissions test when their emissions drop below a pre-determined fast pass level for that portion of the test and the test is ended. Table3.1 presents a summary of the number of tests and vehicles by each I/M program. For details of the programs, the reader should refer to the final report for phase one.

Since all three I/M programs consisted of more than 5 million tests, EPA is in the process of modifying the loading table to handle this I/M data. For this work assignment, only one error was discovered; an out of bounds value for humidity in Dynob_in and Bag_in tables.

Table 3-1: Coverage of I/M Datasets

Program	Start Date	End Date	Number of Tests
Arizona	January 1, 2002	June 30, 2002	317,192
Colorado	January 1, 1999	September 1, 2002	4,366,275
British Columbia	January 1, 2001	June 3, 2002	532,792
Grand Total			5,216,259

3.2 Arizona Car Care (AZ_IM_YYMM)

Arizona has been conducting an enhanced vehicle-testing program in Phoenix since 1995. As part of this program, most light duty gasoline vehicles, model years 1981 through 1995, undergo an IM147 test on a biennial basis. Arizona has provided the results of all IM147 tests performed from January through June 2002 for inclusion into the EPA MSOD. For details on the study and summary and vehicle information, the reader should refer to the final report for phase one.

Missing Data:

None

Missing Supporting Document:

None

Data Errors:

Humidity values are out of bounds in the Dynob_in and Bag_in table.

Humidity errors were caused by an incorrect conversion equation from relative humidity to be absolute humidity in the unit of grain of water per pound of dry air. The SQL code has been written for EPA to correct this data before loading it into the MSOD format.

Additional Table:

None

The complete program used to read in and modify the data can be found in Appendix K.

Contacts:
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Arizona Department of Environmental Quality
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3.3 British Columbia AirCare (BC_IM_YYMM)

A vehicle inspection and maintenance (I/M) program entitled "AirCare" was started in British Columbia, Canada, in 1992. This program originally used centralized testing facilities to perform ASM 2525/idle test procedures. In 2000, the program was reviewed and modified into AirCare II. In the new program, IM240 tests were used for vehicle model years over 1991. Data from the AirCare from January 2001 through June 2002 program has been made available for inclusion into EPA's MSOD. For details on the study and summary and vehicle information, the reader should refer to the final report for phase one.

Missing Data:

None

Missing Supporting Document:

None

Data Errors:

Humidity values are out of bounds in the Dynob_in and Bag_in table.

Humidity errors were caused by an incorrect conversion equation from relative humidity to be absolute humidity in the unit of grain of water per pound of dry air. The SQL code has been written for EPA to correct this data before loading it into the MSOD format.

Additional Table:

None

The complete program used to read in and modify the data can be found in Appendix K.

Contacts:
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3.4 Colorado Air Care (CO_IM_YYMM)

Colorado's inspection and maintenance (I/M) program, titled "Air Care," was started in January of 1995. All 1982 and newer vehicles in Denver and surrounding effected areas are required to have an IM240 emissions test every two years at one of the 15 Air Care testing stations. The test facilities are operated by Envirotest Systems Corp., a subsidiary of Environmental Systems Products, Inc. (ESP). Vehicles older then 1982 are only required to pass an idle emissions test annually and can be taken to any Envirotest Air Care center or to any licensed independent testing center. For details on the study and summary and vehicle information, the reader should refer to the final report for phase one.

Missing Data:

None

Missing Supporting Document:

None

Data Errors:

Humidity values are out of bounds in the Dynob_in and Bag_in table.

Humidity errors were caused by an incorrect conversion equation from relative humidity to be absolute humidity in the unit of grain of water per pound of dry air. The SQL code has been written for EPA to correct this data before loading it into MSOD format.

Additional Table:

None

The complete program used to read in and modify the data can be found in Appendix K.

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4.0 Conclusions

The MSOD update project began in August, 2002 and has been on-going. This work assignment was assigned to address the missing data, missing supporting documents, the correction of the vehicle-testing data that was submitted under WA No. 3-06, and submittal of additional tables. ERG acquired data from thirteen special studies and three inspection and maintenance (I/M) programs for a total number of tests that were provided to EPA of over 5.25 million. During these three phases there were many obstacles that were encountered while processing this information. Some obstacles may have been preventable while some may have been unavoidable. The obstacles are listed below.

- Once the data was processed and submitted to EPA, EPA ran the submitted data through a QA program. Any errors found were communicated to ERG for investigation and correction. In phase one and two of this project, we waited until the end of each phase and submitted all data together to EPA. This submittal process was not practical enough since some data contained errors and it was only discovered after the project ended. In phase three of this project, any new or corrected data were submitted to EPA as soon as it was completed. Processing data in this manner allowed EPA enough time to perform QA on the data and for ERG to verify and correct any data errors.

- Schedule point table was designed for housing data on the time base basis while many of the test cycles for heavy-duty vehicle are route base.

- The length of schedule point was limited to 5 characters long, some special studies developed many schedule points of their own and it was challenging to modify their names to be only 5 characters long.