



Standard Operating Procedure for Complying with CO TAQA Requirements

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Purpose of This SOP

The purpose of this standard operating procedure (SOP) is to explain clearly how to comply with carbon monoxide (CO) Traffic Air Quality Analysis (TAQA) requirements at the project-level. In particular, it assists project sponsors with determining when and how to prepare and coordinate a CO TAQA technical report.

Subject Overview

The National Environmental Policy Act (NEPA) requires that all “major federal actions significantly affecting the quality of the human environment” shall include a “detailed statement” on “the environmental impact of the proposed action.” Federal Highway Administration has identified in its Technical Advisory Guidance for Preparing and Processing Environmental and Section 4(f) Documents (T 6640.8A) that a project-level CO analysis may be necessary in order to comply with this NEPA requirement. This SOP affects all added capacity projects, where the project corridor meets the minimum traffic volume threshold.

Authorities

There is no specific authority or requirement to use this SOP, but it designed to help project sponsors comply with NEPA requirements in regards to CO emissions from transportation projects.

Toolkit

Use the following tools in conjunction with this SOP:

- CO & Mobile Source Air Toxics (MSAT) Emission Rate Table
- Documentation Standard for a CO TAQA Technical Report
- Guideline for Modeling Carbon Monoxide from Roadway Intersections
- SOP for Preparing Air Quality Statements

Personnel

The audience for this SOP includes project sponsors, contractors, and consultants responsible for preparing valid documentation that a project complies with NEPA air quality requirements; in particular, the CO TAQA.

Applicable Models and Data

A CO TAQA is developed through the use of two different models, an emissions model and a dispersion model. The current Environmental Protection Agency (EPA) approved emissions model is MOVES and the current approved EPA dispersion models for Texas are either CALINE3 or CAL3QHC.

Currently MOVES2014 is the approved emission factor model. However, the grace period in which the MOVES2010b version is still acceptable ends on October 7, 2016.



CALINE3 is for projects that are considered free-flow and CAL3QHC is for projects that have major congested intersections. The emission factors obtained from the MOVES model will be used in the appropriate dispersion model to identify the specific concentration of CO at the applicable receptor locations. Obtain traffic data either from the Texas Department of Transportation's (TxDOT's) Transportation Planning and Programming (TPP) Division or other sources that have otherwise been found by TPP to be reasonable.

General Information Regarding the CO TAQA

A TAQA is a project-level analysis that determines the CO impacts of proposed transportation projects under worst-case conditions. In other words, the TAQA assesses whether the project would adversely affect local air quality by contributing to CO levels that exceed the 1-hour or 8-hour CO National Ambient Air Quality Standards (NAAQS). A TAQA determination is not dependent on funding source or attainment status.

Procedure

1. Identify the applicable estimated time of completion (ETC) year and design year to analyze in the TAQA by completing Steps 1.1 through 1.2 as directed.
 - 1.1. Identify the year that the ultimate project¹ will be expected to be open to traffic. This is the ETC year. Continue to Step 1.2.
 - 1.2. Identify the horizon year of the area's current transportation plan². Either this year or the ETC year +20 can be used as the design year³. Continue to Step 2.
2. Determine whether this project is exempt from a CO TAQA by completing Steps 2.1 through 2.2 as directed.
 - 2.1. Determine whether the project adds capacity⁴. If so, continue to Step 2.2. If not, proceed to Step 10.
 - 2.2. Determine whether the annual average daily traffic (AADT) for the ETC or design year is greater than 140,000 vehicles per day⁵. If so, continue to Step 3. If not, proceed to Step 10.
3. Identify applicable receptor locations for the TAQA by completing Steps 3.1 through 3.3 as directed.
 - 3.1. Use project-specific traffic data to identify the sections of each build alternative that contain the highest AADT. Continue to Step 3.2.
 - 3.2. Use project schematics to identify the areas of these high AADT sections that contain the narrowest right-of-way (ROW). Place a receptor on the ROW line at these locations. Continue to Step 3.3.

¹ This refers to the entire project, as it is described in the environmental document.

² For example, use 2035 for the Mission 2035 MTP, 2040 for the Mission 2040 MTP, etc.

³ ENV recommends using the horizon year of the transportation plan when a CO TAQA is required.

⁴ Added capacity projects typically include but are not limited to: new location roadways, adding main lanes, adding through lanes, adding auxiliary lanes > 1 mi, etc.

⁵ The AADT shall be for the entire cross-section of the roadway, including main lanes and frontage roads.



- 3.3. Determine whether the project will contain major signalized intersections. If so, follow the EPA Guideline for Modeling Carbon Monoxide from Roadway Intersections to identify appropriate receptor locations. Either way, continue to Step 4.
4. Obtain the applicable CO emission rates by completing Steps 4.1 through 4.3 as directed.
 - 4.1. Determine whether there is a current applicable CO & MSAT Emission Rate Table that contains CO emission rates for the TxDOT district in which this project resides. If so, continue to Step 4.2. If not, proceed to Step 4.3.
 - 4.2. Use the emission rates provided in that table. Continue to Step 5.
 - 4.3. Develop the applicable CO emission rates using the MOVES emission factor model. Continue to Step 5.
5. Identify the appropriate dispersion model to use for the TAQA by completing Step 5.1 as directed.
 - 5.1. Determine whether the project contains major congested intersections. If so, use the CAL3QHC dispersion model. If not, use the CALINE3 dispersion model. Continue to Step 6.
6. Develop the TAQA results by completing Steps 6.1 through 6.3 as directed.
 - 6.1. Calculate the design hour volume (DHV) traffic for each project segment by multiplying the segment's AADT by the K-factor⁶. Continue to Step 6.2.
 - 6.2. Perform the dispersion modeling for the ETC and design year for each alternative using the parameters for a worst-case scenario in Appendix D, the 1-hr CO background concentrations in Appendix B, the receptor locations identified in Step 3, and the emission rates identified in Step 4. The result will be the 1-hr CO concentrations. Continue to Step 6.3.
 - 6.3. Develop the 8-hr CO concentrations for each receptor by using the formula in Appendix C. Continue to Step 7.
7. Analyze the modeling results by completing Steps 7.1 through 7.4 as directed.
 - 7.1. Determine whether the 1-hr CO concentrations at each receptor are less than the 1-hr CO NAAQS (Appendix B). If so, continue to Step 7.2. If not, proceed to Step 7.3.
 - 7.2. Determine whether the 8-hr CO concentrations at each receptor are less than the 8-hour CO NAAQS (Appendix B). If so, proceed to Step 8. If not, continue to Step 7.3.
 - 7.3. Consult with the Environmental Affairs Division (ENV) air specialist to determine whether there was a flaw in the analysis. If so, correct the flaw and proceed to Step 6. If not, continue to Step 7.4.
 - 7.4. Identify appropriate CO mitigation measures in consultation with the ENV air specialist⁷. Incorporate the mitigation measures into the Environmental Permits Issues & Commitments Sheet, as appropriate. Continue to Step 8.
8. Prepare a technical report and submit it for review by completing Steps 8.1 through 8.4 as directed.

⁶ The AADT and K-factor can be obtained from project-specific traffic analyses.

⁷ Nationwide there are no CO nonattainment areas. Thus far, no project analyzed in Texas has exceeded the CO NAAQS.



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- 8.1. Prepare a technical report for this analysis in accordance with the Documentation Standard for a CO TAQA Technical Report. Continue to Step 8.2.
 - 8.2. Submit the TAQA technical report to the ENV air specialist for review. Continue to Step 8.3.
 - 8.3. Address the ENV air specialist's comments appropriately and resubmit the technical report to the ENV air specialist for approval. Continue to Step 8.4.
 - 8.4. Determine whether the ENV air specialist approved the analysis. If so, continue to Step 9. If not, proceed to Step 8.3.
9. Retain the approved CO TAQA technical report⁸ in the project file. Continue to Step 10.
 10. Determine if an environmental review document will be prepared for this project. If so, refer to the SOP for Preparing Air Quality Statements for the applicable CO TAQA disclosure language to include in the environmental review document.

The procedure is complete.

⁸ Changes in ETC year, design year, traffic data, or significant design changes may prompt the need to revise and update a CO TAQA.



Appendix A: Acronyms and Definitions

Acronyms

Acronym	Full Name
AADT	Annual Average Daily Traffic
CO	Carbon Monoxide
DHV	Design Hourly Volume
ENV	TxDOT Environmental Affairs Division
EPA	Environmental Protection Agency
ETC	Estimated Time to Completion
HR	Hour
MSAT	Mobile Source Air Toxics
MTP	Metropolitan Transportation Plan
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
PPM	Part per Million
ROW	Right-of-Way
SOP	Standard Operating Procedure
TAQA	Traffic Air Quality Analysis
TPP	TxDOT's Transportation Planning and Programming Division
TxDOT	Texas Department of Transportation



Definitions

Term	Definition
Design Year	Typically, the design year for CO analyses is either the out-year (last year) of the current Metropolitan Transportation Plan (MTP) or the ETC year + 20 years.
Design Hour Volume	The DHV, or peak hour traffic volumes, for a given segment of roadway are calculated by multiplying the AADT of the roadway segment by the project-specific K-factor. The DHV can be developed by using Transportation Research Board Special Report 209 (Highway Capacity Manual).
ETC Year	This is the date the entire project, as described in the environmental review document, will be open to traffic.
K-factor	A factor, usually between 0.09 – 0.11, which when multiplied by the project AADT, calculates the project's DHV. The AADT and K-factor can be obtained from project-specific traffic analyses.
CALINE 3	This line source dispersion model calculates the amount of CO generated along a roadway and then applies a dispersion model to calculate the peak hour CO concentrations at specific receiver locations along the ROW line. This model and the user's guide can be found on EPA's web site: http://www.epa.gov/scram001/dispersion_prefrec.htm .
CAL3QHC	A variation of the CALINE3 model, CAL3QHC is available for analyzing CO concentrations at major congested intersections. Use of this model is acceptable in any area of Texas, but is required if the project is located within the CO maintenance area portion of El Paso County. CAL3QHC must also be used if the project TAQA is conducted to evaluate changes to signalized intersections. This model and the user's guide can be found on EPA's web site: http://www.epa.gov/scram001/dispersion_prefrec.htm .
MOVES	MOVES is the EPA's approved mobile source emissions model. This model uses data on temperature, fleet mix, fleet ages, appropriate inspection-maintenance, and vehicle operating modes to calculate volatile organic compounds, CO, and NOx emissions for different speeds and years. CO output data from MOVES is used in CALINE3 and CAL3QHC (CALINE models) to calculate CO concentrations when TxDOT's CO lookup tables are not available. This model can be found on EPA's web site: http://www.epa.gov/otaq/models/moves/ .



Appendix B: Background CO Concentrations & CO NAAQS

Estimates of CO Background Concentrations for Texas Cities and Rural Areas		
City or Region	One Hour Average Background Concentration (ppm)	Eight-Hour Average Background Concentration (ppm)
Austin	1.2	0.4
Beaumont-Port Arthur	0.9	0.4
Corpus Christi	use San Antonio as surrogate	use Dallas as surrogate
Dallas	1.9	2.3
El Paso	5.6	3.0
Fort Worth	use San Antonio as surrogate	use Dallas as surrogate
Houston-Galveston	2.5	1.9
San Antonio	6.1	1.9
Brownsville	1.5	0.9
Laredo	4.4	2.0
Waco	1.2	0.6
Smaller Cities/Rural Areas	use San Antonio as surrogate or contact ENV AQ specialist for other options	use Dallas as surrogate or contact ENV AQ specialist for other options

Source: TxDOT Environmental Affairs Division, CO background concentrations are based upon the average of the first highest CO concentration averaged for three years for the monitor with highest average within the specified metroplex. The 2010-2012 three year average was used for all areas, except San Antonio and Laredo which used the 2008-2010 three year average because data was not available in 2011-2012. On October 16, 2013, quality assured and quality controlled monitoring data was obtained from: http://www.epa.gov/airquality/airdata/ad_rep_mon.html. If 2 monitors were co-located, the monitor with less than 1000 hours was not used. This background data is subject to change, and ENV will release notifications when such changes occur.

Note: San Antonio has the highest 1-hour concentration for Texas. Dallas has the highest 8-hour concentration for Texas for an area that does not also have a CO maintenance area.

CO NAAQS	
1-HR NAAQS	8-HR NAAQS
35 ppm	9 ppm

Source: EPA. <http://epa.gov/air/criteria.html>



Appendix C: Converting the One-Hour CO Standard to the Eight-Hour CO Standard

Modeling results from the CALINE model are in one-hour CO concentrations and are compared to the one-hour NAAQS standard for CO. The eight-hour CO concentration is calculated using the one-hour CO concentration and a persistence factor, and then adding in the appropriate background CO concentration provided in Appendix B. The following formula can be used to convert the one hour results to eight-hour results:

$$CO_8 = (CO_1 - BG_1) 0.6 + BG_8$$

where:

CO₈ = Eight-hour CO concentration

CO₁ = One-hour CO concentration

BG₁ = One-hour background CO concentration (Appendix B)

0.6 = Persistence factor (meteorology and traffic)

BG₈ = Eight-hour background CO concentration (Appendix B)



Appendix D: CALINE Parameters

A worst-case analysis is used to demonstrate that standards will not be exceeded under the worst possible conditions. To help create the worst-case scenario, the CALINE models (referring to both the CALINE3 model and the CAL3QHC model) use the following variables:

Roadway: The CALINE3 model is limited to a maximum of 20 roadway links. A roadway link is defined as a straight segment of roadway having a constant height, width, traffic volume, and emission factor. The links are defined by the coordinates of their start and end points and should be established to reflect orientation to true north.

Determining Receptors: Receptors should be located on the right-of-way line adjacent to the roadway segments with the highest traffic volume at the narrowest portion of the project right-of-way. Receptor should be located outside of the mixing zone (discussed below). If the receptor is located within a mixing zone, consider altering the mixing zone so that the receptor remains outside of the mixing zone. CALINE3 can accommodate a maximum of 20 receptors.

Averaging Time: Averaging time can range from 30 minutes to 60 minutes. Since most predictions are performed for a one hour period, use 60 minutes in the CALINE models.

Surface Roughness: Surface roughness coefficients range between 3 to 400 centimeters. Table 1 of the CALINE3 User's Guide provides surface roughness coefficients for a variety of surface types and land uses. If land use is mixed, use the smaller roughness coefficient for the worst-case analysis.

Settling and Deposition Velocities: Both settling and deposition velocities should be entered as 0 cm/sec.

Scale Factor: The scale conversion factor entered in the CALINE or CAL3QHC models should be 0.3048 if the model units are in feet, or 1.0 if the units are in meters.

Receptor Height: Receptor height should be set at an assumed breathing height of 5.9 if coordinates are in feet, or 1.8 if coordinates are input in meters.

Traffic Volume: CALINE requires Design Hour Volume (DHV), or peak hour traffic volumes, for a given segment of roadway. The DHV is calculated by multiplying the AADT of the segment by the project-specific K Factors. The AADT and K Factor can be obtained from project-specific traffic analyses. The DHV is then divided by the number of travel lanes used in the CALINE model. The DHV can be developed by using Transportation Research Board Special Report 209 (Highway Capacity Manual).

CO Emission Factors: A carbon monoxide emissions look-up table will be provided by ENV upon request, if available. The look-up tables provide estimated TxDOT District-specific CO emissions by year, speed, and roadway type. Use of the CO look-up tables could prevent the need for performing MOVES modeling; however, if MOVES CO results and the CO emissions tables are both available, use the higher value of the two emission factors in the dispersion model for the worst-case analysis. The emission factor is expressed in grams/mile.

Source Height: Source height refers to the elevation of the roadway relative to the receptors. For at-grade roadways, the source height will be zero (at grade). For elevated and depressed roadway links, the elevation should reflect the elevation relative to the receptors. In CALINE, the source height should not be greater than +10 meters (+32 feet) for an elevated roadway section, or lower than -10 meters (-32 feet) for a depressed roadway section. If the receptors are higher or lower than these limits, use +10 or -10 meters (+32 or -32 feet).



Mixing Zone Width: The mixing zone width represents the width of the CO plume that has been generated by the vehicles and dispersed by their wake, and is considered to be uniform in regard to emissions and turbulence. The mixing zone width should equal the width of the travel lanes (without shoulders) plus 3 meters (or 10 feet) on each of the outside travel lanes.

Wind Speed: A wind speed of one meter per second should be used for a worst-case analysis.

Wind Angle: Evaluate wind at 10 degree increments as recommended by the CALINE3 User's Guide. Wind angle is represented in degrees from north (i.e., 0o is equivalent to a wind from the north).

Atmospheric Stability Class: Values of one to six, representing atmospheric stability classes A-F, respectively, can be used in the CALINE models. For worst-case analysis, use a stable atmosphere (Stability Class 6).

Mixing Height: A mixing height of 1000 meters should be used.

Background CO Concentration: Refer to Appendix B.

Additional Considerations and Modeling Parameters for Using the CAL3QHC Model

CAL3QHC is based on the CALINE3 model and will produce the same results as CALINE3 (if CAL3QHC links are set to "free flow"). CAL3QHC requires all the inputs needed for CALINE3 including: roadway geometries, receptor locations, meteorological conditions and vehicle emission rates. In addition to the above, several other parameters are necessary, including signal timing data and information describing the configuration of the intersection being modeled. CAL3QHC can accommodate up to 120 roadway links and 60 receptor links, compared to CALINE 3, which can accommodate only up to 20 roadway links and 20 receptor links.

The additional parameters and considerations required for CAL3QHC are discussed below.

Roadway and Intersection: A roadway link is defined as a straight segment of roadway having a constant height, width, traffic volume, and emission factor. The links are defined by the coordinates of their start and end points and should be established to reflect orientation to true north. Roadway links in the CAL3QHC model are defined as either (1) Free-flow links or (2) Queue links.

Mixing Zone Width: In CAL3QHC, the mixing zone width should equal the width of the free-flow travel lanes (without shoulders) plus 3 meters (or 10 feet) on each of the outside travel lanes. For roadway links defined as queue links, the mixing zone is equal to the width of the travel lane.

Receptor Location: Receptors should be located outside of the mixing zone and about 75 feet (25 meters) from the outside edge of the cross street of the intersection. If a receptor is located within a mixing zone, consider altering the mixing zone so that the receptor remains outside of the mixing zone. CAL3QHC can accommodate up to 60 receptors.

Queue Link Information: CAL3QHC requires the following information for each roadway modeled as a Queue Link:

- Average Signal Cycle Length (in seconds);
- Average Red Time Length (in seconds);
- Clearance Time Lost (Yellow Light), use 2 seconds if the clearance time is unknown;



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- Saturation Flow Rate, the saturation flow rate is the hourly capacity for each roadway queue link expressed in vehicles per hour. Use 1,600 veh/hr if rate is not specified.
- Signal Type, the signal type can be specified as (1) Pretimed, (2) Actuated, or (3) Semiactuated. If the signal type is not specified, CAL3QHC will assume the signal type is (1) Pretimed; and
- Arrival Rate, CAL3QHC has five options for arrival type, (1) Worst, (2) Below Average, (3) Average, (4) Above Average, or (5) Best Progression. Enter an arrival rate of (3) Average for a default value.

Idle Emission Factor: A carbon monoxide idle emissions look-up table will be provided by ENV upon request, if available. Use of the CO look-up tables could prevent the need for performing MOVES modeling; however, if MOVES CO results and the CO idle emissions tables are both available, use the higher value of the two emission factors in the dispersion model for the worst-case analysis. Idle emission is expressed in grams per vehicle-hour.



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The following table shows the revision history for this document.

Revision History	
Effective Date Month, Year	Reason for and Description of Change
September 2015	Version 1 was released.