California Council on Diesel Education and Technology

CCDET III

Student Guide

Opacity Testing for Cargo Handling Equipment (CHE)

Student Guide
September 2018

TWI
Transportation Workforce Institute

California Council on Diesel Education and Technology

CCDET III

Course Outline

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Course Outline: CCDET III: Opacity Testing for Cargo Handling Equipment (CHE)

Table of Contents

Course Overview

This 4-hour course covers implementing the opacity testing for Cargo Handling Equipment (CHE). It includes the environmental and health impacts of particulate matter, smoke test regulations, requirements, and standards as they apply to CHE, SAE J1667 Snap-Acceleration Test procedures with specific variations for CHE, Opacity Test fail procedures, considerations for testing CHE with retrofitted DPFs, and an approved procedure for performing the Snap-Acceleration Test on RTG Cranes. The course includes both classroom and hands-on components.

I. Learning Outcomes and Objectives

Course Learning Outcomes

A. Workers, owners, and managers of cargo handling operations will be able to maintain their vehicles and cargo handling equipment in compliance with CARB regulations.

B. Class participants will be aware of specific regulatory requirements for cargo handling equipment and how they differ from other opacity-test procedures.

Learning Objectives

Upon completion of the course, participants will be able to:

1. Identify health and environmental effects of pollution and particulate matter.
2. Identify smoke test regulations, requirements, and standards as they apply to cargo handling equipment.
3. Correctly perform the SAE Snap-Acceleration Test using equipment provided.
4. Correctly calculate final Snap-Acceleration Test results for CHE when using an opacity meter that is not specifically calibrated for CHE.
5. Correctly perform opacity testing on CHE with OEM DPFs as well as those retrofitted with DPFs.
6. Follow the approved alternative procedure for performing opacity testing on RTG cranes.

II. Course Agenda

The following tables provide the agenda for this 4-hour course. There will be a short break after approximately two hours. There is no scheduled meal break because the course meets for only a half- day.

DAY 1	
15 Minutes	**Introduction** • Housekeeping tasks (sign-ins, etc.) • Course overview and objectives • Review of Course Agenda
10 Minutes	**Environmental Impacts of Particulate Matter** • Why these programs are needed • Detrimental effects of different pollutants • Specific health effect of particulate matter
30 Minutes	**Smoke Test Regulations, Requirements, and Standards** • CHE Regulations • Non-Yard Truck Equipment • CHE Opacity Testing Regulations • Certification Renewal
35 Minutes	**Snap-Acceleration Test Procedures** • Preparation and Safety • Equipment Setup • Test Overview • Performing the test • Validating and calculating results • Fail Procedures • Record Keeping Requirements • Considerations for DPF retrofits
15 Minutes	**Alternate Procedure for Opacity-testing RTG Cranes** • Procedure • Demonstration of RTG Crane controls
15 Minutes	**Break**
90 Minutes	**Hands-on Snap-Acceleration Test Procedures**
30 Minutes	**Assessment**

III. Course Information

COURSE NAME:	CCDET III: Opacity Testing for Cargo Handling Equipment (CHE)
APPROVED:	TBD
CLASS TIME:	4 Hours
PREREQUISITES:	None
TRAINING LOCATION: **MAXIMUM CLASS SIZE:**	8-15 Participants
TARGET AUDIENCE:	Technicians, Owners, Managers, and other responsible for CHE
CERTIFICATE(S):	CCDET Course Completion Certificate

TRAINING AIDS AND EQUIPMENT:

- ☑ Smart Board and/or Projector
- ☑ Computer
- ☑ Whiteboard
- ☑ Personal safety equipment
- ☑ Maintenance reference documentation
- ☑ Vehicle Keys (Crew, operating, and maintenance keys)
- ☑ Set of maintenance tools
- ☑ PowerPoint Presentation
- ☑ Opacity Meter

HANDOUTS:

- ☑ Exercise Handouts
- ☑ Participant Handouts

PARTICIPANT EVALUATION METHODS:

- Written Final Assessment
  - Passing criterion: 70%

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Handouts

Opacity Testing for Cargo Handling Equipment (CHE)

Handouts

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Applying the SAE J1667 Snap Acceleration Test Procedure to RTG Cranes

Target Audience

This procedure is designed specifically for RTG cranes that cannot be tested using the standard SAE J1667 procedure. Prior approval of the Executive Officer **is not** required for this modified procedure.

Other than when using this procedure, if performing the SAE J1667 Snap Acceleration Test is not feasible, the end-user must demonstrate that performing the test is not feasible, and use an alternative method of compliance that has been approved by the Executive Officer. The EO must determine whether the alternative procedure causes an increase in soot accumulation rates in the VDECS. This pre-approved procedure, allows end-users to avoid the case-by-case approval requirements for RTG cranes.

Overview

RTG cranes lack the throttle mechanisms commonly found in other vehicles. Therefore, it is impossible to perform the opacity test in the manner normally required.

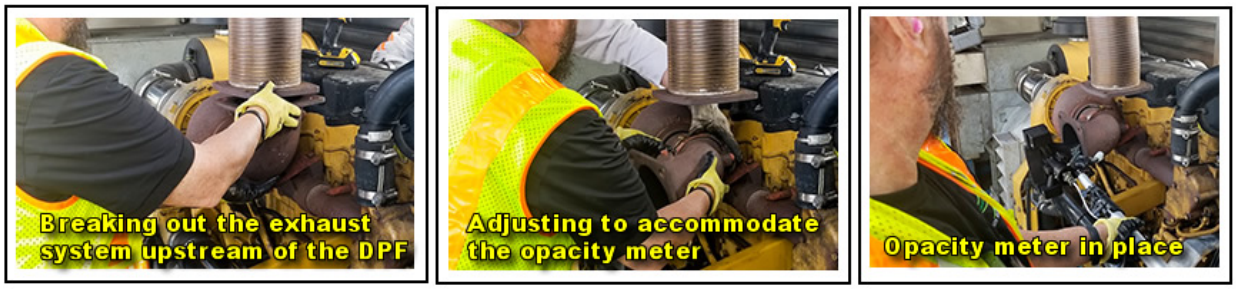
Most RTG cranes operate using a generator set. The diesel engine powers the generator. The engine is switched from *idle speed (650-750 rpm)* to *full speed (1800 rpm)* where it remains during normal operation. The system is designed to maintain 1800 rpm, which enables the generator to deliver consistent electrical frequency (60Hz) and voltage but makes the normal snap acceleration test impossible to administer. However, when the RTG crane begins to lift a load, the engine momentarily drops below 1800 RPM before returning to normal. This somewhat approximates the conditions found in an on-road vehicle during a typical snap acceleration test.

This procedure is performed by lifting the hoist mechanism of the RTG crane without a cargo container or other load attached. It was developed using Cummins and Caterpillar engines. Engines from other manufacturers should function similarly.

Where to Place the Opacity Meter

Cargo handling equipment (CHE), which has been retrofitted with a Diesel Particulate Filter (DPF), must be opacity-tested upstream of the DPF, while equipment that comes from the manufacturer with a DPF in place is tested at the stack or tailpipe as normal. This requirement exists because the retrofitted equipment was originally certified without a DPF in place; so subsequent testing is performed under similar conditions. A DPF greatly reduces but does not eliminate harmful emissions. The upstream testing requirement ensures that the DPF does not mask underlying engine problems.

Figure 1:
RTG Crane with a retrofitted DPF with the exhaust system broken-out at the turbo charger.



Applying the SAE J1667 Snap Acceleration Test Procedure to RTG Cranes

Procedure

This procedure modifies the J1667 opacity test to be used with RTG cranes. All other aspects of the existing J1667 procedure remain in place and should be followed.

Step	Action
1	Start the diesel engine, and allow it to warm-up to normal operating temperature. • Typically, 10 to 15 minutes • Operating the crane often expedites reaching normal temperature
2	Once the engine is at normal operating temperature, lower the hoist mechanism to a low position. • During the test, you will lift the hoist mechanism ***without a cargo container or other weight attached***
3	Attach the opacity testing device as required by the SAE J1667 procedure. • **DPF Retrofit:** Attach opacity test equipment upstream of the DPF • **DPF OEM:** Attach opacity test equipment at the stack or exhaust pipe (downstream of the DPF)
4	On the opacity meter, press the **Start Button** or respond to the prompts to begin the test and to start each snap (varies by device).
5	**Perform the snap:** Lift the crane hoist mechanism for 1- 4 seconds at full speed. • This simulates fully depressing the throttle on an on-road vehicle
6	Stop lifting, and wait 5 to 45 seconds (target 8 to 10 seconds). • Engine should return to normal unloaded RPM (1800 RPM) • If the hoist mechanism is too high to complete the next lifting snap, lower it to a convenient position at a safe speed
7	Repeat steps 5 and 6 for a total of six cycles (three purge & three test). • The three test cycles must be completed within two minutes of the purge cycles
8	End the snap acceleration test.
9	Calculate results based on the nearest two of the three test readings, and retain the test results for your records. • As of this writing, only the *Wager 7500 Smoke Meter* performs CHE calculation automatically. All other opacity meters average all three test values; so the calculation for CHE equipment will need to be performed manually. *See the next page for test criteria and failure instructions.*

Applying the SAE J1667 Snap Acceleration Test Procedure to RTG Cranes

Test Criteria

PM Emission Standards Table

PM Emission Standard		Maximum Opacity
g/kw-hr	g/bhp-hr	
> 0.54	> 0.40	55%
0.42 to 0.54	0.31 to 0.40	45%
0.28 to 0.41	0.21 to 0.30	35%
0.15 to 0.27	0.11 to 0.20	25%
0.07 to 0.14	0.05 to 0.10	15%
< 0.07	< 0.05	5%

Opacity Limits

The ARB Executive Order (EO) lists both the PM certification level and certification standard. The EO for all engines can be found on the ARB website:

https://www.arb.ca.gov/msprog/offroad/cert/cert.php

Calculating Test Results for CHE

Average the closest two of the three snap test results. As of this writing, only the *Wager 7500 Smoke Meter* performs CHE calculation automatically. All other opacity meters average all three test values; so the calculation for CHE equipment will need to be performed manually.

Example: Given readings of 3%, 4%, and 6.5%, the closest two values of 3% and 4% would be averaged together for a final opacity test result of 3.5%.

Failure Instructions

If the equipment fails the opacity test:

- Take the equipment out of service and repair the engine as required
- After making the required repairs, test the equipment again using the same procedure and calculation method
- The opacity test results after repairs may not be more than five percentage points higher than the maximum defined in the CHE regulation, or the equipment may not be placed back into service
    - For example: If the maximum opacity is 35% the maximum opacity after repairs would be 40%; for a maximum opacity of 45%, the maximum opacity after repairs would be 50%

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Student Slides

Opacity Testing for Cargo Handling Equipment (CHE)

Student Slides

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Course Overview

- Environmental and Health Impacts of Particulate Matter
- Opacity Test Regulations, Requirements, and Standards for CHE
- Review of SAE J1667 Snap-Acceleration Test Procedures
  - Variations for CHE
- Snap Acceleration Fail Procedures
- Record Keeping Requirements
- Considerations for CHE DPF Retrofits
- Pre-Approved Procedure for Opacity-testing RTG Cranes

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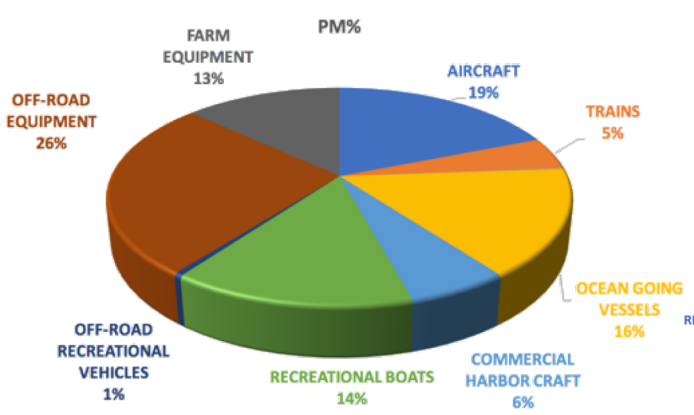
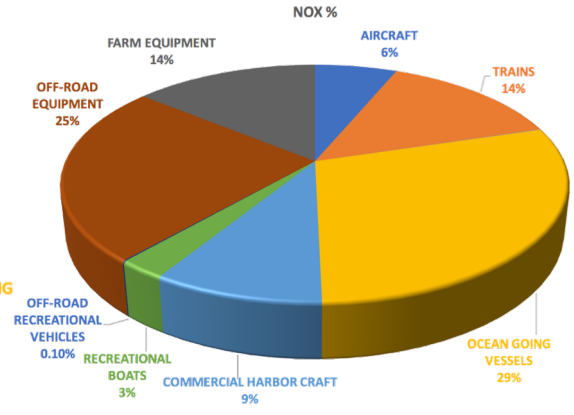
Environmental & Health Impacts of Particulate Matter

3

Why these programs are needed



PM Emissions



NO_x Emissions

Source: https://www.arb.ca.gov/ei/emissiondata.htm
2016 SIP Emission Projection Data, 2012 Estimated Annual Average Emissions, Statewide

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Why these programs are needed

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AMERICAN LUNG ASSOCIATION. | STATE OF THE AIR 2017

Source:
http://www.lung.org/our-initiatives/healthy-air/sota/city-rankings/most-polluted-cities.html

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CCDET III: Opacity Testing for Cargo Handling Equipment (CHE)

Ranking of People at Risk in Most Polluted Cities - 2017			
Rank	Year-Round Particle Pollution	Ozone Pollution	Short-Term Particle Pollution
1	Visalia-Porterville-Hanford, CA	Los Angeles-Long Beach, CA	Kern, CA
2	Bakersfield, CA	Bakersfield CA	Fresno, CA
3	Fresno-Madera, CA	Fresno-Madera, CA	Kings, CA
4	San Jose-San Francisco-Oakland, CA	Visalia-Porterville-Hanford, CA	Stanislaus, CA
5	Los Angeles-Long Beach, CA	Phoenix-Mesa-ScottAZ	Fairbanks North Star Borough, AK
6	Modesto-Merced, CA	Modesto-Merced, CA	Madera, CA
7	El Centro, CA	San Diego-Carlsbad, CA	San Joaquin, CA
8	Pittsburgh-New Castle-Weirton, PA-OH-WV	Sacramento-Roseville, CA	Salt Lake, UT
9	Cleveland-Akron-Canton, OH	New York-Newark, NY-NJ-CT-PA	Cache, UT
10	San Luis Obispo-Paso Robles- Arroyo Grande, CA	Las Vegas-Henderson, NV-AZ	Merced, CA
11	Medford-Grants Pass, OR	Denver-Aurora, CO	Shoshone, ID
12	Philadelphia-Reading-Camden, PA-NJ-DE-MD	Houston-The Woodlands, TX	Utah, UT
13	Indianapolis-Carmel-Muncie, IN	Dallas-Fort Worth, TX-OK	Lemhi, ID
14	Louisville/Jefferson County— Elizabethtown—Madison, KY-IN	El Centro, CA	Riverside, CA
15	Johnstown-Somerset, PA	Fort Collins, CO	Douglas, NV
16	Houston-The Woodlands, TX	El Paso-Las Cruces, TX-NM	Franklin, ID
17	Fairbanks, AK	Redding-Red Bluff, CA	Tulare, CA
18	Detroit-Warren-Ann Arbor, MI	San Jose-San Francisco-Oakland, CA	Ravalli, MT
19	Altoona, PA	San Antonio-New Braunfels, TX	Plumas, CA
20	Lancaster, PA	Salt Lake City-Provo-Orem, UT	Weber, UT
21	Cincinnati Wilmington-Maysville, OH-KY-IN	Hartford-West Hartford, CT	Santa Cruz, CA
22	Birmingham-Hoover-Talladega, AL	Baton Rouge, LA	Los Angeles, CA
23	Harrisburg-York-Lebanon, PA	Philadelphia-Reading-Camden, PA-NJ-DE-MD	Inyo, CA
24	New York-Newark, NY-NJ-CT-PA	Sheboygan, WI	Lincoln, MT
25	Erie-Meadville, PA	Chico, CA	Washoe, NV

Health and Environmental Impacts

Constituent	Detrimental Effect
Particulate Matter (PM)	(PM10/PM2.5) Carcinogenic/Mutagenic Respiratory Disease
HC & Nox (Smog Precursors)	Ozone (smog) Respiratory Disease Crop Losses
NOx & Sox	Acid Deposition Visibility Degradation
Toxic Air Contaminants	Cancer & Other Ill Effects

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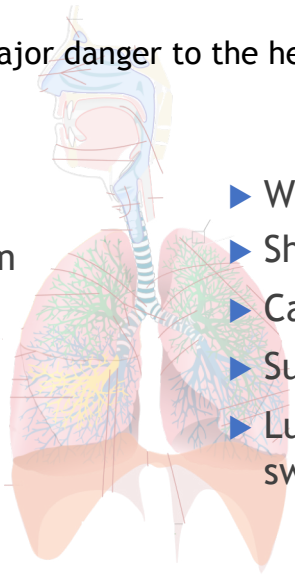
Particle Pollution

Air pollution remains a major danger to the health of both child and adults

Contributes to:

- Premature Death
- Developmental harm
- Reproductive harm
- Asthma attack
- Lung Cancer
- Wheezing and coughing
- Shortness of breath
- Cardiovascular harm
- Susceptibility to infections
- Lung tissue redness, & swelling



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Opacity Test
Regulations, Requirements, and Standards

Cargo Handling Equipment

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Cargo Handling Equipment (CHE) Regulations

- Implementation of CHE Regulation began Jan. 1, 2007
- Regulation applies to:
  - Mobile equipment with compression-ignition engines
  - Used at ports & intermodal rail yards
- Applies to new and in-use engines
- Annual reporting and recordkeeping requirements

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Non-Yard Truck Equipment

- Top picks, side picks, rubber-tired gantry cranes, forklifts, manlifts, pickup trucks, etc.
- Used to load, unload, stack, and store cargo containers, maintenance and repair activities

- Dozers, loaders, excavators, etc.
- Used to handle bulk and dry cargo

Examples of Yard Trucks

Source: Exit2DOS2000
https://commons.wikimedia.org/w/index.php?curid=7265374

Source: © Superbass / CC-BY-SA-4.0
https://commons.wikimedia.org/wiki/File:2016-07-29-Terminal_tractor-6213.jpg

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CHE Regulation & Opacity Testing

- Opacity testing included as part of 2011 amendments
- U.S. EPA authorized enforcement of 2011 amendments to CHE regulation in 2015
- Requires opacity testing similar to the **SAE J1667** procedure used for HDVIP
- Enforcement began October 26 2015
  - Compliance phase-in at 100% since July, 2016
- Regulation requires that all testers must be **CCDET certified**

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Opacity Monitoring Requirements

- New CHE exempt for first four (4) years
  - Example: MY 2015 engine exempt until Jan. 1, 2019
- If not feasible due to engine configuration, end-user must use alternative methods of compliance:
  - Must be approved by ARB
  - Must demonstrate opacity test not feasible
  - Must detect increased soot
  - Pre-approved alternate procedure for RTG cranes
- Testing required on 100% of fleet since July 27, 2016

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Certification Renewal

- CARB recommends all individuals performing opacity testing on CHE take the CCDET course every four (4) years
- Certification must be current to be listed on the ARB website

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A Quick Review of the SAE J1667 Snap-Acceleration Procedures

Smoke-testing Diesel Vehicles (with notes on CHE)

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Snap Acceleration Test: Preparation & Safety

- Wear appropriate **personal safety equipment**
  - Gloves, goggles, and ear protection to protect against hot exhaust, heated exhaust elbows etc., and loud engines
- Wheels chocked and brakes released
- Transmission in **neutral**
- Vehicle A/C off, engine brake off
- Any **devices that affect normal acceleration** must be **turned off**
- Verify proper governor speed limiting and engine soundness
- Check for exhaust leaks and exhaust smoke color

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Snap Acceleration Test: Equipment Setup

- Altitude above 1500 feet reading correction
- Air **temperature** above or below 36 to 86 degrees F.
- Excessively **windy conditions should be avoided**
- **Dry air density** may affect the exhaust smoke opacity
- Humidity no visible fog, rain, or snow in the area were the smoke plume is measured
- Opacity meter type may adjust readings or may not
- Choose your type of meter depending on, cost, test location, and ambient conditions encountered

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Snap Acceleration Test: Overview

- Follow Owners Manual regarding installing the meter
- Readings are in % of opacity
- Standard depend on horsepower rating of the engine
- Readings taken from stack with visually highest opacity

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Snap Acceleration Test: Performing the Test

- Engine should be at normal operating temperature
  - Operate for at least 15 minutes

1. Perform the Snap:
   a. Driver depresses throttle to full open as rapidly as possible
   b. When engine reaches max RPM, hold throttle at max governed speed for 1 to 4 seconds, and then release the throttle
2. Let engine reach low idle RPM, wait 5-45 secs. (target 8-10 secs)
3. Repeat six times (3 cleanout/purge snaps; 3 test snaps)
   - Test snaps must be completed within 2 minutes of the purge snaps

Note: At the beginning of each snap, the tester indicates a new snap in the test meter according the the Owners Manual the opacity meter being used.

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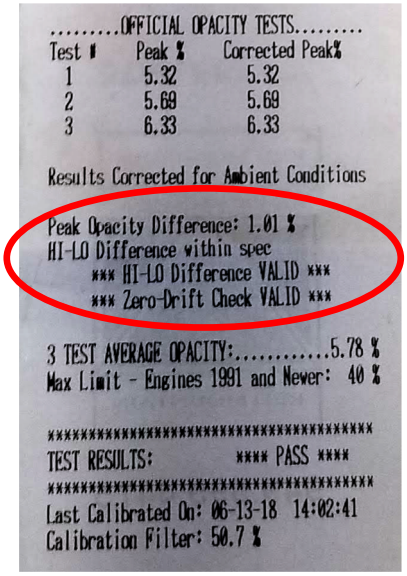
Snap Acceleration Test: Are the Test Results Valid?

Test Validity Check:

- Post-test smoke meter zero shift check - Not to exceed 2% opacity
- The differences between test snaps must not exceed 5% opacity



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Snap Acceleration Test: Are the Test Results Valid?

Conditions that will invalidate an opacity test:

- Engine not at **operating temperature**
- Improper or **inconsistent** application of the vehicle **throttle**
- Improper **smoke meter installation** on the tail pipe
- **Post-zero shift check** exceeds 2% opacity
  - Possible cause, soot accumulation on the lens/optics of the smoke meter head

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Sample Results

Test #86

Test Date: 06-30-18	Test Time: 09:42:08
Year	2000
Make	Cummins
HP	685
Stack Direction	Side
Exhaust Retrofit	Yes
Retro PM Level	4
Ambient Temp	71.3F
Baro. Press.	29.88 inHg
Rel. Humidity	48.5%

Visual Inspection ..... OK

Preliminary Cleanout Snaps

Test #	Peak %
1	3.92
2	3.17
3	3.21

..... Official Opacity Tests .....

Test #	Peak %	Corrected Peak %
1	5.32	5.32
2	5.69	5.69
3	6.33	6.33

Peak Opacity Difference: 1.01%

HI-LO Difference within spec

*** HI-LO Difference VALID ***

*** Zero-Drift Check VALID ***

Test Average Opacity: 5.78%

Max Limit Engines 1991 & Newer: 40%

****

TEST RESULTS *** PASS ***

****

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Calculating Final Opacity Value per CHE Regulation

CHE Regulation:

- Average the nearest two of the three test readings

Example: Snaps of 3%, 4%, and 6.5%	
CHE Result: (Average of 3% and 4%)	3.5%
PSIP / HDVP Result: (Average 3%, 4%, & 6.5%)	4.5%

J1667 Method:

- Average final three
- Average maximum 0.5-second peak opacities
- Total span no greater than 5% opacity

Calculating the average: Add to two nearest test readings together. Divide the result by 2

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CHE Opacity Limits Table

PM Standard or Emissions Limit g/kw-hr	g/bhp-hr	Maximum Opacity Limit
> 0.54 or uncertified	Greater than 0.40	55%
0.42 to 0.54	0.31 to 0.40	45%
0.28 to 0.40	0.21 to 0.30	35%
0.15 to 0.27	0.11 to 0.20	25%
0.07 to 0.13	0.05 to 0.10	15%
Less than 0.07	Less than 0.05	5%

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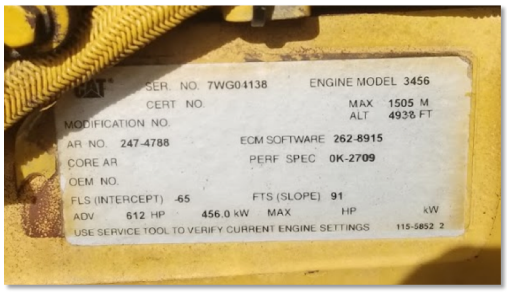
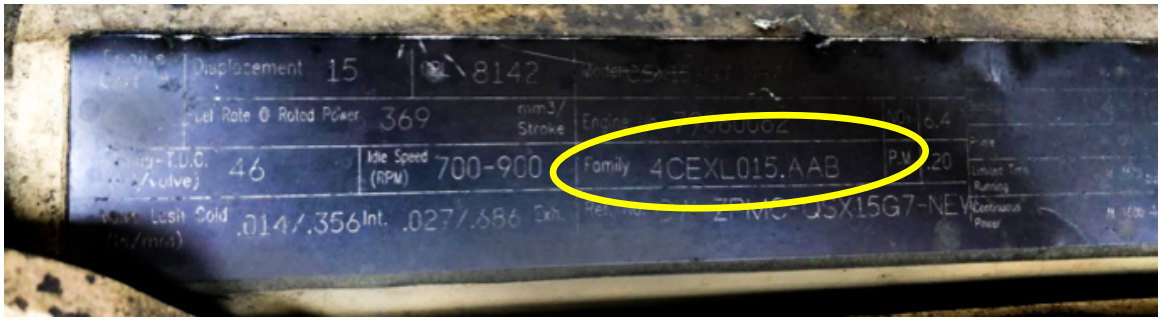
Opacity Limits

- Opacity limit is a function of the engine's PM Certification Standard
- The ARB Executive Order (EO) lists both the PM certification level and the certification standard
- The certification standard (STD) is the emissions standard/limit, and is used to determine the opacity limit per the mobile CHE regulation



Opacity Limits: Finding Limits Demonstration

- The EO for all engines can be found on the ARB web site: http://www.arb.ca.gov/msprog/offroad/cert/cert.php



Shown here: Cummins Engine on a RTG Crane

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Snap Acceleration Test: Smoke Meter Selection

- As of this writing, only the *Wager 7500 Smoke Meter* performs CHE calculation automatically
- All other opacity meters average all three test values; so the calculation for CHE equipment will need to be performed manually.

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Snap-Acceleration Fail Procedures

Opacity-testing Diesel Vehicles

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Opacity Is Above the Limit - Now What?

- Take engine out of service and perform required repair or maintenance
- Repeat opacity test after repair/maintenance
- Post-repair/maintenance opacity must be no more than five percentage points higher than the listed opacity limit
  - Example: Opacity limit of 10% would be 15% post repair; 20% would be 25%
- Equipment must remain out of service until measured opacity is no more than five percentage points above opacity limit

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Examples of Initial and Post-Repair Opacity Tests

Opacity Limit	Initial Result	Action Needed	Retest Result	Retest Pass or Fail?
45%	49% - Fail	Reparative maintenance	47%	**Pass**, within 5% of post-repair limit (50%)
45%	48% - Fail	Reparative maintenance	35%	**Pass**, below opacity limit (45%)
35%	13% - Pass	None	N/A	**No retest required**
45%	54% - Fail	Reparative maintenance	52%	**Fail**, must stay out of service until retested at an opacity below 50%

Note: Opacity testing to be repeated each year regardless of the results of the previous year's test.

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Record Keeping Requirements

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2479(i)(1)(D) Record Keeping Requirements

Vehicle owner requirements, record the following Information:

(D) Records of opacity testing results

1. Brand name and model of the opacity meter
2. Dates of last calibration of the opacity meter and chart recorder
3. Name of the smoke meter operator who conducted the test
4. Name and address of the contracted smoke test facility or vehicle repair facility that conducted the test (if applicable)
5. Applicability of smoke opacity standard for the tested vehicle
6. Vehicle identification number, vehicle's engine model, engine make, engine model year, and test date
7. Initial smoke test opacity levels (for three successive test readings)

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2479(i)(1)(D) Record Keeping Requirements

(i) Recordkeeping Requirements

(D) Records of opacity testing results

1. Brand name and model of the opacity meter
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6. Vehicle identification number, vehicle's engine model, engine make, engine model year, and test date

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2479(i)(1)(D) Record Keeping Requirements

7. Initial smoke test opacity levels (for three successive test readings)
8. Indication of whether the vehicle passed or failed the initial smoke test
9. For vehicles that failed the smoke test and that were repaired, the following information:
   a. Name of the mechanic
   b. Date of the repair
   c. A statement identifying the nature of the repairs made
   d. An itemized list of parts used in the repair
   e. Post-repair test date
   f. Post-repair smoke test opacity levels (for three successive test readings)
   g. Indication of whether the vehicle passed or failed the post-repair smoke test

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Considerations for DPF Retrofits

Retrofitted Cargo Handling Equipment

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Where to Place the Opacity Meter

- **CHE with OEM DPF:** is tested at the ***stack or tailpipe*** as normal (for Tier 4 off-road and on-road engines)
- **CHE retrofitted with a DPF:** Smoke-tested ***upstream of the DPF***

Why:

- Retrofitted CHE originally certified without a DPF in place; so subsequent testing is performed under similar conditions
- A DPF greatly reduces but does not eliminate harmful emissions. Upstream testing ensures that the DPF does not mask underlying engine problems

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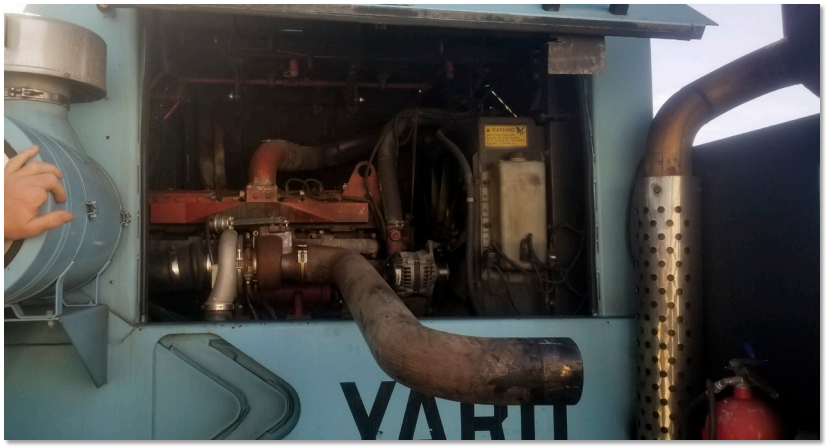
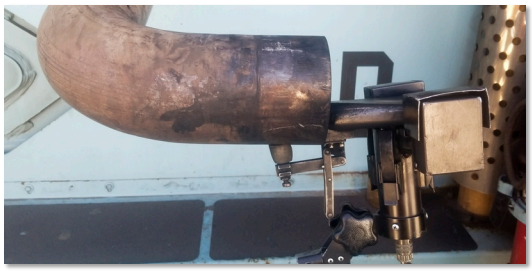
Top Pick with Temporary Attached Elbow



Note: *The elbow pipe, shown above, is attached to enable the opacity test. It is removed at the conclusion of the test, and the equipment is reassembled. CARB does not permit permanent installation of an elbow pipe, bypass line, or other sampling port on CHE that is retrofit with a DPF* 39

Placement of Smoke Test Device

- **Retrofitted engines**
  - Might require modified placement of the opacity testing device to avoid excessive heat
  - May damage or even melt equipment



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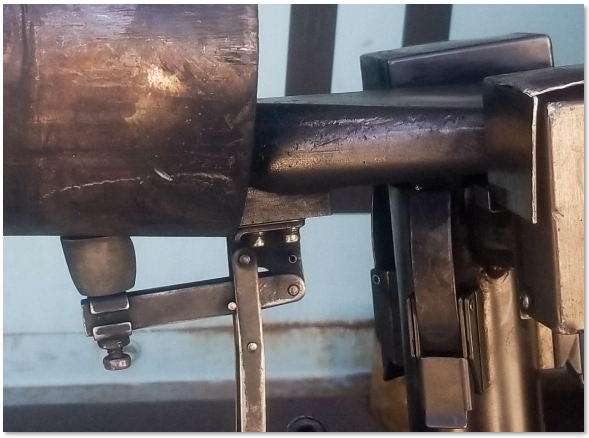
Close-Up: Adjusted Smoke Test Device



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Pre-Approved Alternate Procedure for Smoke-testing RTG Cranes

Approximating the Acceleration Test

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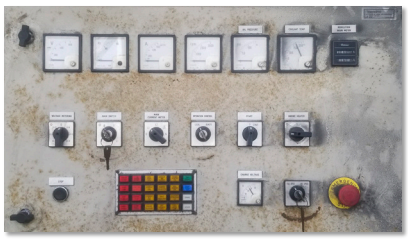
RTG Cranes, DPF, & Controls



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RTG Crane Video

Demo of Opacity-Testing an RTG Crane by Lifting the Hoist Mechanism

Opacity Test Procedure for RTG Cranes

Step	Action
1	Start the diesel engine, and allow it to warm-up to normal operating temperature. • Typically 10 to 15 minutes • Operating the crane often expedites reaching normal temperature
2	Lower the hoist mechanism to a low position.
3	Attach the opacity testing device as required by the SAE J1667 procedure. • **DPF Retrofit:** Attach opacity test equipment upstream of the DPF • **DPF OEM**: Attach opacity test equipment at the stack or exhaust pipe (downstream of DPF)
4	Begin the snap idle test (Press the **Start Button** or whatever is required by your meter).
5	**Perform the snap:** List the hoist mechanism for 1 - 4 seconds at full speed.
6	Stop lifting, and wait 5-45 seconds (target 8 -10 seconds). • Lower the hoist if too high to complete the next snap
7	Repeat steps 5 and 6 for a total of six cycles (3 purge & 3 test).
8	End the snap idle test, and retain the test results for your records.
9	Calculate average using nearest two of the three test readings. Service the engine as required.

ARB Contacts

Cargo Handling Equipment Information

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Written Assessment

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Hands-on with Opacity Meter

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End

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