

COPY

SMITH-EMERY COMPANY

ESTABLISHED 1910

CHEMISTS - ENGINEERS

920 SANTEE STREET

LOS ANGELES, CALIF.

OUR NEW ADDRESS
781 E. WASHINGTON BLVD.
LOS ANGELES 21, CALIFORNIA

Order No. 379371

Date February 18, 1954

Metropolitan Coach Lines,
610 South Main Street,
Los Angeles, 14, California.

S.C.R.T.D. LIBRARY

Att: J. L. Naugh

REPORT

In accordance with instructions we sampled and tested a motor fuel and took samples of the exhaust gases from the engine operating a passenger bus.

On January 29th. 1954, after breaking the seal on a 53 gallon drum of Standard Automotive Diesel Fuel, Sample No. 26612-A-E, Standard Oil Company of California, we obtained a sample of this fuel for analysis and the fuel was run into the empty tank of the test coach. The fuel tank was sealed in our presence and we retained the sealing tool (V58)

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Description of Coach and Engine

Coach Model : GMC TDH5103
 Coach Number : 2797
 Coach I.D. Number : TDH 5103098
 Engine Model : G.M.C. 671 Diesel
 Engine Number : _6a 9915
 Engine Mileage : (per Mr. Hatzler, (Metropolitan)
 Total Mileage Approximately
 119,000 miles
 Re-worked at Approximately
 98,000 miles

DISTILLATION ON FUEL

	<u>Drum "A"</u>		<u>Drum B</u>
Gravity at 60°F. -----	41.8°API		41.8°API
Sulphur (S) -----	0.14%		0.14%
Distillation Test: 200 ml Run twice (from Drum A)			
Initial Boiling Point	348°F.	349°F.	349°F.
5% over at -----	388°F.	389°F.	388°F.
10% over at -----	402°F.	403°F.	402°F.
20% over at -----	416°F.	416°F.	416°F.
30% over at -----	425°F.	426°F.	425°F.
40% over at -----	436°F.	437°F.	436°F.
50% over at -----	447°F.	449°F.	447°F.
60% over at -----	457°F.	459°F.	458°F.
70% over at -----	470°F.	472°F.	471°F.
80% over at -----	484°F.	486°F.	486°F.
90% over at -----	505°F.	508°F.	507°F.
95% over at -----	522°F.	524°F.	523°F.
End Point -----	543°F.	543°F.	545°F.
Recovery -----	98.5%	98.5%	98.5%
Residue -----	1.0%	1.0%	1.0%
Loss -----	0.5%	0.5%	0.5%

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The proposed exhaust sampling procedure and operating conditions were discussed during a conference on January 26, 1954, at the Consolidated Engineering Company.

Present at this meeting were the following:

Mr. Walker	: Consolidated Engineering Company, Manager of Analytical Service
Dr. Martin A. Elliott	: Illinois Institute of Technology & General Motors Corp. Consultant
Dr. D. Lemaux	: G.M.C. Assistant Director of the Truck & Coach Research
Mr. Clifford Dick	: G.M.C. Truck & Coach Regional Sales Manager
Mr. G. H. Wells	: Mechanical Service Supervisor Metropolitan Coach Lines
E.N. Rockwell	: Smith-Emery Company

The sampling technique was specified by Mr. Walker and Dr. Elliott, the operating conditions by Dr. Elliott, Mr. Lemaux and Mr. Dick. Mr. Walker furnished Smith-Emery Company with a list of equipment necessary for the sampling procedure.

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January 29, 1954 Test No. 1 Constant Speed

Engine Speed : Approximately 1300 rpm Direct drive
(27.5 mph)

Engine Temperature : 170°F. - 180°F.

Sampling Period : 15 minutes, Total

Sampling Rate : Approximately 4 liters per minute

Route : Ramona Freeway, from San Gabriel Blvd.,
to Mission Road

Procedure : After a suitable warm-up period, the
engine speed was maintained at
approximately 1300 rpm during the
sampling period. Sample 1 (A, B, C
& D) were taken and delivered to
Consolidated Engineering Company

February 15, 1954 Test No. 1 Constant Speed - Repeat

Engine Speed : Approximately 1400 rpm, in direct
drive (27.28 mph)

Engine Temperature : 170°F - 180°F.

Route : On Ramona Freeway from City Terrace
Drive to Atlantic Blvd., and return
to City Terrace Drive.

Sampling Period : 15 Minutes, Total

Sampling Rate : Approximately 4 liters per minute

Procedure : After a suitable warm-up period the
Engine speed was maintained at approx:
imately 1450 rpm during the
sampling period. Sample 1 (C₁ D₁)
and C₂ D₂ were taken and delivered
to Consolidated Engineering Co.,

Test No. 1 constant speed was repeated as per instructions

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January 29, 1954

Test No. 2 Idling

Engine Speed : 450 - 500 rpm (idle setting)
Engine Temperature : 160° - 180°F.
Sampling Period : 15 minutes, total
Sampling Rate : Less than 2 liters per minute
Location : Approximately level site at
Metropolitan's Macy Street Yard.
Procedure : Engine was idled for one minute
and then was accelerated to
900 rpm for one-half minute. This
cycle was repeated 15 times,
sampling was done during the
idling interval. Sample 2 (A, B, C & D
was taken and delivered to

Consolidated Engineering Company

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February 3rd. 1954

Test No. 3

Acceleration

Engine Speed : From idle to approximately 2000 rpm
(24 mph) in hydraulic drive

Engine Temperature : 170°F - 180°F.

Sampling Period : 15 minutes, total

Sampling Rate : Varied from 1 to 6 liters per minute

Route : On Garvey Blvd., from Alhambra Avenue
to Peck Road and return to San Gabriel Blvd

Procedure : After a suitable warm-up period the
vehicle was accelerated from a standing
stop to the shift point from hydraulic
to direct drive at approximately 2000 rpm.
The coach was operated according to
Metropolitan's notice to drivers No. G 159
This cycle was repeated 57 times to
obtain a total sample time of 15 minutes.
Samples 3 (A, B, C & D) were taken and
delivered to Consolidated Engineering Co.,

Test No. 4 Deceleration

Engine Speed : From approximately 1900 rpm to
approximately 850 rpm (40 - 17 mph)
in direct drive

Engine Temperature : 170°F. 180°F.

Sampling Period : 15 minutes, total

Sampling Rate : Varied from 2 to 6 liters per minute

Route : On Ramona Freeway, from San Gabriel Blvd.
to Mission Road and return to San Gabriel
Blvd.

Procedure : The vehicle was allowed to decelerate from
approximately 1900 rpm, without braking to
the point where the down shift to
hydraulic drive occurs. This cycle was
repeated 16 times to obtain a total
sampling time of 15 minutes. Samples 4
(A, B, C & D) were taken and delivered to
Consolidated Engineering Co.

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February 6, 1954 Test No. 4 Deceleration Repeat

This test was performed to replace Samples 4-A and 4-B, which were contaminated with hydrogen, due to sulphuric acid backing up into the sample container during

Test No. 4, February 3rd, 1954.

Route : On Ramona Freeway, from Mission Road. to San Gabriel Blvd. and return to Mission Road.

Sampling Period : 15 minutes, Total, 20 cycles

All other conditions were the same as Test No. 4 February 3rd, 1954

The following is a record of the samples obtained and the date they were delivered to Consolidated Engineering Company, Pasadena, California.

<u>Test Number</u>	<u>1</u>	<u>1-Repeat</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>4-Repeat</u>
<u>Date -----</u>	1-29	2-15	1-29	2-3	2-3	2-6-54
Raw Exhaust gas -----	1-A		2-A	3-A-	4-A	4-A1
Washed Exhaust Gas ---	1-B		2-B	3-B	4-B	4-B1
Solid Carbon Dioxide Condensate -	1-C	1-C ₁ 1-C ₂	2-C	3-C	4-C	
Liquid Nitrogen Condensate -	1-D	1-D ₁ 1-D ₂	2-D	3-D	4-D	

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Description of Exhaust Sampling Apparatus

A copper tube was tapped into the exhaust manifold of the test coach between the exhaust ports and the muffler. The copper tubing was wrapped with asbestos to prevent condensation and terminated in a fitting from which connections were made to each of two sampling lines, with copper tubing.

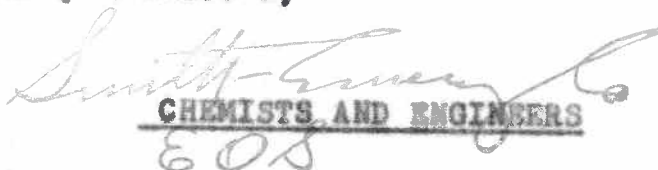
Each sampling train was controlled with separate valves and all connections were made with Tygon tubing.

The Gas Sampling Train (Line #1) consisted of the following: a stainless steel double valve high pressure cylinder, 300 ml (new exhaust gas, Sample A) a Fleming bulb trap, a Drechsel gas washing bottle, containing 20% sulphuric Acid; a Fisher contact pipette, containing 20% sulphuric acid; a Fleming bulb trap, and a glass gas collecting tube, 250 ml. (washed exhaust gas - Sample B)

The Hydrocarbon Freeze-Out Train (line #2) Consisted of the following: a calibrated flowmeter, a Fleming bulb trap, a precooling trap immersed in ice water, a trap immersed in solid carbon dioxide (CO₂) and acetone (solid carbon dioxide condensate - Sample C) a trap immersed in liquid nitrogen (liquid Nitrogen Condensate - Sample D). The freeze-out traps used were either liquid air traps or Shepherd traps.

The attached photograph shows the gas sampling train at the bottom and the hydrocarbon Freeze-Out Train at the top.

Respectfully submitted,


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Date February 20, 1954

Metropolitan Coach Line,
610 South Main Street,
Los Angeles, 14, California.

Att: J. L. Haugh

SUPPLEMENTARY REPORT

The following chart shows the a time(*) that the samples of condensates taken from your bus were obtained and the time they were delivered to Consolidated Engineering Company

<u>Test Number</u>	<u>Sample</u>	<u>Time of Sampling</u>	<u>Time Delivered to Consolidated Engineering Co.</u>	<u>Date</u>
#1	A, B, C, D	2:30 PM	5:00 PM	1-29-54
#1 Repeat	G ₁ C ₂ D ₁ D ₂	12:30 PM	1:30 PM	2-15-54
#2	A, B, C, D,	4:00 PM	5:00 PM	1-29-54
#3	A, B, C, D,	2:30 PM	4:00 PM	2-3-54
#4	A. B. C. D.	3:30 PM	4:00 PM	2-3-54
#4 Repeat	A ₁ B ₁	10:30 AM	11:30 AM	2-6-54

*Plus or minus 15 minutes.

Respectfully submitted,

Smith-Emery
CHEMISTS AND ENGINEERS

