VAPOR RETURN PATH HYDROCARBON CONCENTRATIONS IN VACUUM ASSIST VAPOR RECOVERY SYSTEMS DISPENSING GASOLINE TO ONBOARD REFUELING VAPOR RECOVERY (ORVR) EQUIPPED VEHICLES

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1. SUMMARY

Air Resources Board personnel performed tests in June and July, 1997 to determine hydrocarbon concentrations in the vapor return path of vacuum assist Phase II vapor recovery systems while dispensing fuel to Onboard Refueling Vapor Recovery (ORVR) systems. The testing was performed in response to concerns that air ingested to the vapor recovery system while dispensing to ORVR systems may produce flammable mixtures of air and gasoline vapor in the vapor recovery system. Hydrocarbon concentrations were measured at two locations in the vapor return path: the union of the dispensing nozzle with the coaxial vapor recovery hose and the intersection of the dispenser vapor return line with the underground vapor return line.

Vapor path hydrocarbon testing was performed at five Sacramento area service stations and represented three independent methods of transporting gasoline vapor from the vehicle fill pipe to the underground storage tank 1) a variable speed, dispenser mounted, vapor pump; 2) a product driven jet pump located at one of the underground tanks and 3) an assembly consisting of a blower and a thermal vapor processor located at the underground tank vapor vent riser. Three primary test modes were examined: high clip dispensing, low clip dispensing and high clip dispensing alternating between ORVR and conventional fuel systems.

A total of nine liquid seal ORVR systems and ten vapor recovery nozzles were available for testing. Mechanical seal ORVR systems were unavailable for evaluation. Mechanical seal ORVR systems expose the vehicle fuel tank headspace vapor to the nozzle vapor return path. Conversely, liquid seal systems rely on dispensed fuel to force vehicle headspace vapors through the ORVR system, exposing the nozzle vapor return path to ambient air. Since the two systems use different physical principles to achieve an ORVR seal, vapor path hydrocarbon concentrations measured for liquid seal systems cannot be extrapolated to predict the behavior of mechanical seal systems.

The vapor recovery systems, nozzles and ORVR systems that participated in vapor return hydrocarbon concentration testing are identified in Summary Table S-1 and Summary Table S-2. With the exception of the Husky 6250 nozzle with the Gilbarco vapor recovery system, only nozzles certified for use with the respective vapor recovery systems were evaluated.

Test results for consecutive ORVR refuelings are summarized in Summary Table S-3. Summary Table S-4 summarizes results for alternating conventional and ORVR dispensing. Each table shows the system combinations tested and the average percent of elapsed dispensing time in which the hydrocarbon vapor concentration at the nozzle exit remained in the flammable range. For the purpose of this report, the flammable range for a mixture of hydrocarbon vapor in air is defined as 2% to 8% total hydrocarbon vapor concentration.

Inspection of Summary Table S-3 shows the nozzle exit hydrocarbon vapor concentration enters the flammable range at some point during dispensing for every combination of ORVR system, vapor recovery system and nozzle tested with three exceptions. Table S-3 also shows no identifiable relation between the amount of dispensing time in the flammable range and the various combinations of ORVR and vapor recovery systems tested. However, the data shown in Table S-3 is the average of the high and low clip

refueling modes.

Inspection of Summary Table S-4 shows the nozzle exit hydrocarbon concentration enters the flammable range during approximately 4 out of every 5 dispensing events. Of the twenty-one tests in which the hydrocarbon concentration did not enter the flammable range, twenty were distributed among three ORVR systems. All three systems (Honda, GM-Green and Nissan) utilized vapor recirculation. However, the nozzle exit vapor concentration at the start of each alternating refueling test was not constant throughout testing. It is uncertain how nonuniform conditions at the start of each test may have affected the test results.

SUMMARY TABLE S-1: PARTICIPATING VAPOR RECOVERY SYSTEMS AND NOZZLES	
VAPOR RECOVERY SYSTEM	**NOZZLES TESTED**
Wayne Vac	EW A4505, Husky 6250, OPW 11VAI-69
Hasstech VacuRite	EW A4500, Husky V34, OPW 11VAI-29
Gilbarco Vapor Vac	EW 4500, Husky V3 & 6250*, OPW 11VAI-27
Catlow Vapor Mate	Catlow ICVN
Healy 600	Healy 600

* Husky 6250 not currently certified for use with Gilbarco Vapor Vac system.

SUMMARY TABLE S-2: PARTICIPATING ORVR SYSTEMS AND CONFIGURATIONS
Chrysler #1 (cut body, liquid seal, orifice*, no vapor recirculation)
Chrysler #2 (cut body, liquid seal, orifice*, no vapor recirculation)
Nissan (cut body, liquid seal, orifice*)
Toyota (cut body, liquid seal, canister)
Ford (stick car, liquid seal, canister, vapor recirculation)
GM-Black (stick car, liquid seal, canister, vapor recirculation)
GM-Green (stick car, liquid seal, canister, vapor recirculation)
GM-White (stick car, liquid seal, canister, no vapor recirculation)
Honda (stick car, liquid seal, canister, vapor recirculation)

* Orifice simulating canister pressure drop used in place of canister.

SUMMARY TABLE S-3

AVERAGE PERCENT OF DISPENSING TIME VAPOR PATH HYDROCARBON CONCENTRATION@ IN FLAMMABLE RANGE CONSECUTIVE ORVR REFUELINGS

	WAYNE			HASSTECH			GILBARCO				CATLOW	HEALY	
ORVR SYSTEM	OPW 11-69	HUS 6250	EW 4505	OPW 11-29	EW 4500	HUS V34	HUS V3	EW 4500	OPW 11-27	HUS 6250*	ICVN	600	AVG
CHRY WHT	NT	NT	25%	100%	100%	100%	96%	93%	61%	36%	100%	100%	**81%**
CHRY GRN	NT	NT	100%	100%	56%	100%	59%	97%	55%	50%	61%	16%	**68%**
FORD	NT	NT	100%	100%	100%	100%	89%	98%	92%	20%	100%	100%	**90%**
GM BLACK	NT	NT	NT	100%	100%	100%	80%	70%	100%	17%	90%	100%	**84%**
GM GRN	0%	100%	0%	100%	54%	100%	2%	9%	18%	50%	50%	74%	**46%**
GM WHITE	14%	26%	35%	6%	6%	4%	20%	46%	28%	14%	15%	26%	**20%**
HONDA	NT	NT	8%	0%	42%	98%	18%	17%	5%	26%	6%	53%	**27%**
NISSAN	NT	NT	7%	100%	96%	100%	12%	6%	31%	8%	57%	44%	**46%**
TOYOTA	NT	NT	73%	100%	50%	97%	43%	100%	97%	3%	40%	100%	**70%**
AVERAGE	NC	NC	**44%**	**78%**	**67%**	**70%**	**47%**	**60%**	**54%**	**25%**	**58%**	**68%**	

@ = Hydrocarbon concentration measured at union of dispensing nozzle and coaxial vapor recovery hose.
NT = Not tested.
NC = Not calculated.
AVG = Average.
* = Husky 6250 nozzle not currently certified for use with Gilbarco Vapor Vac system.

SUMMARY TABLE S-4

PERCENT OF DISPENSING TIME VAPOR PATH HYDROCARBON CONCENTRATION@ IN FLAMMABLE RANGE ALTERNATING ORVR AND CONVENTIONAL DISPENSING

	WAYNE			HASSTECH			GILBARCO				CATLOW	HEALY	
ORVR SYSTEM	OPW 11-69	HUS 6250	EW 4505	OPW 11-29	EW 4500	HUS V34	HUS V3	EW 4500	OPW 11-27	HUS 6250*	ICVN	600	AVG
CHRY WHT	NT	NT	82%	61%	94%	92%	61%	84%	84%	31%	21%	74%	**68%**
CHRY GRN	NT	NT	84%	93%	34%	91%	76%	69%	80%	26%	82%	25%	**68%**
FORD	NT	NT	72%	91%	94%	90%	96%	73%	71%	40%	100%	84%	**81%**
GM BLACK	NT	NT	NT	86%	96%	89%	20%	67%	71%	38%	70%	26%	**63%**
GM GRN	0%	72%	0%	91%	40%	91%	0%	0%	0%	28%	46%	0%	**31%**
GM WHITE	44%	20%	21%	10%	8%	12%	79%	60%	94%	31%	44%	25%	**37%**
HONDA	NT	NT	0%	0%	35%	0%	0%	0%	0%	29%	0%	0%	**6%**
NISSAN	NT	NT	0%	84%	84%	83%	0%	0%	0%	74%	0%	0%	**33%**
TOYOTA	NT	NT	46%	90%	100%	88%	0%	76%	75%	35%	85%	78%	**67%**
AVERAGE	NC	NC	**38%**	**67%**	**65%**	**61%**	**37%**	**48%**	**53%**	**37%**	**50%**	**35%**	

@ = Hydrocarbon concentration measured at union of dispensing nozzle and coaxial vapor recovery hose.
NT = Not tested.
NC = Not calculated.
AVG = Average.
* = Husky 6250 nozzle not currently certified for use with Gilbarco Vapor Vac system.

2. INTRODUCTION

Personnel from the Air Resources Board Compliance Division (CD) and Monitoring and Laboratory Division (MLD) performed field testing to determine vapor path hydrocarbon concentrations in selected vacuum assist vapor recovery systems when refueling liquid seal ORVR systems at high clip and low clip dispensing rates. Phase II vapor recovery systems are installed at California service stations to control vehicle refueling emissions. Preliminary testing by ARB staff in November 1995 and March 1996 has shown refueling ORVR vehicles with vacuum assist systems introduces ambient air into the vapor return line. Depending on the combination of vapor recovery and ORVR system, the vapor return line hydrocarbon concentration can enter the flammable range (approximately 2% to 8%) for an air / hydrocarbon vapor mixture. In addition, the equilibrium driven volume increase of the lean hydrocarbon mixture during repeated ORVR dispensing can result in increased fugitive emissions or increased emissions from the underground storage tank vent riser, especially in systems not equipped with a vapor processor.

The tests were performed using nine liquid seal ORVR systems at five vacuum assist service stations in the Sacramento area during the weeks of June 23, 1997 and July 14, 1997. Fuel was delivered to ORVR systems at each test location with the nozzles certified for use with each system. A total of twelve vacuum assist nozzles were evaluated.

3. TEST SYSTEMS

Vapor path hydrocarbon testing was performed on nine liquid seal ORVR systems at five vacuum assist vapor recovery systems (Wayne, Hasstech, Gilbarco, Catlow and Healy) using twelve different nozzles. The vacuum assist vapor recovery systems and their locations, features, test nozzles and test dates are identified in Table 3-1. The participating ORVR systems and their configurations are identified in Table 3-2.

4. SAMPLING LOCATIONS

Hydrocarbon vapor concentration, temperature, volumetric flow rate and gauge pressure were determined at the intersection of the dispenser and underground vapor return lines according to procedures contained in ARB TP-201.2 - "*Determination of Efficiency of Phase II Vapor Recovery Systems of Dispensing Facilities.*" In addition, hydrocarbon concentration was also determined at the nozzle / coaxial hose interface by inserting a fitting between the nozzle and hose allowing a recirculating vapor sample to a NDIR analyzer, as shown in Figure 4-1. The sampling locations and parameters determined are shown in Figure 4-2. Instrumentation used to collect test data are identified in Table 4-1. Test parameters were recorded by a data acquisition system and strip charts.

FIGURE 4-1

Nozzle Exit Hydrocarbon Sampling Fitting

FIGURE 4-2
Test Locations

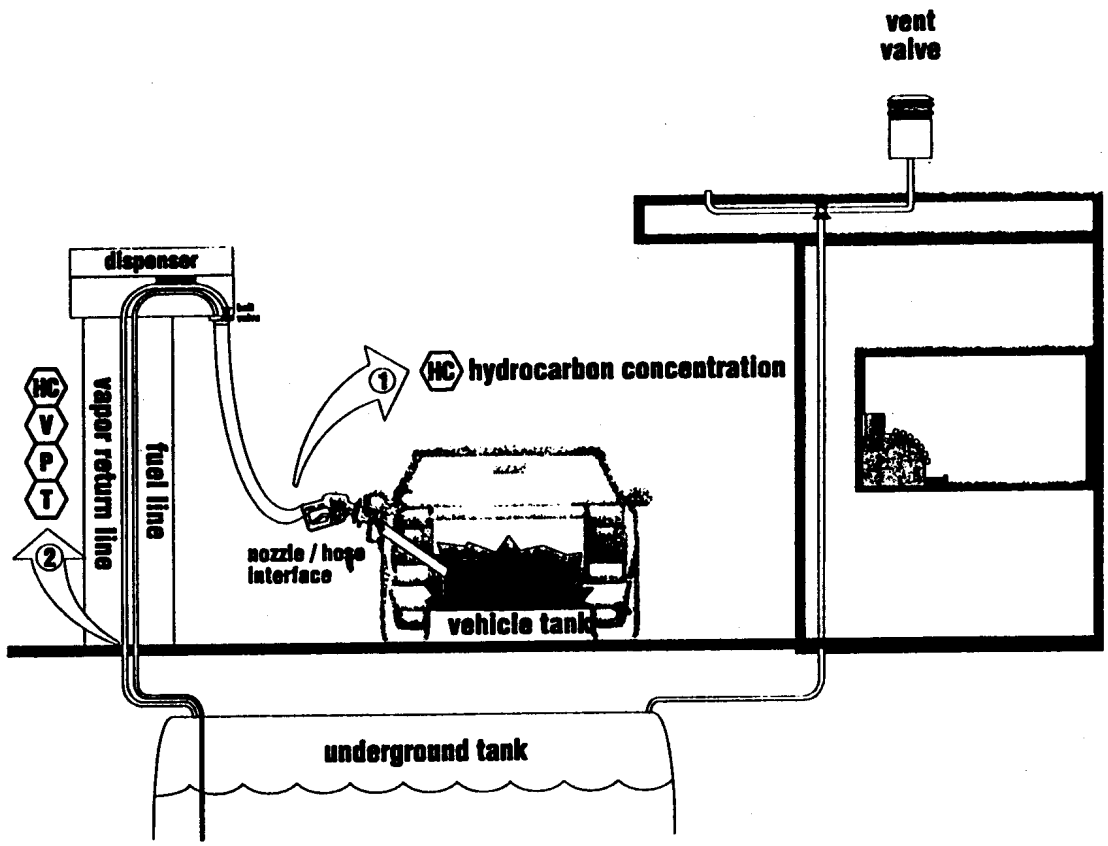


TABLE 3-1: VAPOR RECOVERY SYSTEMS, NOZZLES AND TEST DATES			
SYSTEM & DATE TESTED	**LOCATION**	**SYSTEM FEATURES**	**NOZZLES TESTED**
Wayne Vac (6/23, 24/97)	Chevron, 4221 Raley Blvd., Sacramento	Dispenser Vapor Pump (Variable Speed) Nozzle Vapor Valve	EW A4505, Husky 6250, OPW 11VAI-69
Hasstech VacuRite (6/25, 26/97)	ARCO, 9300 Chantree Hill Rd., Newcastle	Central Vapor Pump Thermal Processor Nozzle Vapor Valve	EW A4500, Husky V34, OPW 11VAI-29
Gilbarco Vapor Vac (7/14, 15/97)	Shell, 1599 W. El Camino, Sacramento	Dispenser Vapor Pump (Variable Speed) Dispenser Vapor Valve	EW 4500, Husky V3 & 6250, OPW 11VAI-27
Catlow Vapor Mate (7/17/97)	ARCO, Reed & Riverpoint, West Sacramento	Dispenser Vapor Pump Dispenser Vapor Valve	Catlow ICVN
Healy 600(7/18/97)	Exxon, 1401 W. Capitol Ave., West Sacramento	Central Jet Pump Nozzle Vapor Valve	Healy 600

TABLE 3-2: ORVR SYSTEM CONFIGURATIONS
Chrysler #1 (cut body, liquid seal, orifice, no vapor recirculation)
Chrysler #2 (cut body, liquid seal, orifice, no vapor recirculation)
Nissan (cut body, liquid seal, orifice)
Toyota (cut body, liquid seal, canister)
Ford (stick car, liquid seal, canister, vapor recirculation)
GM-Black (stick car, liquid seal, canister, vapor recirculation)
GM-Green (stick car, liquid seal, canister, vapor recirculation)
GM-White (stick car, liquid seal, canister, no vapor recirculation)
Honda (stick car, liquid seal, canister, vapor recirculation)

TABLE 4-1: TEST INSTRUMENTATION

PARAMETER	INSTRUMENT	UNITS
HC - underground line	NDIR	0 - 100% as propane
HC - hose/nozzle interface	NDIR	0 - 100% as propane
volume	positive displacement meter	cubic feet
gauge pressure	transducer	0 - 100 inches H_2O
temperature	thermocouple	0 -200 degrees Fahrenheit

NDIR = Non-dispersive infrared.

4.1 Pretest Determinations

Prior to testing at each facility, the test dispenser air to liquid (A/L) ratio was determined to establish representative dispensing within the A/L range certified for the vapor recovery system. Pretest air to liquid ratios were determined at the high clip dispensing rate according to TP-201.5 using an OPW nozzle at the Wayne, Hasstech and Gilbarco locations, while Catlow ICVN and Healy 600 nozzles were used at the Catlow and Healy locations, respectively. Only these nozzles were used for A/L determinations because the nozzle spout vapor port locations matched the available A/L fitting.

5. TEST DISPENSING MODES

The original test protocol included three test modes for dispensing fuel to participating liquid seal ORVR systems: high clip dispensing, low clip dispensing and slow fill dispensing for the last $1 of the high clip mode. However, the test plan was modified to replace slow fill dispensing with a high clip dispensing mode which alternated between conventional fuel system refueling and ORVR system refueling (high clip alternating). The high clip alternating mode was included to simulate the interaction of vacuum assist systems with a mixed fleet of ORVR and conventional vehicles.

5.1 High Clip Dispensing

One trial was performed in the high clip dispensing mode for each ORVR system, nozzle and Phase II vapor recovery system combination tested using the following procedure:

a) If the vehicle was equipped with a canister, it was disconnected from the tank and purged with ambient air for 20-30 minutes. Some ORVR systems were equipped with an orifice in place of a canister and do not require purging.

b) Drain fuel from the tank according to the manufacturer's procedure.

c) If applicable, connect the purged canister to the vehicle fuel tank.

d) Prefill the tank to 10% of its usable capacity (first test only).

e) If first dispensing event of day, wait at least 15 minutes. (This duration allows the vapor/air mixture in the ullage space to reach the equilibrium which occurs in normally driven vehicles.)

f) Insert the nozzle spout fully into the fillneck or lower the spout into the fillneck until the nozzle latch ring engages in the nozzle retaining position of the fillneck opening. The fillneck for an ORVR system is designed to be compatible with a dispenser nozzle which conforms with SAE J285 SEP.'92. The plane of the nozzle handle shall be as close to vertical as possible and in all cases form an angle which is less than or equal to 50 degrees from vertical.

g) Activate the dispenser and dispense fuel in the "hands off" mode by latching nozzle at maximum flow rate. The tester then removes his hands from the nozzle. Determine the dispensing rate with a stop watch as described in Section 4.6.

h) Connect the underground storage tank vapor return line to the fillpipe opening and drain fuel from the tank according to the manufacturer's procedure.

5.2 Low Clip Dispensing

One trial was performed in the low clip dispensing mode for each ORVR system, nozzle, and vacuum assist vapor recovery system combination by repeating Sections 5.1.a through 5.1.h, with the nozzle latched in the low clip dispensing position.

5.3 High Clip Alternating Dispensing

One high clip alternating trial was performed for each combination of ORVR system, vacuum assist vapor recovery system and nozzle. This test was performed as described in Section 5.1, except approximately six to eight gallons of gas were dispensed to an A/L testing tank prior to refueling the ORVR system. This was done to return vapor path hydrocarbon concentration to a level representative of conventional vehicle refueling.

6. TEST RESULTS

This section presents, in chronological order, vapor path hydrocarbon concentrations determined at the nozzle exit and dispenser for two different vehicle matrixes. The first consisting solely of ORVR fuel systems, the second simulated alternating between ORVR and conventional fuel systems. Conventional fuel system simulation for the alternating test mode was achieved by dispensing 6 - 8 gallons of gasoline to a 50 gallon A/L proving tank prior to dispensing fuel to the ORVR system.

As stated in the Summary, all tests were performed with liquid seal ORVR systems, no mechanical seal ORVR systems were evaluated due to availability. Mechanical seal ORVR systems expose the vehicle fuel tank headspace vapor to the nozzle vapor return path. Conversely, liquid seal systems rely on dispensed fuel to force vehicle headspace vapors through the ORVR system, exposing the nozzle vapor return path to ambient air. Since the two systems use different physical principles to achieve an ORVR seal, vapor path hydrocarbon concentrations measured for liquid seal systems cannot be extrapolated to predict the behavior of mechanaical seal systems.

All tabular data presented herein is sorted according to refueling mode and system manufacturer. High clip refueling of consecutive ORVR systems is designated "HC". High clip refueling alternating between ORVR and conventional systems is designated "HCA". Low clip refueling modes for consecutive ORVR systems and alternating ORVR with conventional systems are designated "LC" and "LCA", respectively.

Hydrocarbon concentrations presented in the test results are discussed relative to the flammable range. The flammable range for air / hydrocarbon vapor mixtures are all hydrocarbon concentrations between the lower flammable limit (LEL) of 2% total hydrocarbons and the upper flammable limit (UEL) of 8% total hydrocarbons.

6.1 Air to Liquid (A/L) and Vapor to Liquid (V/L) Ratios

Pretest A/L ratios determined for the test dispenser at each test facility are presented in Table 6-1. The pretest A/L results show each vapor recovery system tested operated within the allowable A/L range when measured at the test dispenser.

The V/L ratio determined for each ORVR refueling are presented with the hydrocarbon concentration data for each vapor recovery system in Table 6-2 through 6-13. Upon examination of the V/L data with the tabular and graphical hydrocarbon concentration data, some general trends are noticed:

1. There appears to be an inverse relation between the V/L ratio and the asymptotic hydrocarbon concentration value when refueling ORVR vehicles. For example, the graphical data for the vapor recovery systems with operating V/L ratios of 1.25 and greater (Healy, Hasstech) operate with vapor path hydrocarbon concentrations in or sometimes below the lower flammable range (2% - 5%), while systems with V/L ratios approaching unity tend to operate in or above the upper flammable range (5% - 8%).

2. When performing alternating refueling modes (HCA, LCA) there is also an inverse relation between the V/L ratio and the elapsed dispensing time for vapor path hydrocarbon concentrations to reach both the UEL and asymptotic value. Systems with V/L ratios much greater than one require less dispensing time to reach the UEL and the final vapor path concentration than systems with V/L ratios of one or less.

3. In vapor recovery systems with similar V/L ratios, ORVR systems **without** vapor recirculation require less dispensing time for vapor path hydrocarbon concentrations to reach the UEL and asymptotic value than ORVR systems with vapor recirculation. In addition, the asymptotic hydrocarbon concentration for ORVR systems without recirculation is generally lower than for systems with recirculation.

6.2 WayneVac Vapor Recovery System

Vapor path hydrocarbon concentrations determined for the GM ORVR systems with the OPW 11VAI-69 and Husky 6250 nozzles are presented in Tables 6-2 and 6-3 and Figures 6-1 through 6-4. Examination of the plotted data for the GM Green system shows nozzle exit concentrations remained above the flammable range for OPW nozzle, while spending a majority of time in the flammable range with the Husky 6250. Plotted data for the GM White system shows nozzle exit concentrations traversing through the flammable range for both the OPW and Husky nozzles. No data is presented for other ORVR systems because a lack of satisfactory electrical power forced termination of testing at this facility.

Vapor return hydrocarbon concentrations determined for the Emco Wheaton A4505 nozzle with all ORVR systems (except GM Black, broken fill neck) are presented in

Table 6-4 and Figures 6-5 through 6-12. Examination of the data generally shows nozzle exit concentrations remaining above the flammable range or in the upper flammable range for ORVR systems with vapor recirculation. Nozzle exit concentrations for ORVR systems without vapor recirculation generally spend a majority of time in the lower flammable range.

6.3 Hasstech Vapor Recovery System

Vapor return line hydrocarbon concentrations determined for ORVR systems with the OPW 11VAI-29 nozzle are reported in Table 6-5 and Figures 6-13 through 6-21. Examination of the data shows average nozzle exit concentrations in the flammable range for all ORVR systems except Honda and GM White. The plotted data (Figures 6-13 thru 6-21) shows nozzle exit concentrations remained in the flammable range for all systems except Honda and GM White, regardless of dispensing mode.

Vapor return line hydrocarbon concentrations determined for ORVR systems with the Emco Wheaton A4500 and Husky V34 nozzles are reported in Table 6-6 and Table 6-7, and Figures 6-22 through 6-39. Examination of the plotted data in Figures 6-22 through 6-39 shows nozzle exit concentrations for both nozzles remained in the flammable range for all systems except GM White, regardless of dispensing mode.

6.4 Gilbarco Vapor Recovery System

Vapor return line hydrocarbon concentrations determined for ORVR systems with the Husky V3, Emco Wheaton A4500 and OPW 11VAI-27 nozzles are reported in Table 6-8 through Table 6-10 and Figures 6-40 through 6-66. General examination of the data shows nozzle exit concentrations primarily in the flammable range for ORVR systems without vapor recirculation, while ORVR systems with vapor recirculation maintained nozzle exit concentrations in or slightly above the upper flammable range.

Vapor return line concentrations were also determined for ORVR systems using the Husky 6250 nozzle, although this nozzle is not currently certified for use with the Gilbarco system. Tabular and graphical results for the Husky 6250 are presented in Table 6-11 and Figures 6-67 through 6-75. The results indicate nozzle exit concentrations for all systems reside primarily in the lower flammable range.

6.5 Catlow Vapor Recovery System

Vapor return line hydrocarbon concentrations determined for ORVR systems with the Catlow ICVN nozzle are reported in Table 6-12 and Figures 6-76 through 6-84. General examination of the data shows nozzle exit concentrations exhibiting the same characteristics demonstrated by the Gilbarco and Wayne systems, which also perform at an A/L ratio approaching unity. Thus, nozzle exit concentrations were primarily in the flammable range for ORVR systems without vapor recirculation, while ORVR systems with vapor recirculation maintained nozzle exit concentrations in or slightly above the upper flammable range.

6.6 Healy Vapor Recovery System

Vapor return line hydrocarbon concentrations determined for ORVR systems with the Healy 600 nozzle are presented in Table 6-13 and Figures 6-85 through 6-93. The results show nozzle exit concentrations primarily in the flammable range for all systems except the Honda and Nissan "HCA" and "LC" dispensing modes.

TABLE 6-1 PRETEST A/L DETERMINATIONS			
SYSTEM	**NOZZLE**	**PRETEST A/L**	**ALLOWABLE A/L**
WAYNE	OPW 11VAI-69	0.92* 1.00 1.00 1.00 1.00	**0.90 - 1.10** **Executive Order:**
	AVERAGE	**1.00**	**G-70-153-AB**
HASSTECH	HUSKY V34	1.80* 1.72 1.69 1.71	**1.40 - 2.30** **@ 8 gpm** **Executive Order:**
	AVERAGE	**1.71**	**G-70-164**
GILBARCO	OPW 11VAI-27	1.06 1.05 1.05 1.05	**1.00 - 1.20** **Executive Order:**
	AVERAGE	**1.05**	**G-70-150-AD**
CATLOW	ICVN	0.96* 0.99 0.99 0.99	**0.90 - 1.10** **Executive Order:**
	AVERAGE	**0.99**	
HEALY	600	1.07 1.06 1.07 1.06	**1.00 - 1.20** **Executive Order:**
	AVERAGE	**1.06**	**G-70-165**

* Value excluded from average calculation.

TABLE 6-2

WayneVac Vapor Recovery System w/ OPW 11VAI-69 Nozzle, 6-23-97

				NOZZLE EXIT HYDROCARBON CONCENTRATION - %C3H8											
ORVR		Dispensing		START		MAXIMUM		MINIMUM		FINAL		AVERAGE		V/L@	
SYSTEM	R/N	Mode	Rate*	Noz	Dis	Noz	Dis	Noz	Dis	Noz	Dis	Noz	Dis		%ER
GM Wht	N	HC	7.14	14.4	14.4	14.5	14.4	1.0	3.5	1.0	3.5	3.5	7.3	1.02	13%
GM Wht	N	HCA	7.14	46.0	46.0	47.9	46.6	1.4	11.1	1.4	11.1	11.4	24.8	1.00	41%
GM Wht	N	LC	5.00	23.4	23.4	23.5	23.5	1.0	3.9	1.1	3.9	3.9	9.2	1.26	16%
GM Wht	N	LCA	5.00	49.2	49.2	52.7	50.4	1.5	10.9	1.5	10.9	10.8	25.0	1.00	48%
GM Grn	R	HC	7.14	27.7	27.7	27.7	27.7	9.7	12.1	12.1	10.3	12.1	16.4	1.01	0%
GM Grn	R	HCA	7.14	43.1	43.1	46.4	44.0	10.0	15.5	10.2	15.5	15.4	24.8	1.00	0%
GM Grn	R	LC	5.00	25.5	25.5	25.6	25.5	9.6	11.4	10.1	11.4	11.4	14.8	0.98	0%
GM Grn	R	LCA	5.00	46.6	46.6	51.5	48.3	10.7	16.3	10.9	16.3	16.2	26.2	0.98	0%

R/N - Vapor Recirculating (R) or Non-recirculating (N).
%ER - Percent dispensing time nozzle concentration in flammable range (2% - 8%).
* - Dispensing rate in GPM.
@ - V/L based on actual vapor volume.

FIGURE 6-1

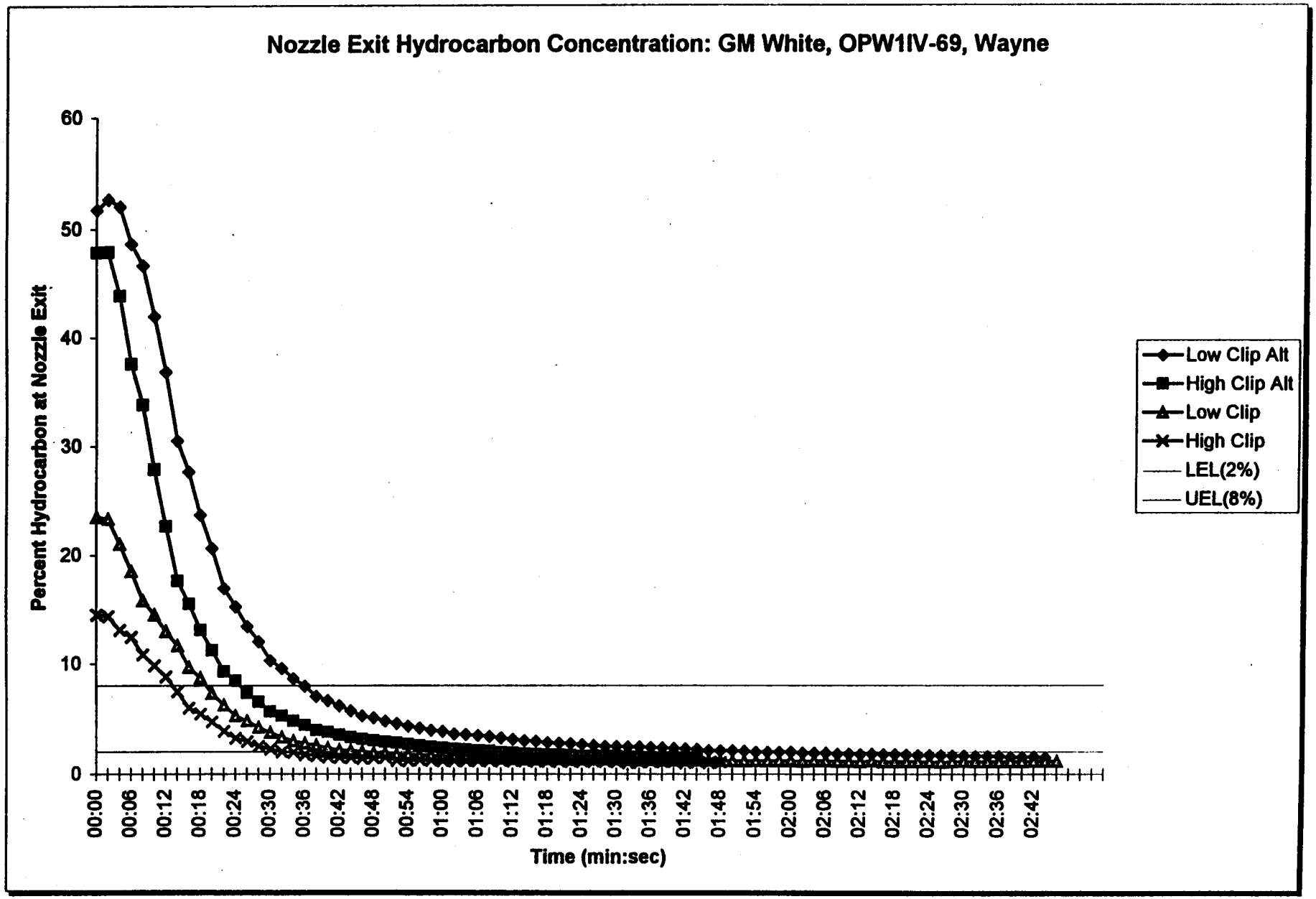

Nozzle Exit Hydrocarbon Concentration: GM White, OPW1IV-69, Wayne
Percent Hydrocarbon at Nozzle Exit
60
50
40
30
20
10
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
02:24
02:30
02:36
02:42
Time (min:sec)
Low Clip Alt
High Clip Alt
Low Clip
High Clip
LEL(2%)
UEL(8%)

FIGURE 6-2

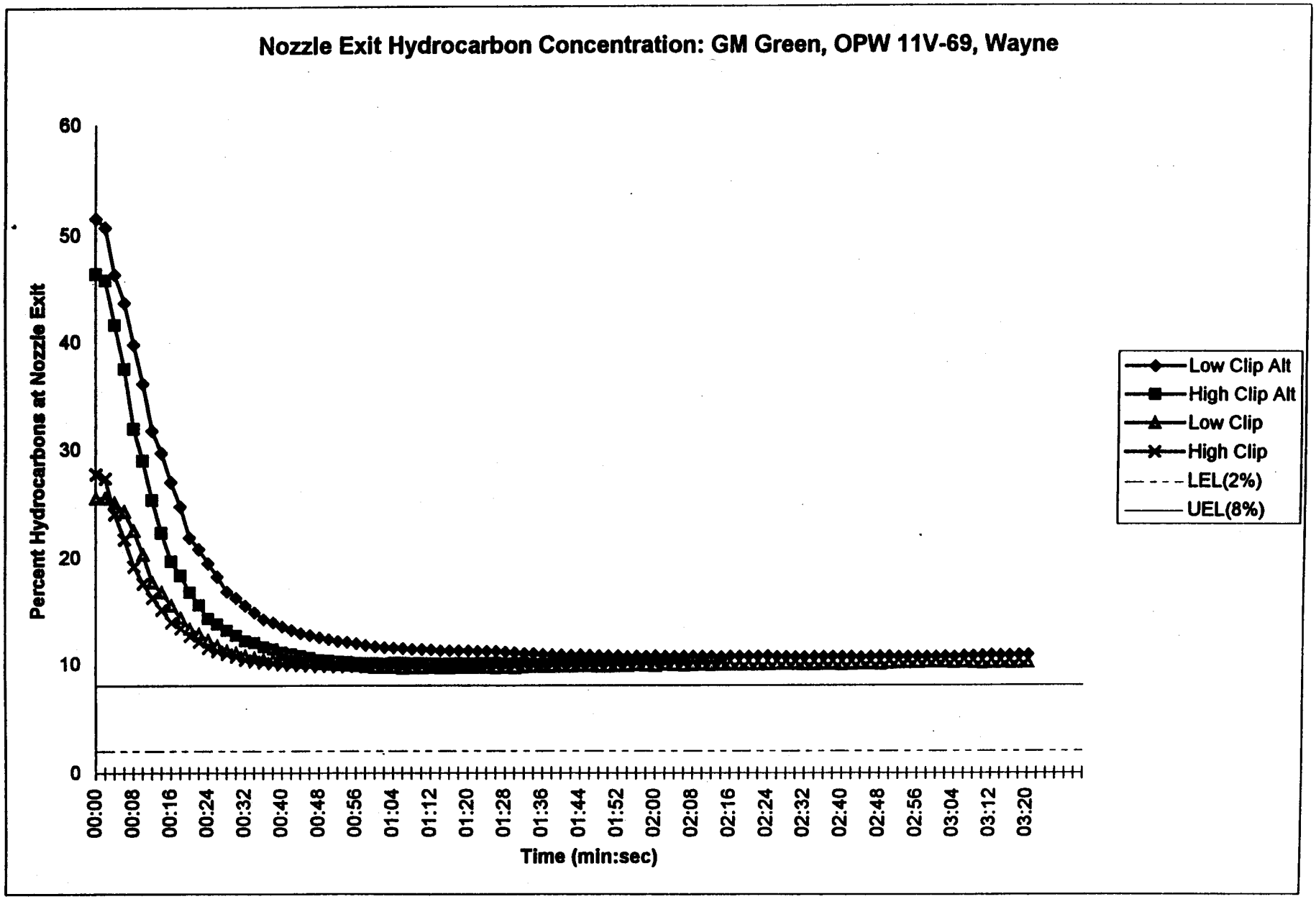

Nozzle Exit Hydrocarbon Concentration: GM Green, OPW 11V-69, Wayne
Percent Hydrocarbons at Nozzle Exit
60
50
40
30
20
10
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
02:56
03:04
03:12
03:20
Time (min:sec)
Low Clip Alt
High Clip Alt
Low Clip
High Clip
LEL(2%)
UEL(8%)

TABLE 6-3

WayneVac Vapor Recovery System w/ Husky 6250 Nozzle, 6-23-97

ORVR SYSTEM	R/N	Dispensing Mode	Dispensing Rate*	NOZZLE EXIT HYDROCARBON CONCENTRATION - %C3H8 START Noz	START Dis	MAXIMUM Noz	MAXIMUM Dis	MINIMUM Noz	MINIMUM Dis	FINAL Noz	FINAL Dis	AVERAGE Noz	AVERAGE Dis	V/L●	%ER
GM Wht	N	HC	6.12	16.9	16.9	16.9	16.9	1.0	3.4	1.0	3.4	3.4	7.4	1.05	20%
GM Wht	N	HCA	6.67	46.1	46.1	46.1	46.1	1.0	6.5	1.0	6.5	6.5	16.5	0.94	32%
GM Wht	N	LC	5.34	6.5	6.5	8.4	7.8	0.6	1.7	0.6	1.7	1.7	3.5	0.98	19%
GM Wht	N	LCA	5.45	10.3	10.3	29.8	19.0	0.8	4.8	0.8	4.8	4.8	9.6	0.94	21%
GM Grn	R	HC	6.67	5.6	4.9	5.6	5.1	2.7	3.6	3.4	3.6	3.4	4.2	1.03	100%
GM Grn	R	HCA	6.82	36.2	36.2	47.5	40.1	3.3	10.3	3.3	10.3	10.2	20.4	0.99	77%
GM Grn	R	LC	5.36	6.2	6.2	6.2	6.2	3.4	4.0	3.8	4.0	4.0	4.7	0.99	100%
GM Grn	R	LCA	5.45	10.4	10.4	30.1	20.2	5.9	9.5	5.9	9.5	9.5	13.2	1.00	68%

R/N	-	Vapor Recirculating (R) or Non-recirculating.
%ER	-	Percent dispensing time nozzle concentration in flammable range (2% - 8%).
*	-	Rate in gpm.
●	-	V/L based on actual vapor volume.

FIGURE 6-3

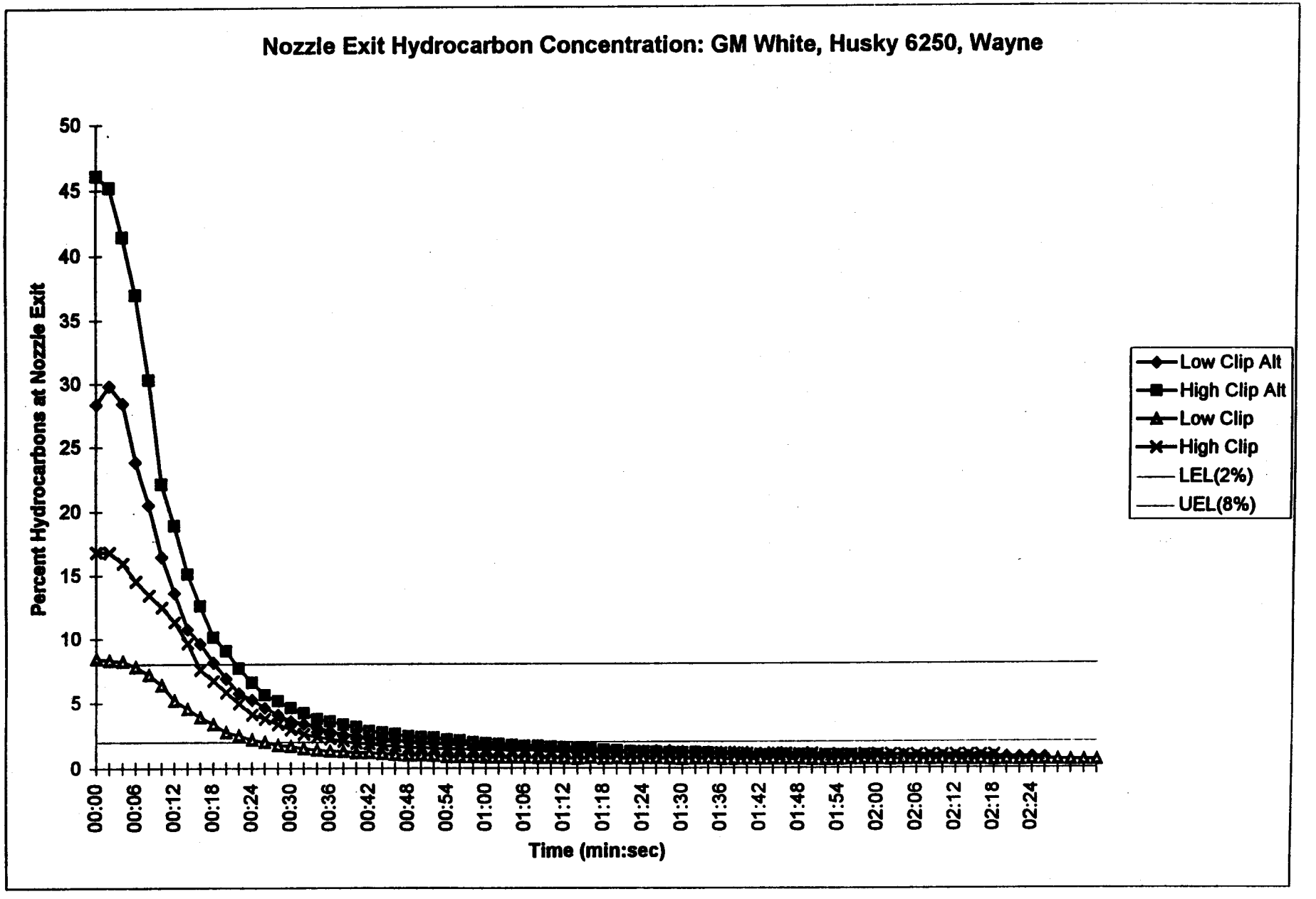

Nozzle Exit Hydrocarbon Concentration: GM White, Husky 6250, Wayne
Percent Hydrocarbons at Nozzle Exit
50
45
40
35
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
02:24
Time (min:sec)
Low Clip Alt
High Clip Alt
Low Clip
High Clip
LEL(2%)
UEL(8%)

FIGURE 6-4

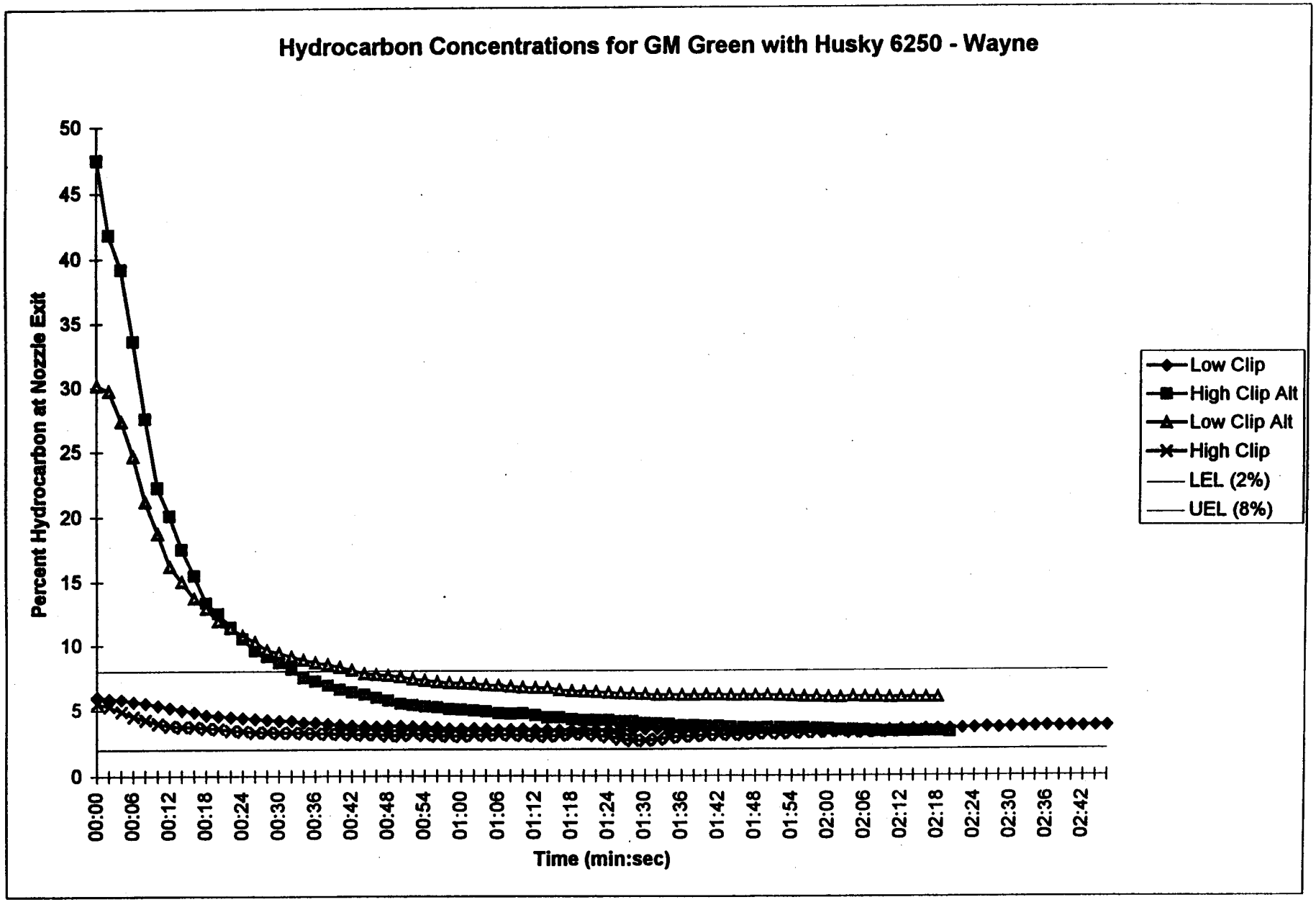

Hydrocarbon Concentrations for GM Green with Husky 6250 - Wayne
Percent Hydrocarbon at Nozzle Exit
50
45
40
35
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
02:24
02:30
02:36
02:42
Time (min:sec)
Low Clip
High Clip Alt
Low Clip Alt
High Clip
LEL (2%)
UEL (8%)

TABLE 6-4

WayneVac Vapor Recovery System w/ Emco Wheaton 4505 Nozzle, 6-24-97

ORVR SYSTEM	R/N	Dispensing Mode	Dispensing Rate*	NOZZLE EXIT HYDROCARBON CONCENTRATION - %C3H8 START Noz	START Dis	MAXIMUM Noz	MAXIMUM Dis	MINIMUM Noz	MINIMUM Dis	FINAL Noz	FINAL Dis	AVERAGE Noz	AVERAGE Dis	V/L@	%ER
Cry Grn	N	HC	5.88	2.5	2.5	2.8	2.5	2.0	2.3	2.3	2.3	2.3	2.3	1.00	100%
Cry Grn	N	HCA	5.90	35.5	35.5	40.1	36.8	2.4	8.6	2.4	8.6	8.5	18.4	1.04	84%
Cry Grn	N	LC	1.67	No data available. Low dispensing rate resulted in minimal vapor return volume.										0.01	
Cry Wht	N	HC	5.88	15.1	15.1	15.1	15.1	1.0	3.3	1.0	2.4	3.3	7.1	1.02	25%
Cry Wht	N	HCA	5.88	40.3	40.3	45.0	42.0	4.1	9.8	4.1	9.8	9.7	19.7	1.04	82%
Cry Wht	N	LC	2.18	No data available. Low dispensing rate resulted in minimal vapor return volume.										0	
GM Wht	N	HC	5.77	6.8	6.8	7.8	7.18	1.0	2.38	1.0	2.4	2.4	4.2	1.02	35%
GM Wht	N	HCA	5.36	31.2	31.2	35.1	32.5	0.7	7.1	0.7	7.1	7.0	16.5	1.02	21%
GM Wht	N	LC	2.14	No data available. Low dispensing rate resulted in minimal vapor return volume.										0.02	
Ford	R	HC	5.88	3.7	3.7	6.2	5.7	3.6	3.7	6.1	5.7	5.7	5.1	0.96	100%
Ford	R	HCA	5.77	34.5	34.5	40.8	36.6	6.7	11.8	6.7	11.8	11.7	20.1	1.01	72%
Ford	R	LC	1.92	No data available. Low dispensing rate resulted in minimal vapor return volume.										0	
GM Grn	R	HC	5.88	7.5	7.5	10.3	9.0	7.5	7.5	8.2	8.6	8.6	8.7	1.01	0%
GM Grn	R	HCA	5.77	9.9	9.9	12.8	11.7	8.3	9.1	9.3	9.1	9.1	9.8	0.99	0%
GM Grn	R	LC	2.34	No data available. Low dispensing rate resulted in minimal vapor return volume.										0.20	
Honda	R	HC	5.85	2.9	2.9	16.6	13.4	2.8	2.9	16.6	13.4	13.4	9.8	1.00	8%
Honda	R	HCA	5.83	25.8	25.8	33.7	28.8	13.6	17.8	14.6	17.8	17.8	21.8	1.02	0%
Honda	R	LC	2.14	No data available. Low dispensing rate resulted in minimal vapor return volume.										0	
Nissan	R	HC	5.77	4.9	4.9	12.0	10.6	4.9	4.9	12.0	10.6	10.6	8.5	1.01	7%
Nissan	R	HCA	5.80	19.7	19.7	22.4	20.9	13.1	15.1	12.0	10.6	15.0	17.3	1.02	0%
Nissan	R	LC	1.91	No data available. Low dispensing rate resulted in minimal vapor return volume.										0	
Toyota	R	HC	5.88	13.2	13.2	15.6	13.9	6.5	8.9	8.4	8.9	8.9	10.6	1.07	73%
Toyota	R	HCA	5.87	10.8	10.8	22.4	11.1	6.2	7.6	8.4	8.9	7.8	8.6	1.01	46%
Toyota	R	LC	2.05	No data available. Low dispensing rate resulted in minimal vapor return volume.										0.18	

R/N	-	Vapor Recirculating (R) or Non-Recirculating.
%ER	-	Percent dispensing time nozzle concentration in flammable range (2% - 8).
*	-	Rate in gpm.
@	-	V/L based on actual vapor volume.

FIGURE 6-5

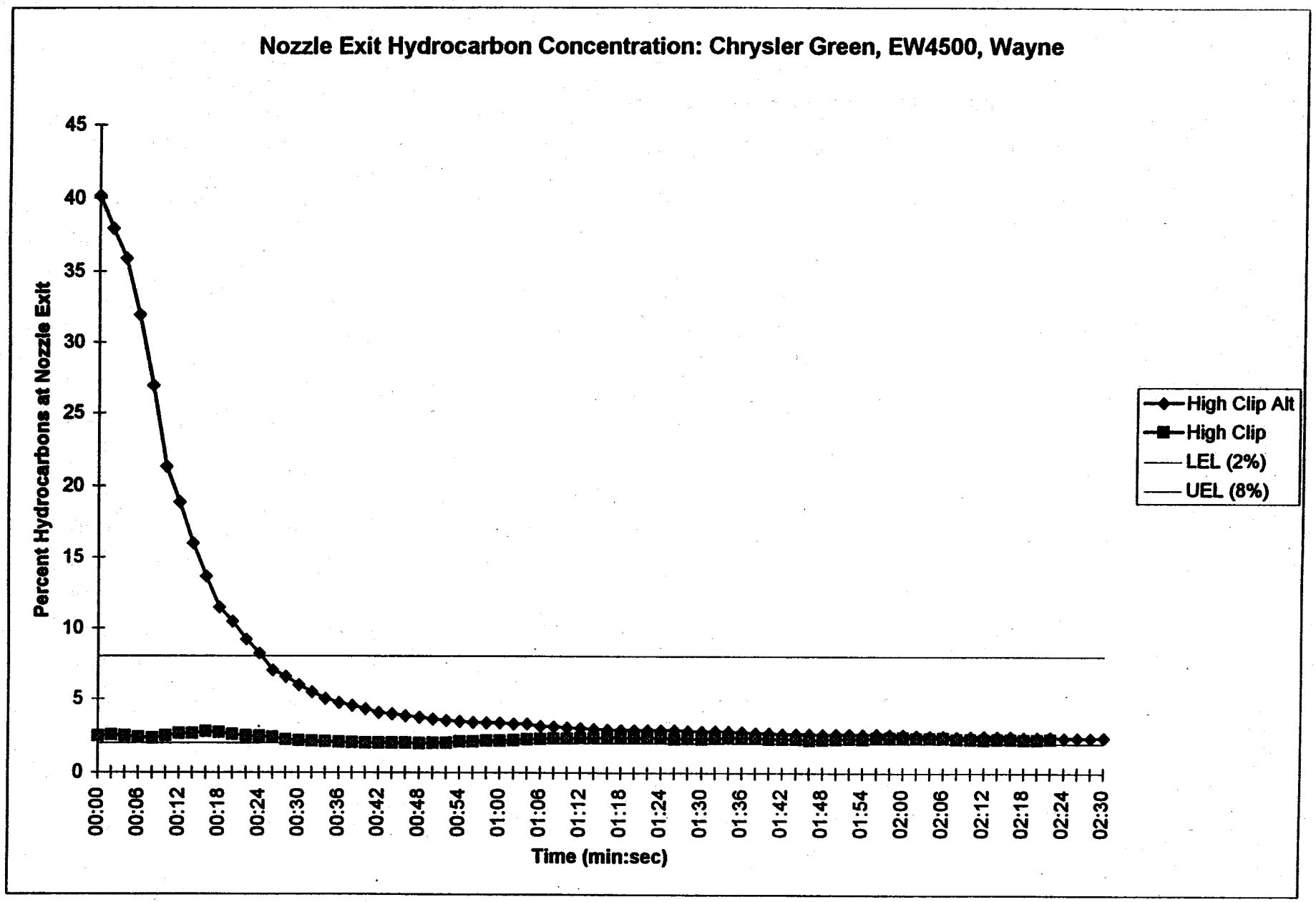

Nozzle Exit Hydrocarbon Concentration: Chrysler Green, EW4500, Wayne
Percent Hydrocarbons at Nozzle Exit
45
40
35
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
02:24
02:30
Time (min:sec)
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-6

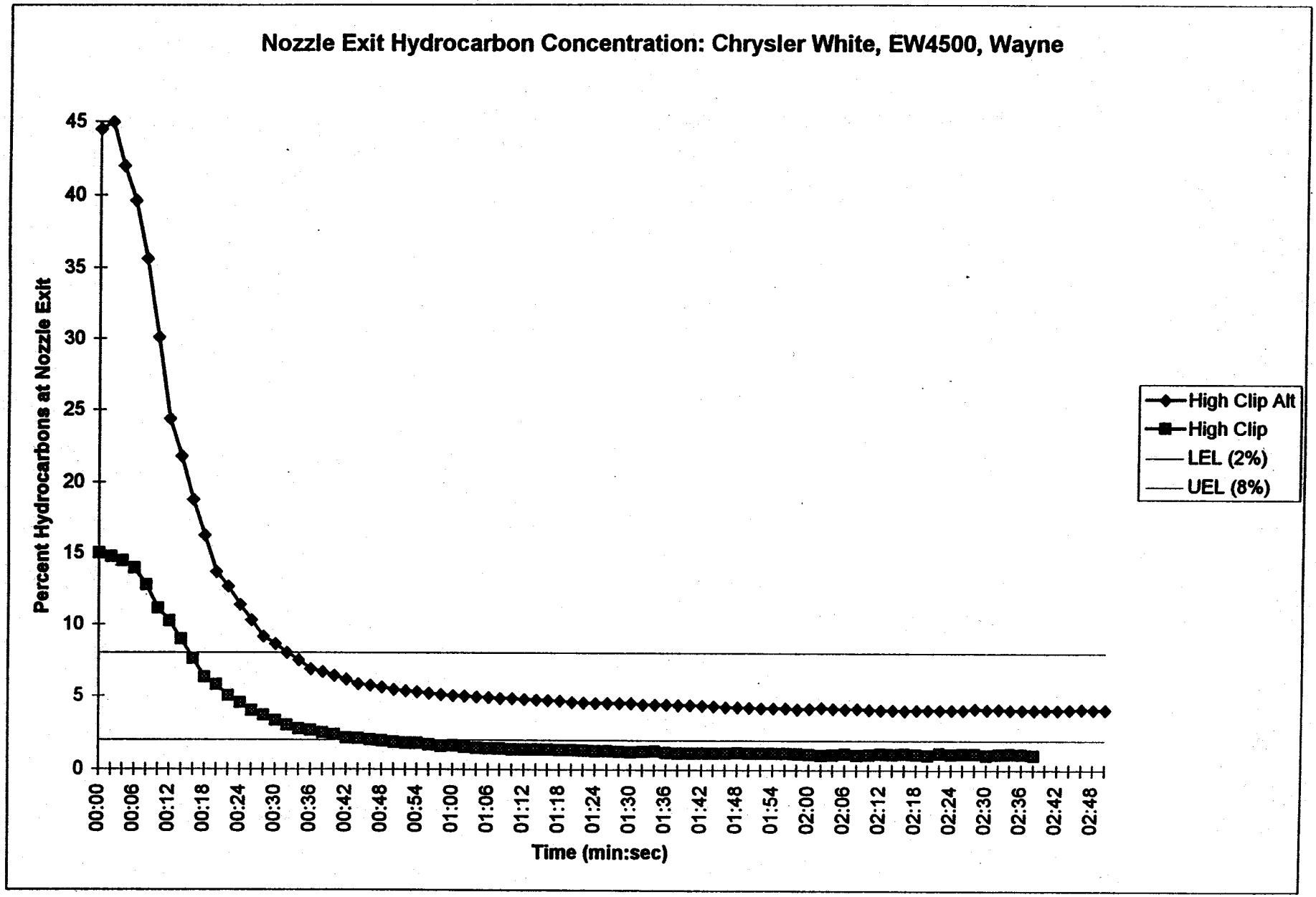

Nozzle Exit Hydrocarbon Concentration: Chrysler White, EW4500, Wayne
Percent Hydrocarbons at Nozzle Exit
45
40
35
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
02:24
02:30
02:36
02:42
02:48
Time (min:sec)
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-7

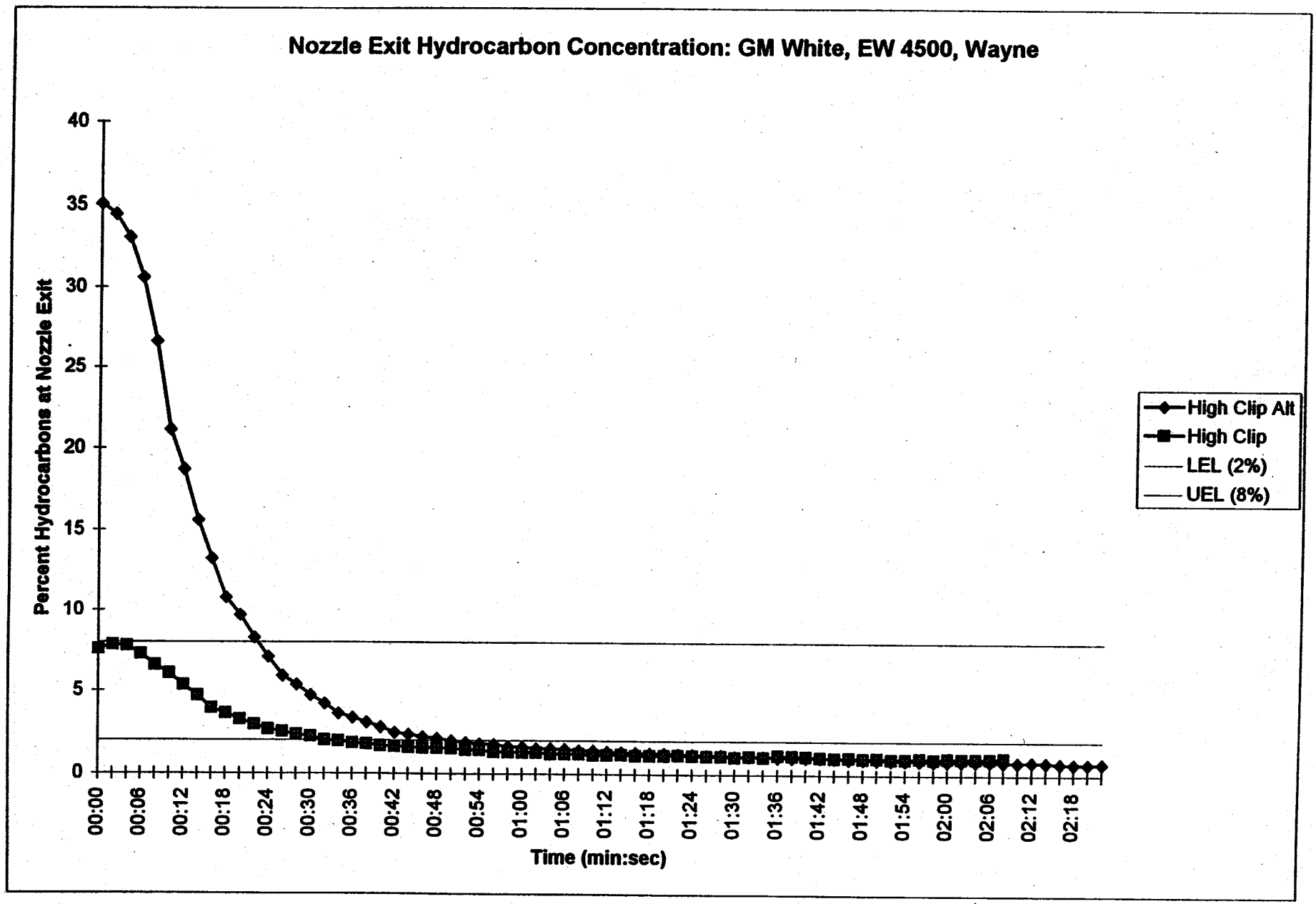

Nozzle Exit Hydrocarbon Concentration: GM White, EW 4500, Wayne
Percent Hydrocarbons at Nozzle Exit
40
35
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
Time (min:sec)
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-8

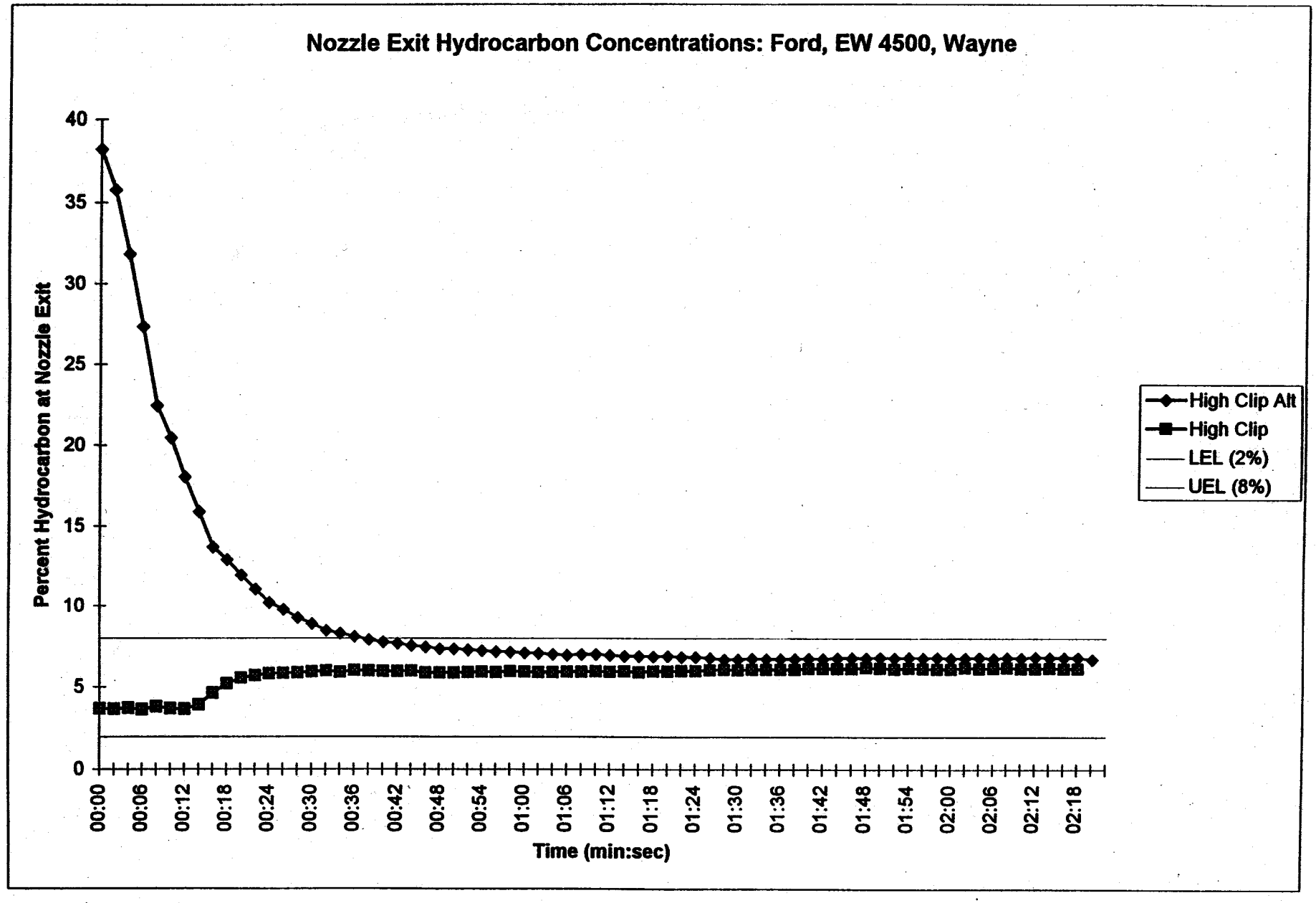

Nozzle Exit Hydrocarbon Concentrations: Ford, EW 4500, Wayne
Percent Hydrocarbon at Nozzle Exit
40
35
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
Time (min:sec)
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-9

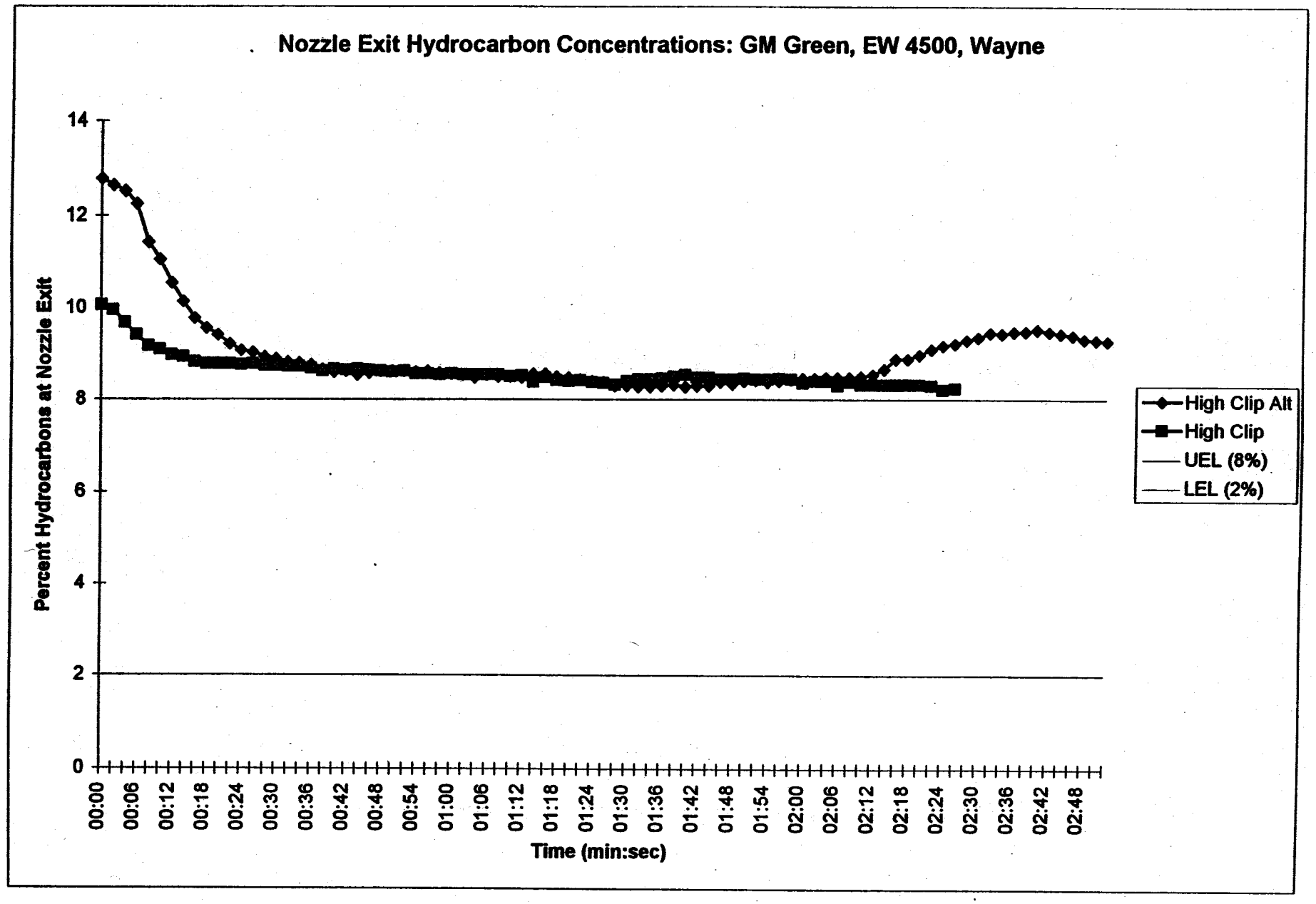

Nozzle Exit Hydrocarbon Concentrations: GM Green, EW 4500, Wayne
Percent Hydrocarbons at Nozzle Exit
14
12
10
8
6
4
2
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
02:24
02:30
02:36
02:42
02:48
Time (min:sec)
High Clip Alt
High Clip
UEL (8%)
LEL (2%)

FIGURE 6-10

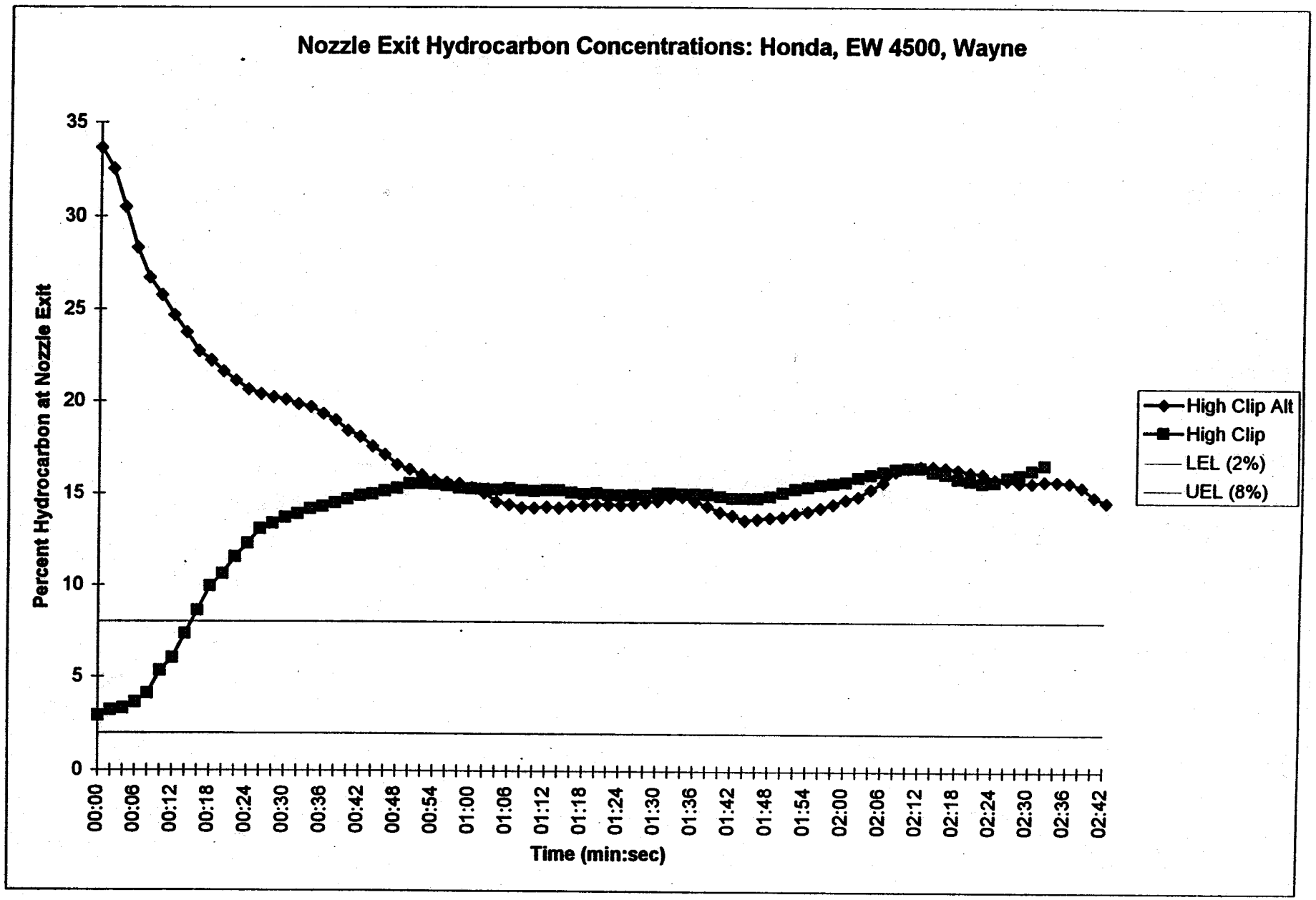

Nozzle Exit Hydrocarbon Concentrations: Honda, EW 4500, Wayne
Percent Hydrocarbon at Nozzle Exit
35
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
02:24
02:30
02:36
02:42
Time (min:sec)
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-11

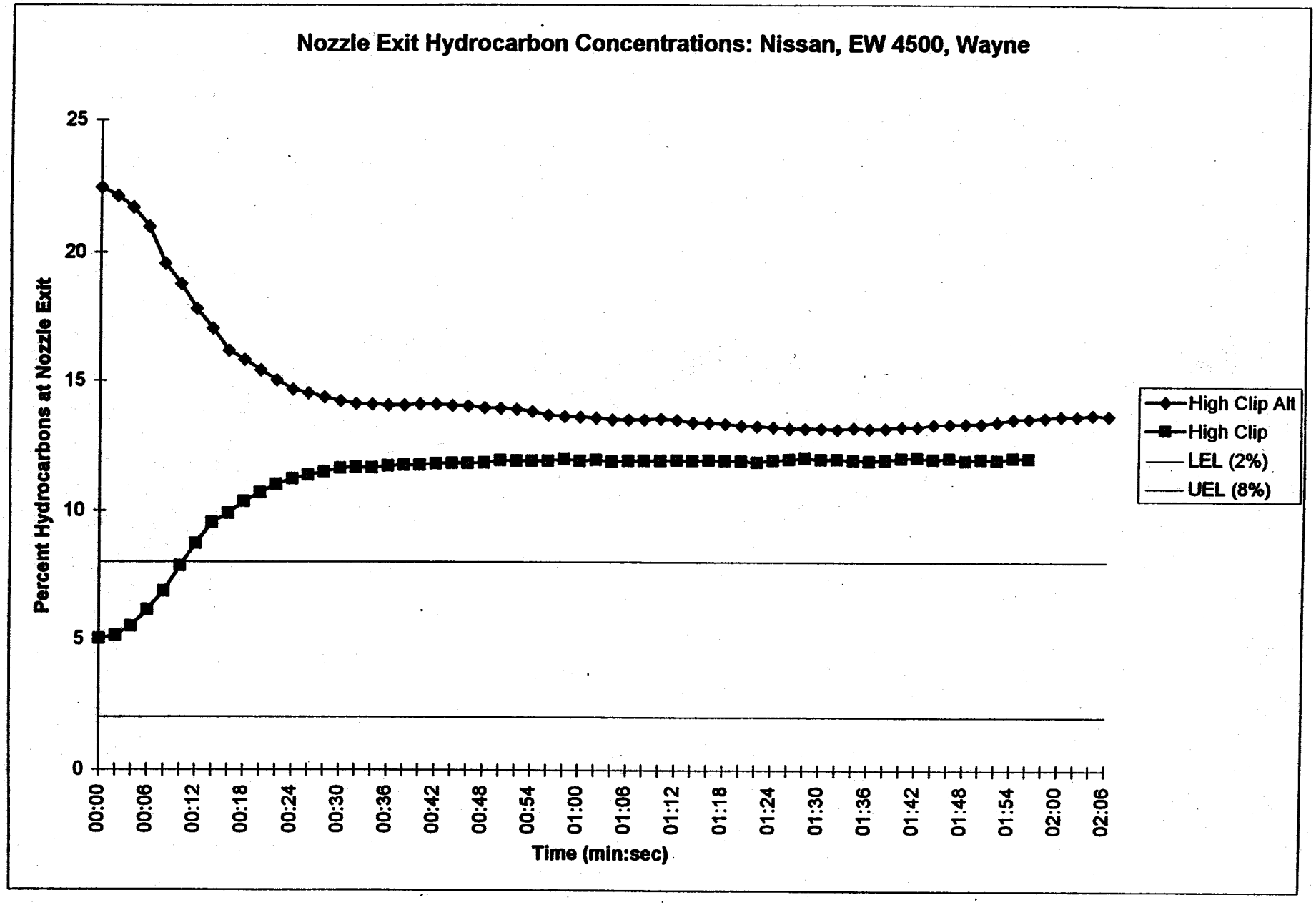

Nozzle Exit Hydrocarbon Concentrations: Nissan, EW 4500, Wayne
Percent Hydrocarbons at Nozzle Exit
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
Time (min:sec)
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-12

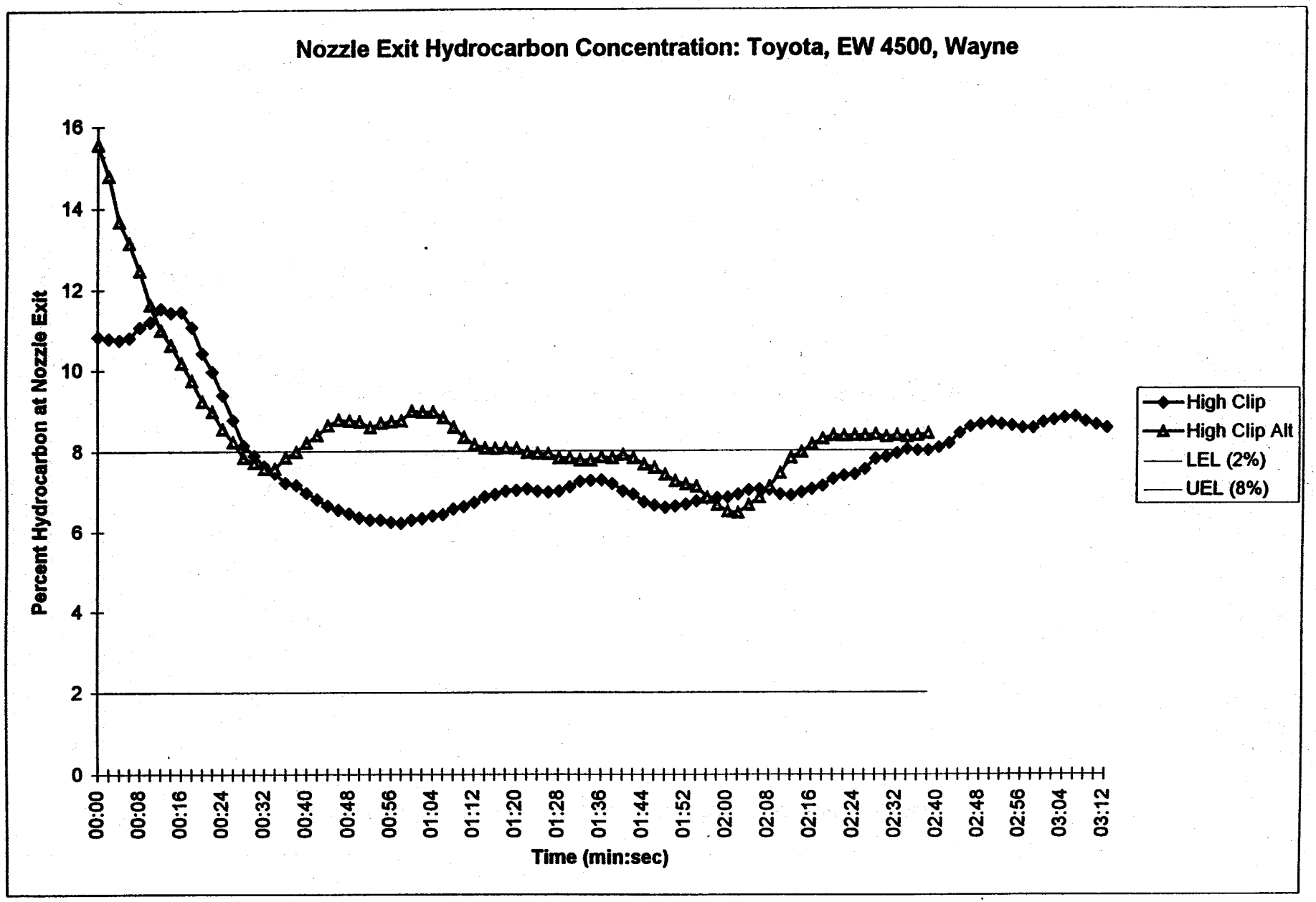

Nozzle Exit Hydrocarbon Concentration: Toyota, EW 4500, Wayne
Percent Hydrocarbon at Nozzle Exit
16
14
12
10
8
6
4
2
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
02:56
03:04
03:12
Time (min:sec)
High Clip
High Clip Alt
LEL (2%)
UEL (8%)

TABLE 6-5

Hasstech Vapor Recovery System w/ OPW 11VAI-29 Nozzle, 6-25-97

ORVR SYSTEM	R/N	Dispensing Mode	Dispensing Rate*	NOZZLE EXIT HYDROCARBON CONCENTRATION - %C3H8 START Noz	START Dis	MAXIMUM Noz	MAXIMUM Dis	MINIMUM Noz	MINIMUM Dis	FINAL Noz	FINAL Dis	AVERAGE Noz	AVERAGE Dis	V/L@	%ER
Cry Grn	N	HC	8.19	0.4	0.4	5.6	3.6	0.4	0.4	3.8	3.6	3.6	3.0	1.66	100%
Cry Grn	N	HCA	8.15	2.9	2.9	14.8	7.5	2.7	2.8	3.9	4.8	4.8	5.4	1.67	100%
Cry Grn	N	LC	3.00	Data acquisition system failure. No data availabe											
Cry Wht	N	HC	8.39	1.5	1.5	5.7	3.1	1.5	1.5	2.0	2.3	2.3	2.4	1.70	100%
Cry Wht	N	HCA	8.20	7.1	7.1	17.1	10.3	1.8	3.3	1.8	3.3	3.3	5.5	1.60	61%
Cry Wht	N	LC	3.33	1.1	1.2	4.2	3.7	1.0	1.1	3.7	3.7	3.7	3.5	3.83	100%
GM Wht	N	HC	8.09	1.1	1.1	5.2	2.7	0.0	0.7	0.2	0.7	0.7	1.3	1.70	7%
GM Wht	N	HCA	8.33	2.6	2.6	16.5	7.3	0.3	1.9	0.3	1.9	1.8	3.6	1.70	10%
GM Wht	N	LC	3.27	9.8	9.8	10.1	9.8	0.5	1.4	1.5	1.4	1.4	2.7	3.88	6%
Ford	R	HC	8.28	0.8	0.8	3.7	3.0	0.7	0.7	3.7	3.0	3.0	2.3	1.67	100%
Ford	R	HCA	8.33	4.1	4.1	19.3	9.8	1.8	1.8	4.9	4.6	4.9	5.3	1.65	91%
Ford	R	LC	3.48	1.2	1.3	4.3	3.6	1.2	1.3	2.5	3.2	3.2	3.2	3.81	100%
GM Blk	R	HC	8.39	1.8	1.8	8.1	4.6	1.8	1.8	4.9	4.6	4.6	4.1	1.59	100%
GM Blk	R	HCA	8.37	2.4	2.4	23.0	9.96	2.2	2.3	4.5	6.2	6.2	7.1	1.65	86%
GM Blk	R	LC	2.90	0.4	0.4	5.6	4.7	0.4	0.4	3.6	4.7	4.7	4.2	1.68	100%
GM Grn	R	HC	8.30	0.3	0.3	6.7	5.3	0.3	0.3	6.7	5.3	5.3	3.5	1.67	100%
GM Grn	R	HCA	8.29	4.9	4.9	21.9	10.9	4.5	4.7	7.4	7.2	7.4	8.0	1.70	91%
GM Grn	R	LC	3.38	2.0	2.0	6.6	5.9	1.8	1.93	6.5	5.9	5.9	5.2	1.78	100%
Honda	R	HC	8.33	0.5	0.5	10.3	8.6	0.5	0.5	9.7	8.6	8.6	8.6	1.64	0%
Honda	R	HCA	8.24	5.2	5.2	26.3	15.2	4.9	5.1	9.8	10.9	10.8	11.8	1.60	0%
Honda	R	LC	3.33	0.9	1.2	10.4	9.3	0.8	1.0	10.4	9.3	9.1	7.9	3.81	0%
Nissan	R	HC	8.26	0.5	0.5	6.9	6.0	0.5	0.5	6.7	6.0	6.0	4.4	1.64	100%
Nissan	R	HCA	8.33	7.6	7.6	19.1	11.2	6.7	7.2	6.8	7.8	7.8	8.8	1.67	84%
Nissan	R	LC	3.33	1.0	1.0	7.4	6.7	1.0	1.0	3.4	6.4	6.4	6.3	3.73	100%
Toyota	R	HC	8.24	0.7	0.7	9.4	6.2	0.6	0.7	6.0	6.0	6.0	5.5	1.64	90%
Toyota	R	HCA	8.31	6.5	6.5	6.5	6.5	3.8	4.7	3.8	4.9	4.8	5.0	1.78	100%
Toyota	R	LC	NA	2.3	2.3	5.9	5.1	2.1	2.2	5.9	5.1	5.1	4.3	1.58	100%

R/N - Vapor Recirculating (R) or Non-Recirculating (N).
%ER - Percent dispensing time nozzle concentration in flammable range (2% - 8%).
* - Rate in gpm.
@ - V/L based on actual vapor volume.

FIGURE 6-13

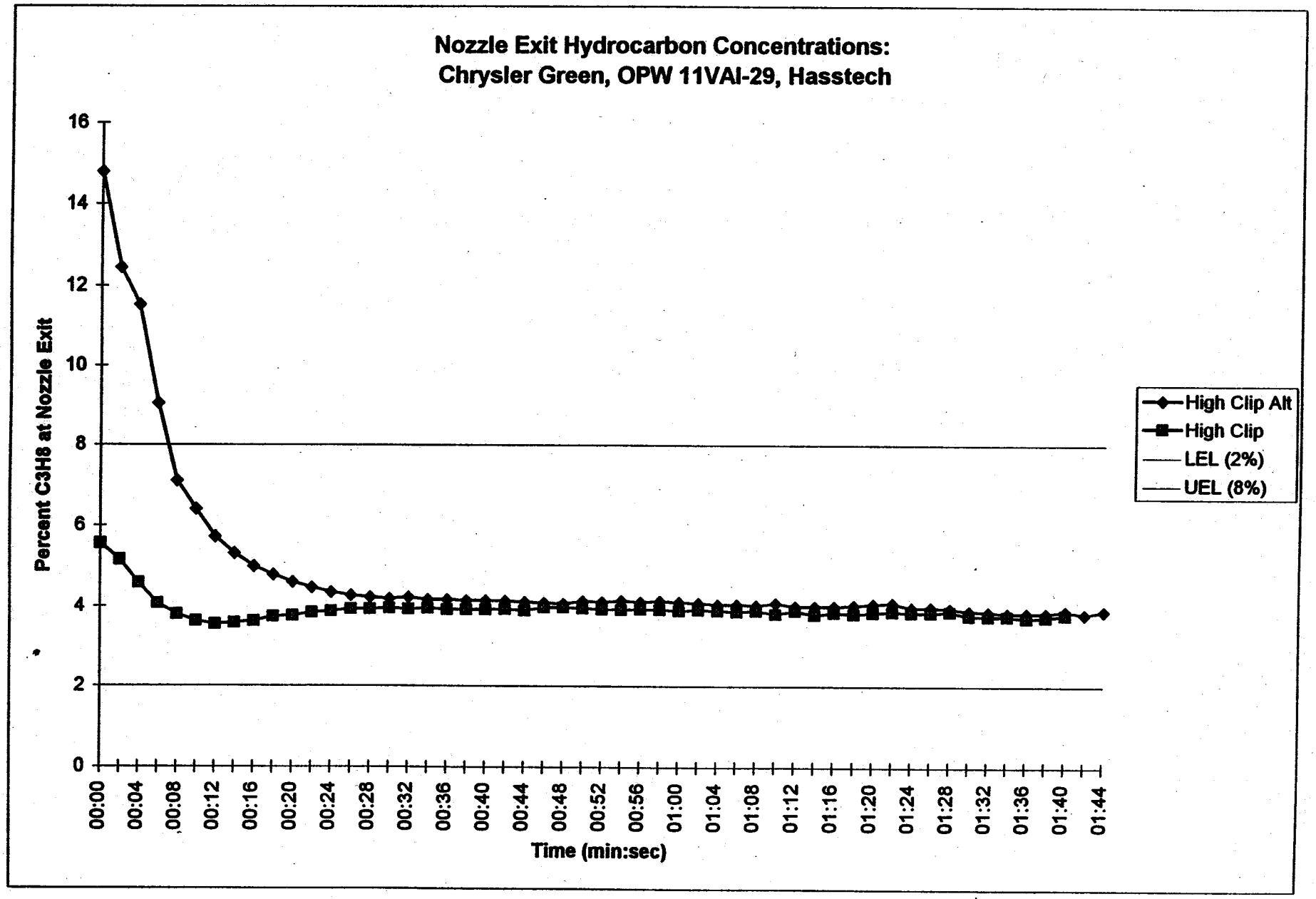

Nozzle Exit Hydrocarbon Concentrations:
Chrysler Green, OPW 11VAI-29, Hasstech
Percent C3H8 at Nozzle Exit
16
14
12
10
8
6
4
2
0
00:00
00:04
00:08
00:12
00:16
00:20
00:24
00:28
00:32
00:36
00:40
00:44
00:48
00:52
00:56
01:00
01:04
01:08
01:12
01:16
01:20
01:24
01:28
01:32
01:36
01:40
01:44
Time (min:sec)
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-14

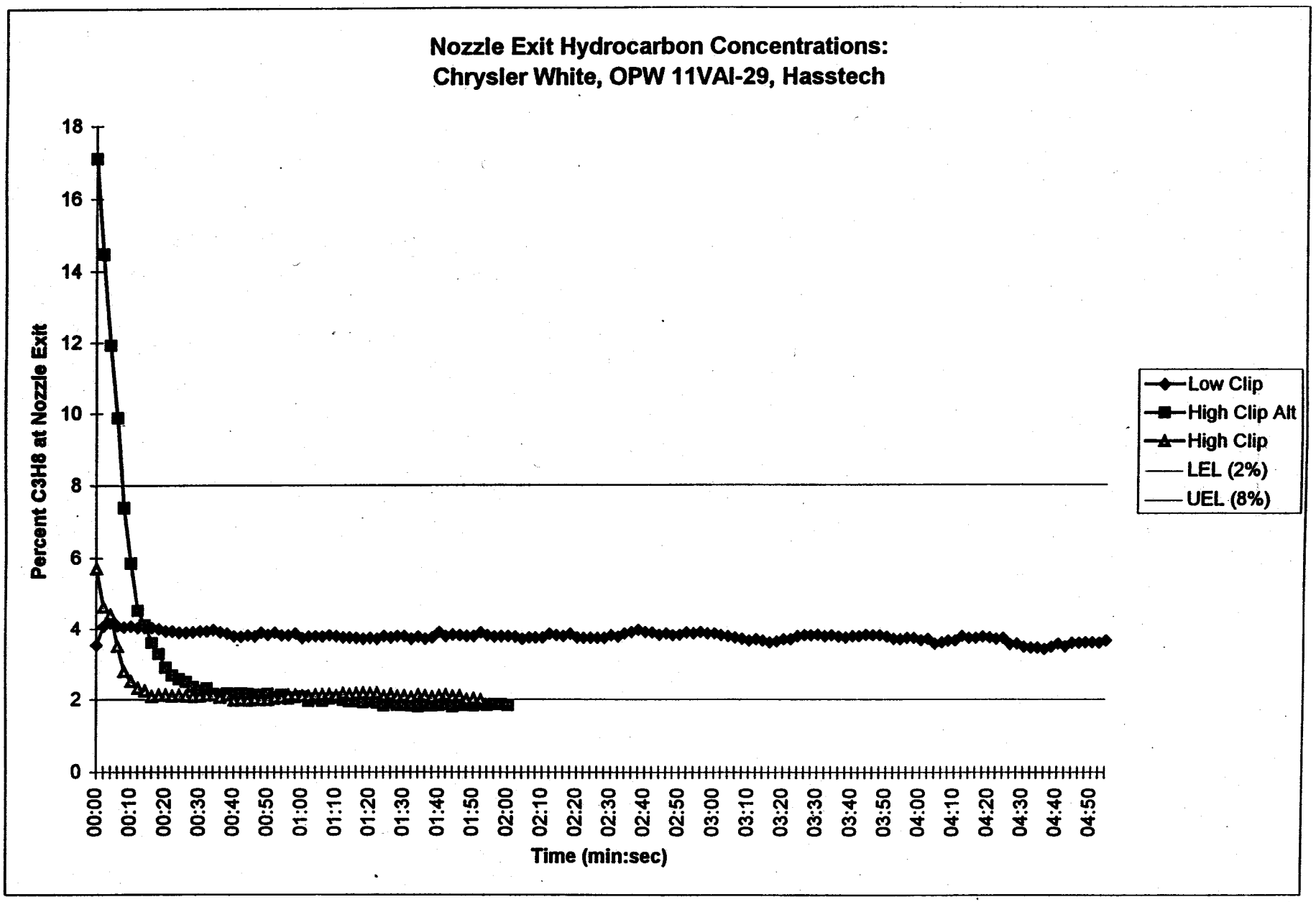

Nozzle Exit Hydrocarbon Concentrations:
Chrysler White, OPW 11VAI-29, Hasstech
Percent C3H8 at Nozzle Exit
0
2
4
6
8
10
12
14
16
18
00:00
00:10
00:20
00:30
00:40
00:50
01:00
01:10
01:20
01:30
01:40
01:50
02:00
02:10
02:20
02:30
02:40
02:50
03:00
03:10
03:20
03:30
03:40
03:50
04:00
04:10
04:20
04:30
04:40
04:50
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-15

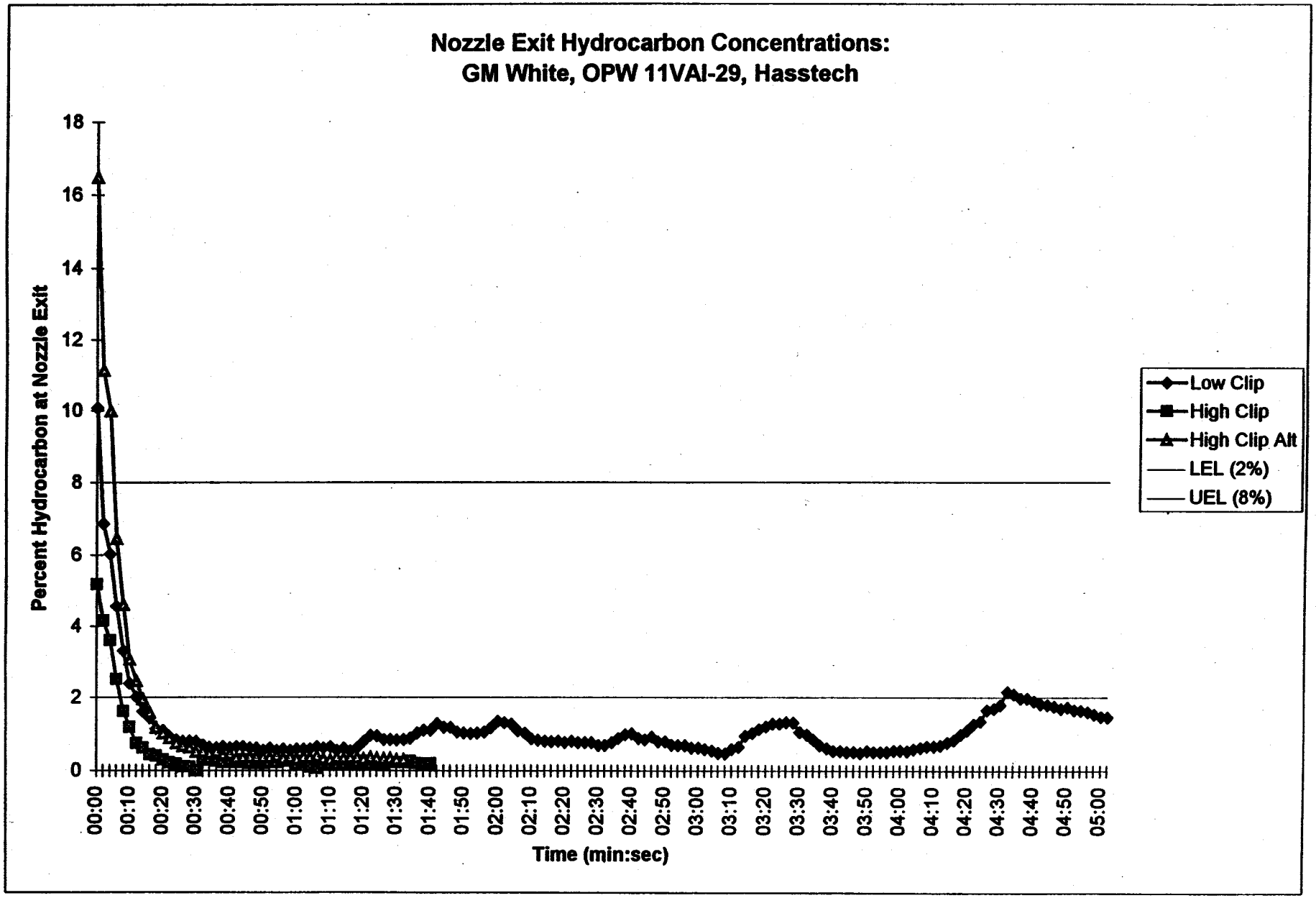

Nozzle Exit Hydrocarbon Concentrations:
GM White, OPW 11VAI-29, Hasstech
Percent Hydrocarbon at Nozzle Exit
18
16
14
12
10
8
6
4
2
0
00:00
00:10
00:20
00:30
00:40
00:50
01:00
01:10
01:20
01:30
01:40
01:50
02:00
02:10
02:20
02:30
02:40
02:50
03:00
03:10
03:20
03:30
03:40
03:50
04:00
04:10
04:20
04:30
04:40
04:50
05:00
Time (min:sec)
Low Clip
High Clip
High Clip Alt
LEL (2%)
UEL (8%)

FIGURE 6-16

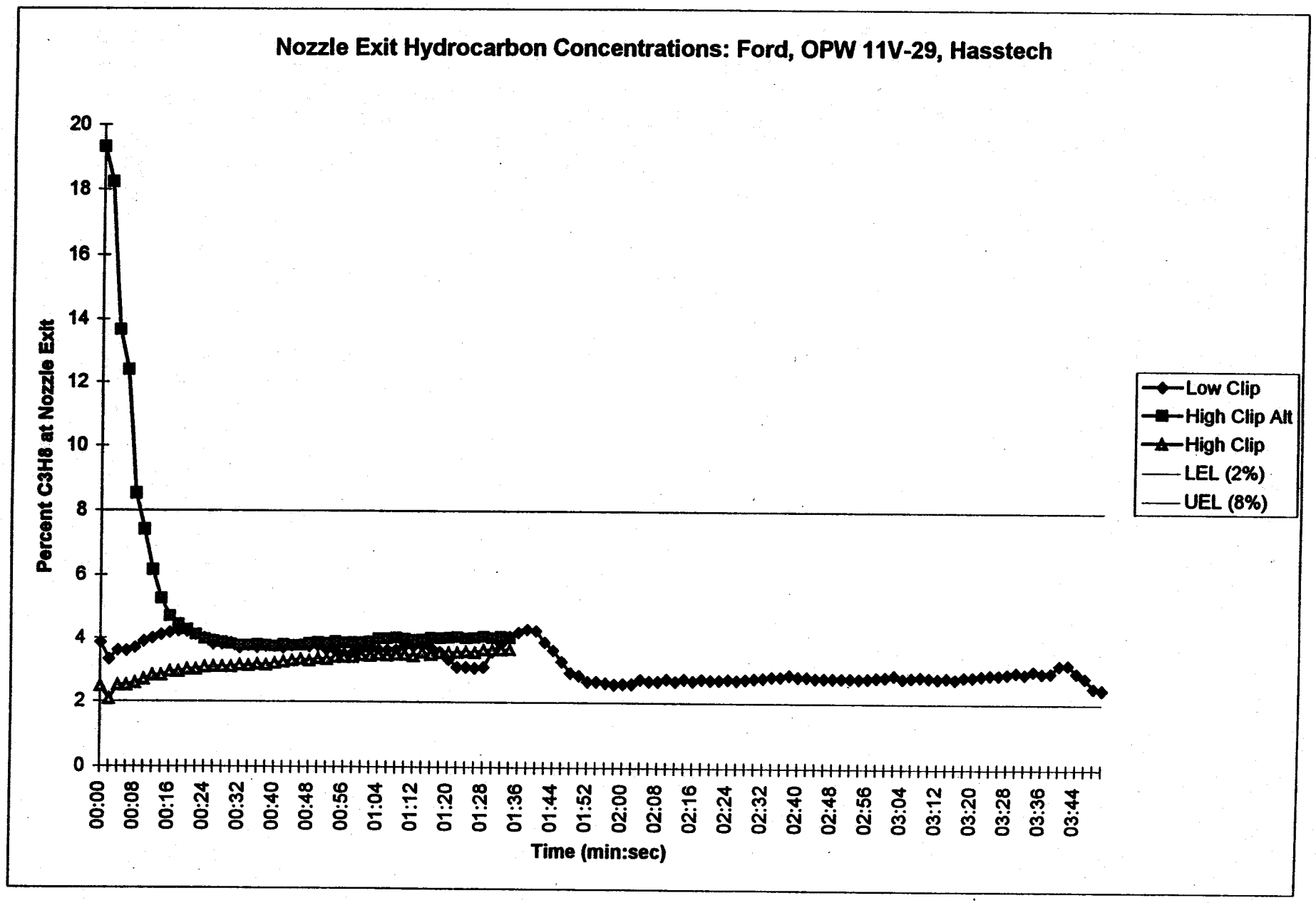

Nozzle Exit Hydrocarbon Concentrations: Ford, OPW 11V-29, Hasstech
Percent C3H8 at Nozzle Exit
20
18
16
14
12
10
8
6
4
2
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
02:56
03:04
03:12
03:20
03:28
03:36
03:44
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-17

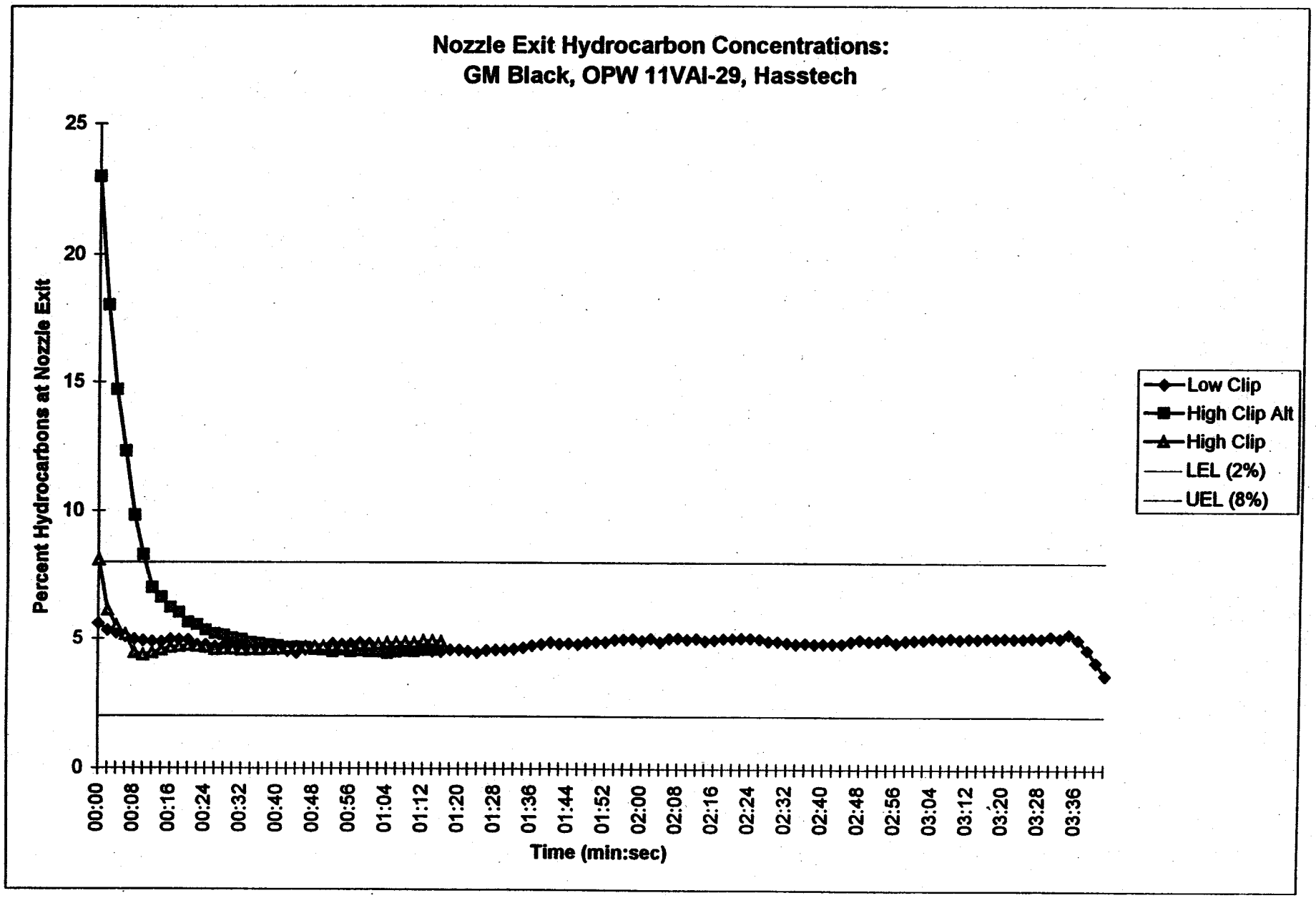

Nozzle Exit Hydrocarbon Concentrations:
GM Black, OPW 11VAI-29, Hasstech
Percent Hydrocarbons at Nozzle Exit
25
20
15
10
5
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
02:56
03:04
03:12
03:20
03:28
03:36
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-18

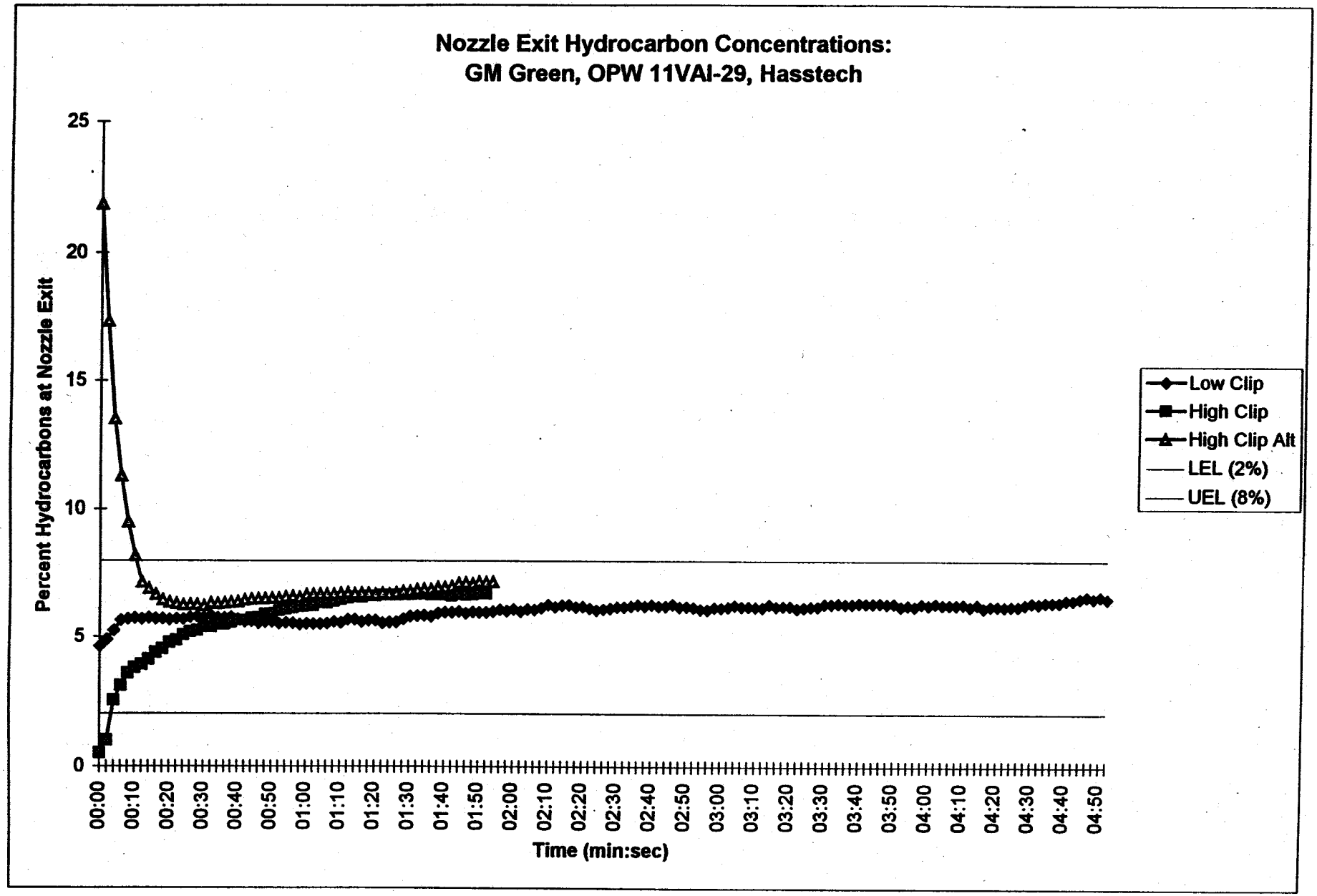

Nozzle Exit Hydrocarbon Concentrations:
GM Green, OPW 11VAI-29, Hasstech
Percent Hydrocarbons at Nozzle Exit
25
20
15
10
5
0
00:00
00:10
00:20
00:30
00:40
00:50
01:00
01:10
01:20
01:30
01:40
01:50
02:00
02:10
02:20
02:30
02:40
02:50
03:00
03:10
03:20
03:30
03:40
03:50
04:00
04:10
04:20
04:30
04:40
04:50
Time (min:sec)
Low Clip
High Clip
High Clip Alt
LEL (2%)
UEL (8%)

FIGURE 6-19

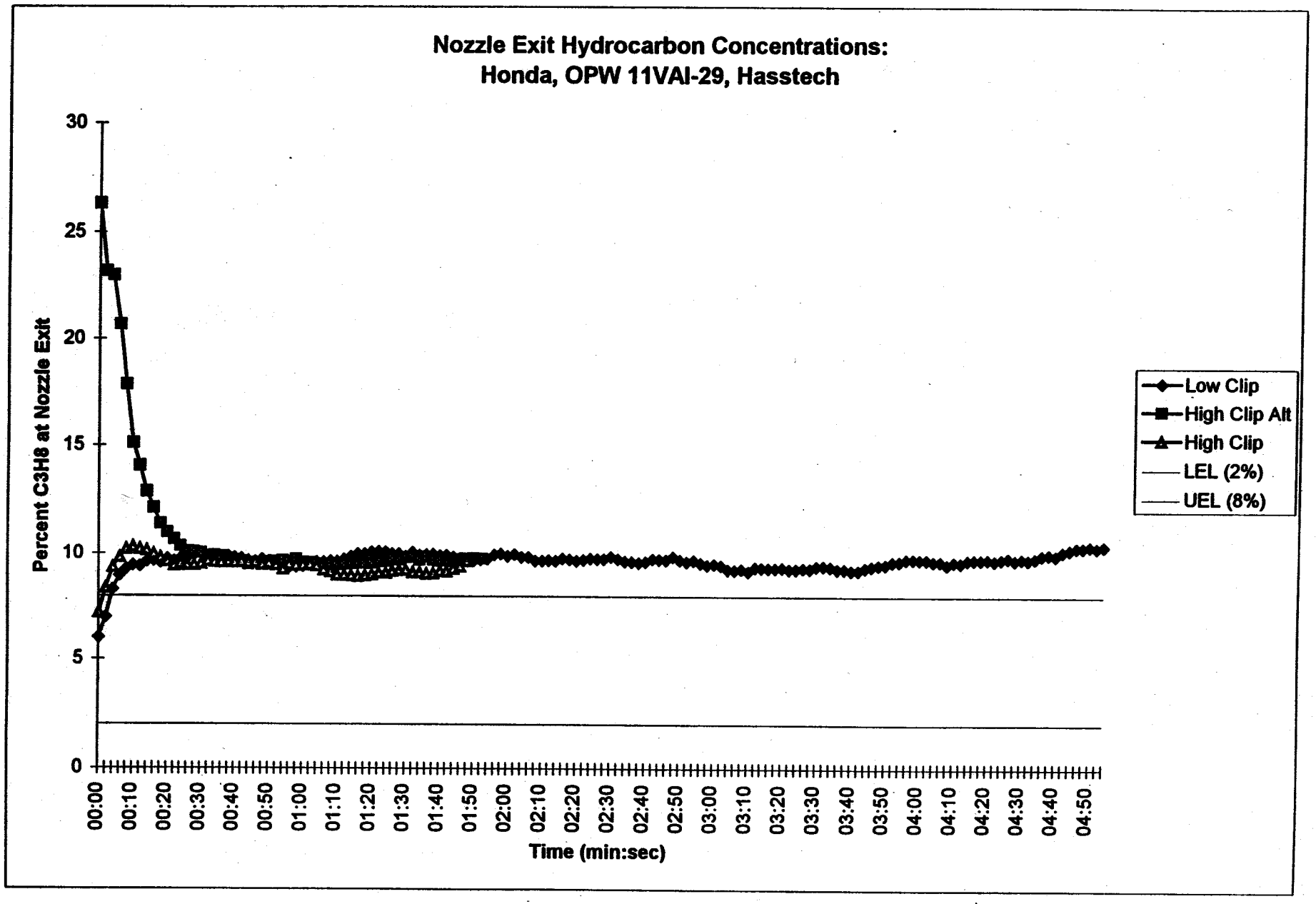

Nozzle Exit Hydrocarbon Concentrations:
Honda, OPW 11VAI-29, Hasstech
Percent C3H8 at Nozzle Exit
30
25
20
15
10
5
0
00:00
00:10
00:20
00:30
00:40
00:50
01:00
01:10
01:20
01:30
01:40
01:50
02:00
02:10
02:20
02:30
02:40
02:50
03:00
03:10
03:20
03:30
03:40
03:50
04:00
04:10
04:20
04:30
04:40
04:50
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-20

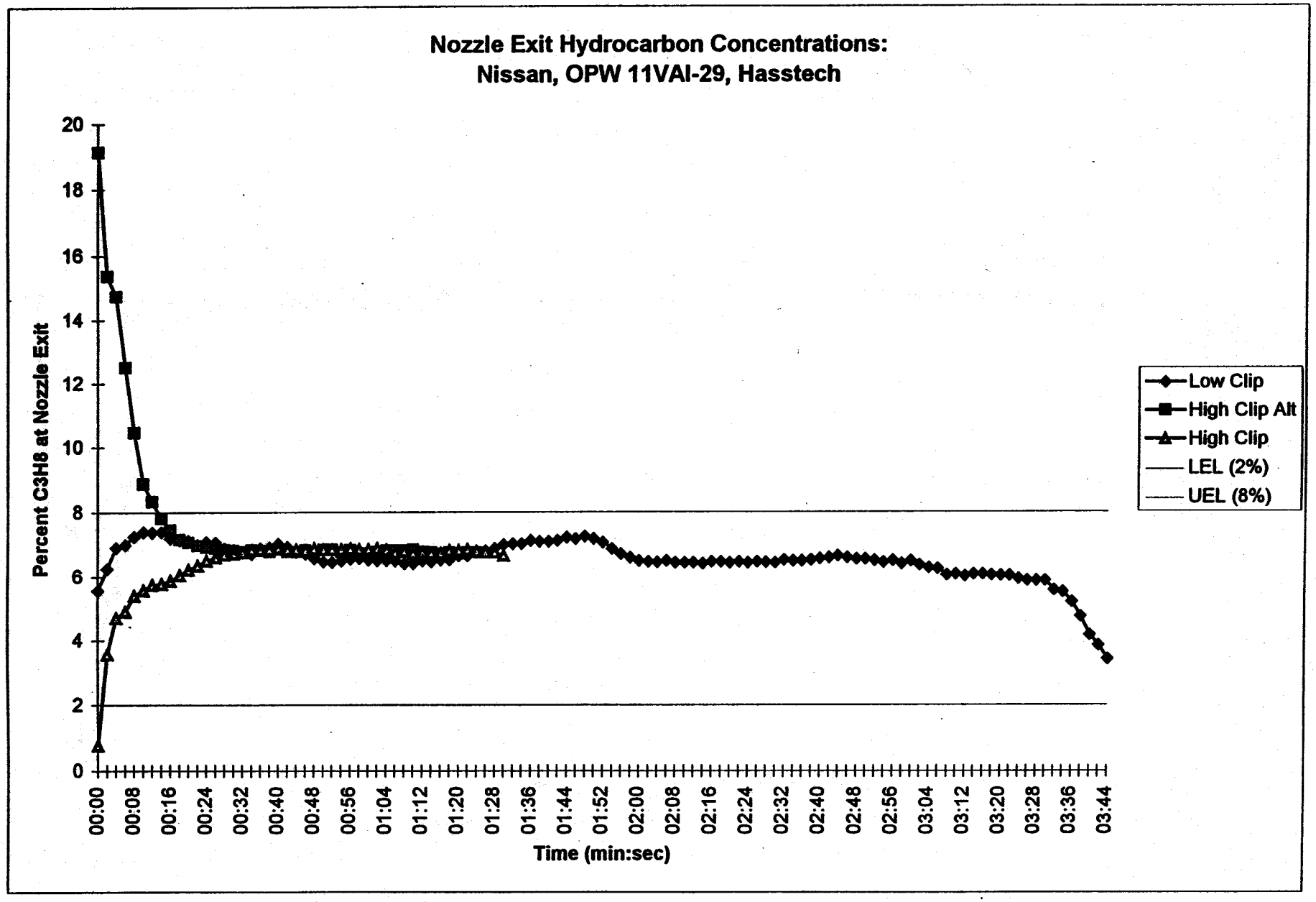

Nozzle Exit Hydrocarbon Concentrations:
Nissan, OPW 11VAI-29, Hasstech
Percent C3H8 at Nozzle Exit
20
18
16
14
12
10
8
6
4
2
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
02:56
03:04
03:12
03:20
03:28
03:36
03:44
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-21

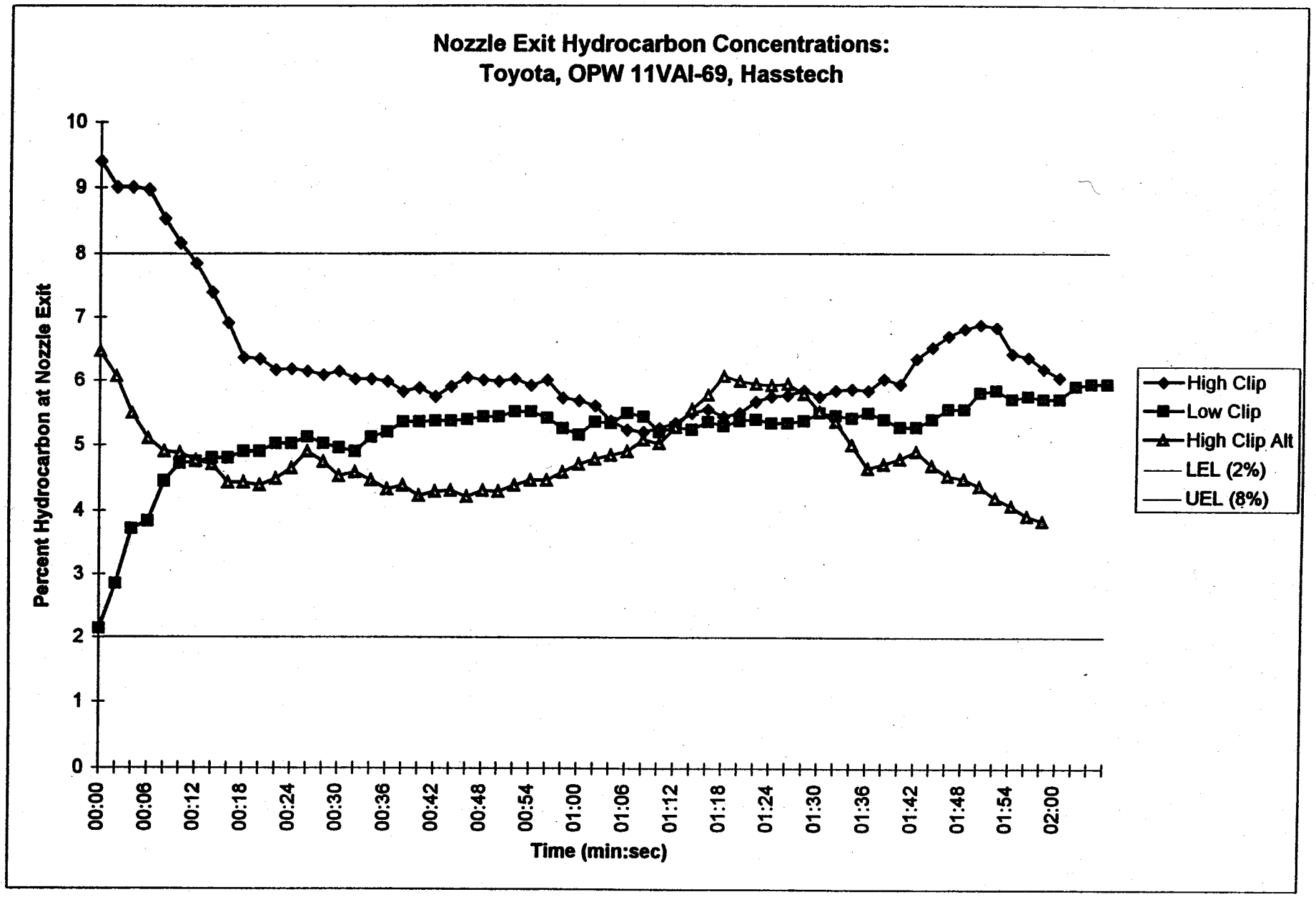

Nozzle Exit Hydrocarbon Concentrations:
Toyota, OPW 11VAI-69, Hasstech
Percent Hydrocarbon at Nozzle Exit
10
9
8
7
6
5
4
3
2
1
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
Time (min:sec)
High Clip
Low Clip
High Clip Alt
LEL (2%)
UEL (8%)

TABLE 6-6

Hasstech Vapor Recovery System w/ Wmco Wheaton A4500 Nozzle, 6-25&26-97

ORVR SYSTEM	R/N	Dispensing Mode	Dispensing Rate*	NOZZLE EXIT HYDROCARBON CONCENTRATION - %C3H8 START Noz	START Dis	MAXIMUM Noz	MAXIMUM Dis	MINIMUM Noz	MINIMUM Dis	FINAL Noz	FINAL Dis	AVERAGE Noz	AVERAGE Dis	V/L@	%ER
Cry Grn	N	HC	7.06	0.8	0.8	2.8	2.2	0.7	0.7	3.7	3.6	2.2	2.0	1.84	100%
Cry Grn	N	HCA	6.19	6.5	6.5	17.0	10.1	1.6	3.0	1.7	1.7	3.0	5.0	1.88	34%
Cry Grn	N	LC	6.21	0.3	0.3	2.4	1.8	0.3	0.3	1.7	1.7	1.7	1.6	2.11	13%
Cry Wht	N	HC	7.10	0.7	0.7	3.9	3.6	0.7	0.7	3.7	3.6	3.6	3.0	1.92	100%
Cry Wht	N	HCA	7.09	12.9	12.9	20.1	15.1	2.6	4.6	2.7	4.6	4.6	7.4	1.88	94%
Cry Wht	N	LC	6.12	0.3	0.3	4.3	2.9	0.3	0.3	2.5	2.8	2.8	2.7	2.17	100%
GM Wht	N	HC	6.98	1.6	1.6	5.4	2.9	0.3	0.8	0.3	0.8	0.8	1.4	2.06	8%
GM Wht	N	HCA	7.14	5.3	5.3	17.3	10.2	0.4	1.9	0.4	1.9	1.9	4.2	1.98	8%
GM Wht	N	LC	6.11	0.7	0.7	3.2	1.8	0.4	0.7	8.4	6.9	0.7	1.0	2.18	3%
Ford	R	HC	7.00	0.5	0.5	4.2	3.8	0.5	0.5	4.0	3.8	3.8	3.2	1.82	100%
Ford	R	HCA	7.09	8.4	8.4	16.9	10.8	3.2	4.4	3.4	4.4	4.4	6.1	2.07	94%
Ford	R	LC	6.28	0.4	0.4	3.3	2.8	0.4	0.4	2.8	2.8	2.8	2.4	2.20	100%
GM Blk	R	HC	7.03	0.2	0.2	5.5	4.2	0.2	0.2	4.4	4.2	4.2	3.3	1.91	100%
GM Blk	R	HCA	6.96	6.9	6.9	22.2	12.6	5.2	6.7	5.2	7.0	7.0	8.5	1.56	96%
GM Blk	R	LC	NA	1.2	1.3	4.3	3.9	1.1	1.2	8.8	7.7	3.9	3.4	2.18	100%
GM Grn	R	HC	7.14	0.4	0.4	8.9	7.7	0.3	0.3	8.8	7.7	7.7	6.1	1.80	8%
GM Grn	R	HCA	7.02	5.6	5.6	19.2	11.0	5.2	5.5	8.8	7.7	8.5	8.9	1.88	40%
GM Grn	R	LC	5.93	0.2	0.2	7.1	6.3	0.2	0.2	7.1	6.3	6.3	5.2	2.11	100%
Honda	R	HC	7.02	0.3	0.3	8.6	6.9	0.3	0.3	8.4	6.9	6.9	5.4	1.89	85%
Honda	R	HCA	6.98	23.1	23.1	26.4	23.3	7.3	9.5	7.6	9.5	9.5	12.9	1.89	35%
Honda	R	LC	6.25	0.2	0.2	9.0	8.2	0.2	0.2	8.7	8.2	8.2	6.9	2.09	0%
Nissan	R	HC	6.94	1.8	1.8	8.7	6.5	1.8	1.8	6.6	6.5	6.5	5.9	1.92	93%
Nissan	R	HCA	6.90	12.9	12.9	22.3	15.4	6.6	8.3	6.6	8.3	8.3	10.6	1.89	84%
Nissan	R	LC	6.25	0.4	0.4	6.3	5.6	0.4	0.4	5.4	5.6	5.6	4.7	2.10	100%
Toyota	R	HC	7.14	0.8	0.8	4.4	2.4	0.8	0.8	6.6	6.5	1.9	1.8	1.93	31%
Toyota	R	HCA	7.02	5.6	5.6	22.5	11.1	3.9	5.5	6.0	5.8	5.8	6.8	1.99	100%
Toyota	R	LC	6.19	0.5	0.5	7.2	3.3	0.5	0.5	2.2	2.1	2.1	2.3	2.22	68%

R/N - Vapor Recirculation (R) or Non-Recirculating (N).
%ER - Percent dispensing time nozzle concentration in flammable range (2% - 8%).
* - Rate in gpm.
@ - V/L based on actual vapor volume.

FIGURE 6-22

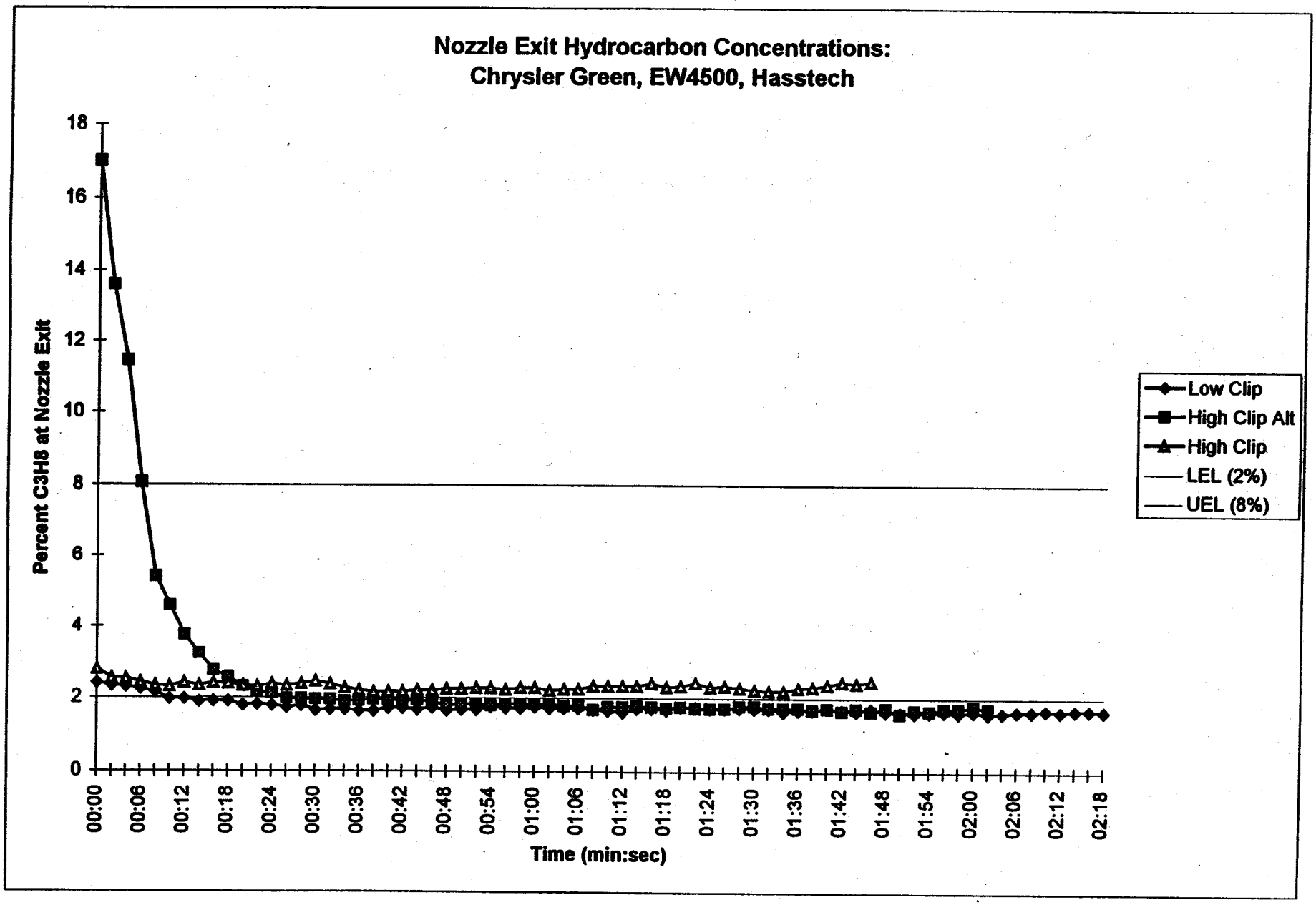

Nozzle Exit Hydrocarbon Concentrations:
Chrysler Green, EW4500, Hasstech
Percent C3H8 at Nozzle Exit
18
16
14
12
10
8
6
4
2
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-23

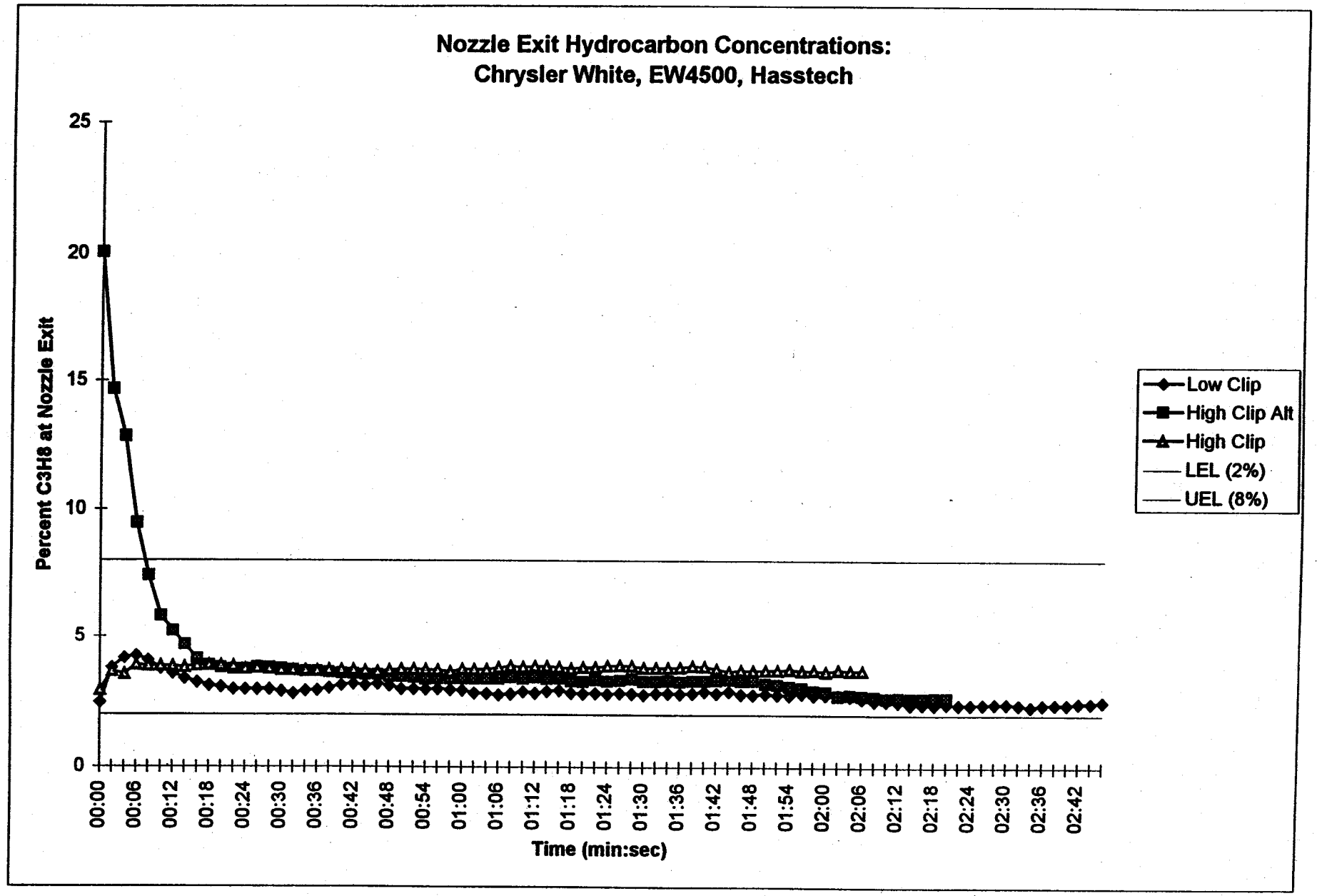

Nozzle Exit Hydrocarbon Concentrations:
Chrysler White, EW4500, Hasstech
Percent C3H8 at Nozzle Exit
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
02:24
02:30
02:36
02:42
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-24

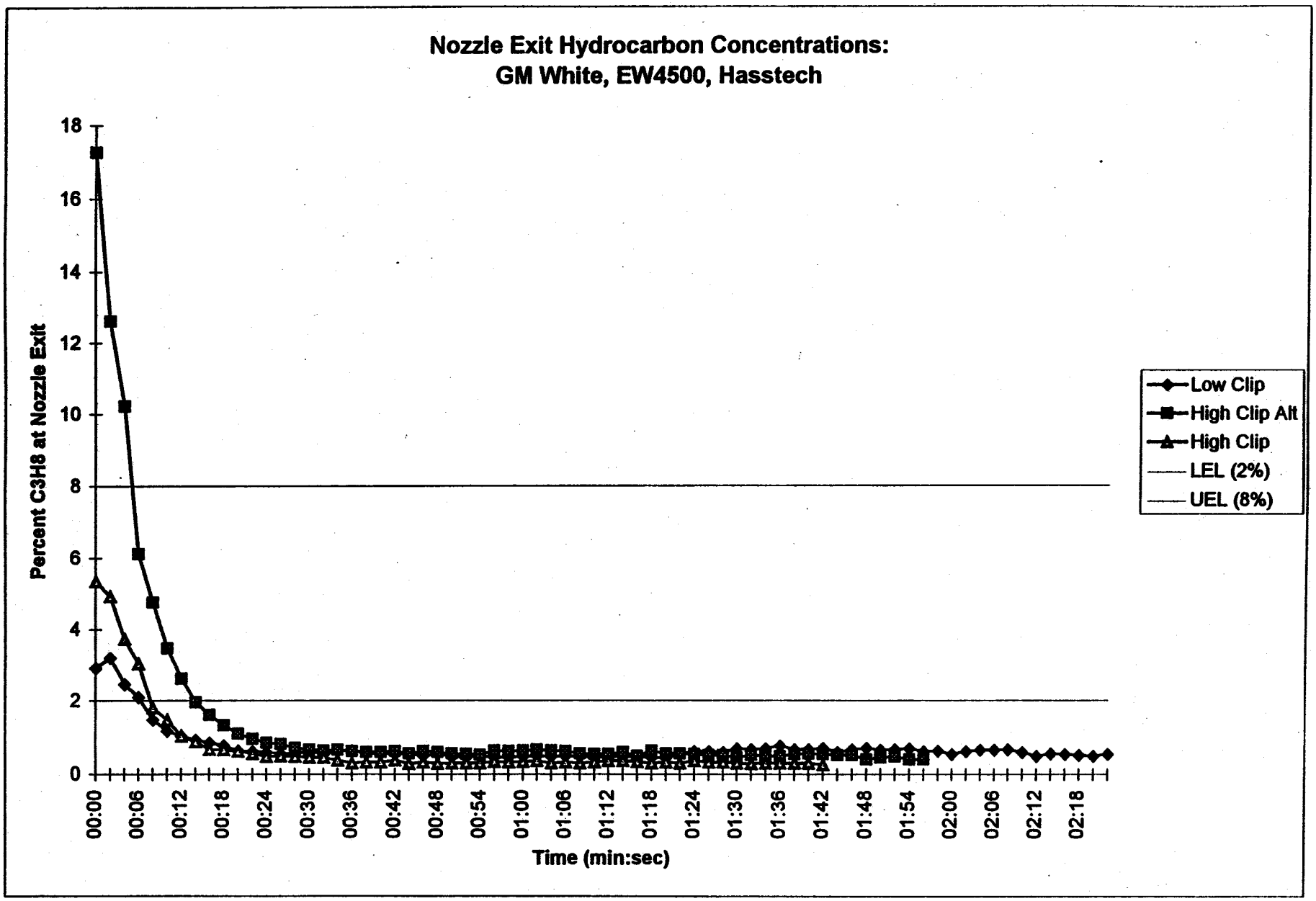

Nozzle Exit Hydrocarbon Concentrations:
GM White, EW4500, Hasstech
Percent C3H8 at Nozzle Exit
18
16
14
12
10
8
6
4
2
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-25

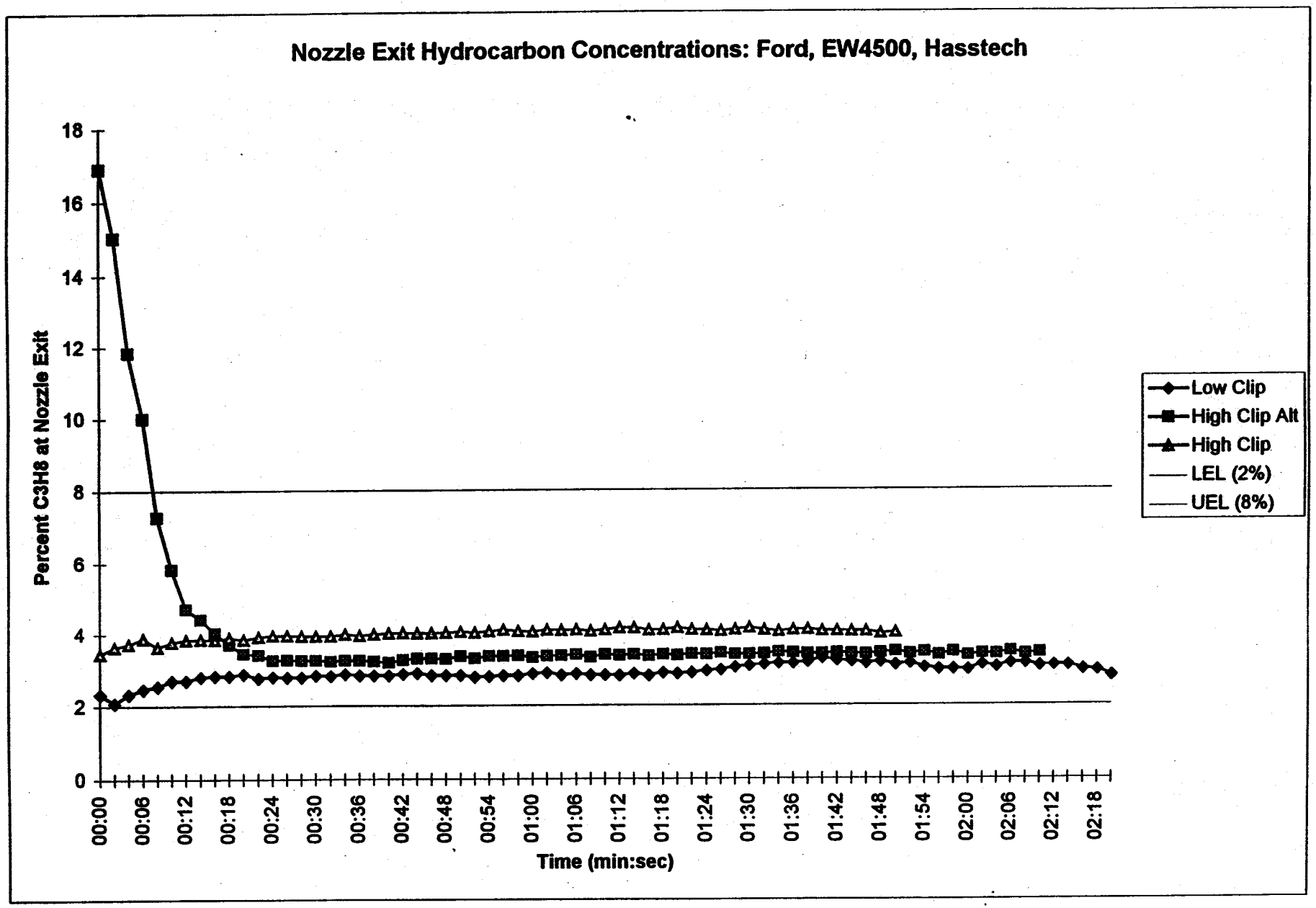

Nozzle Exit Hydrocarbon Concentrations: Ford, EW4500, Hasstech
Percent C3H8 at Nozzle Exit
18
16
14
12
10
8
6
4
2
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-26

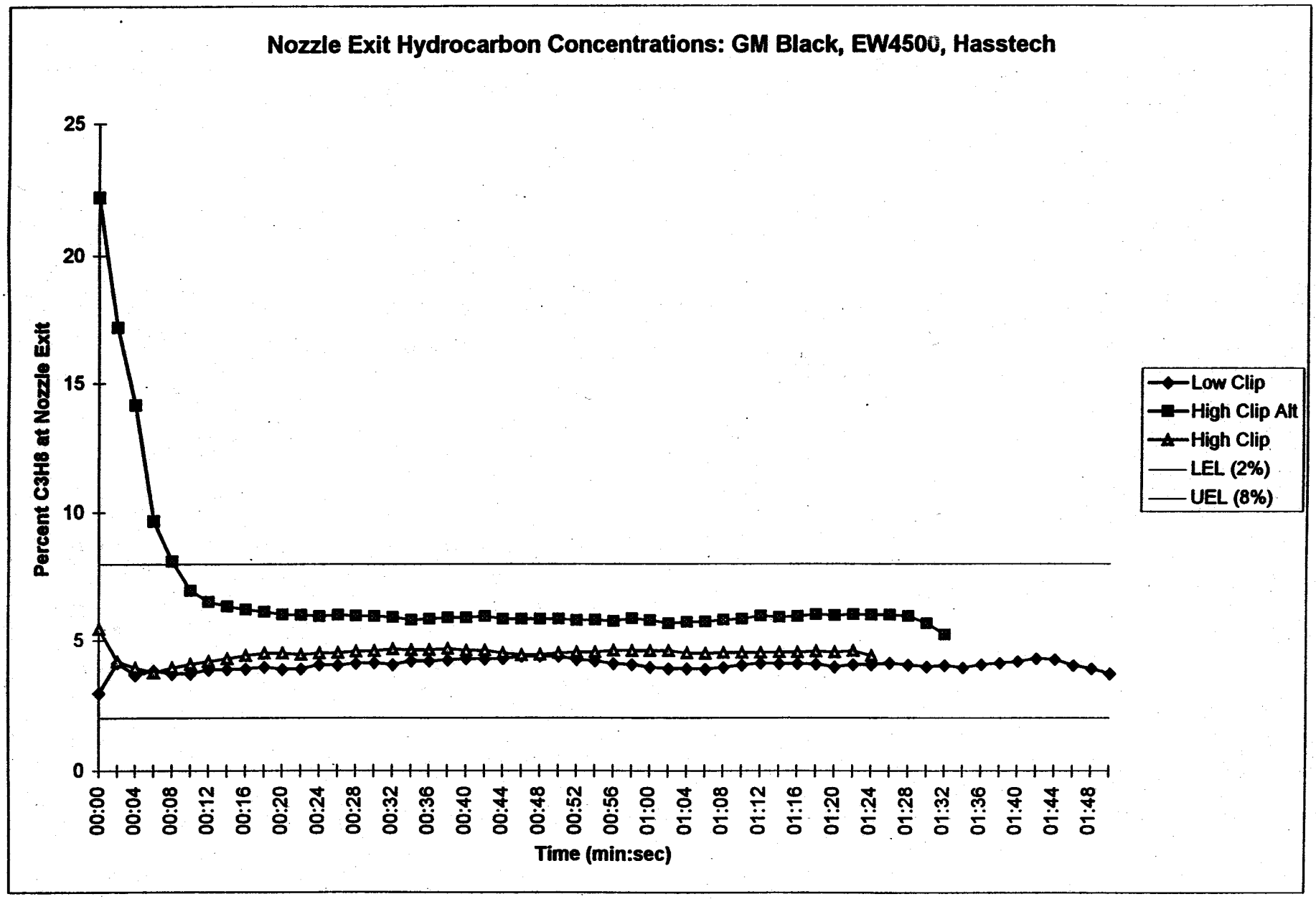

Nozzle Exit Hydrocarbon Concentrations: GM Black, EW4500, Hasstech
Percent C3H8 at Nozzle Exit
25
20
15
10
5
0
00:00
00:04
00:08
00:12
00:16
00:20
00:24
00:28
00:32
00:36
00:40
00:44
00:48
00:52
00:56
01:00
01:04
01:08
01:12
01:16
01:20
01:24
01:28
01:32
01:36
01:40
01:44
01:48
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-27

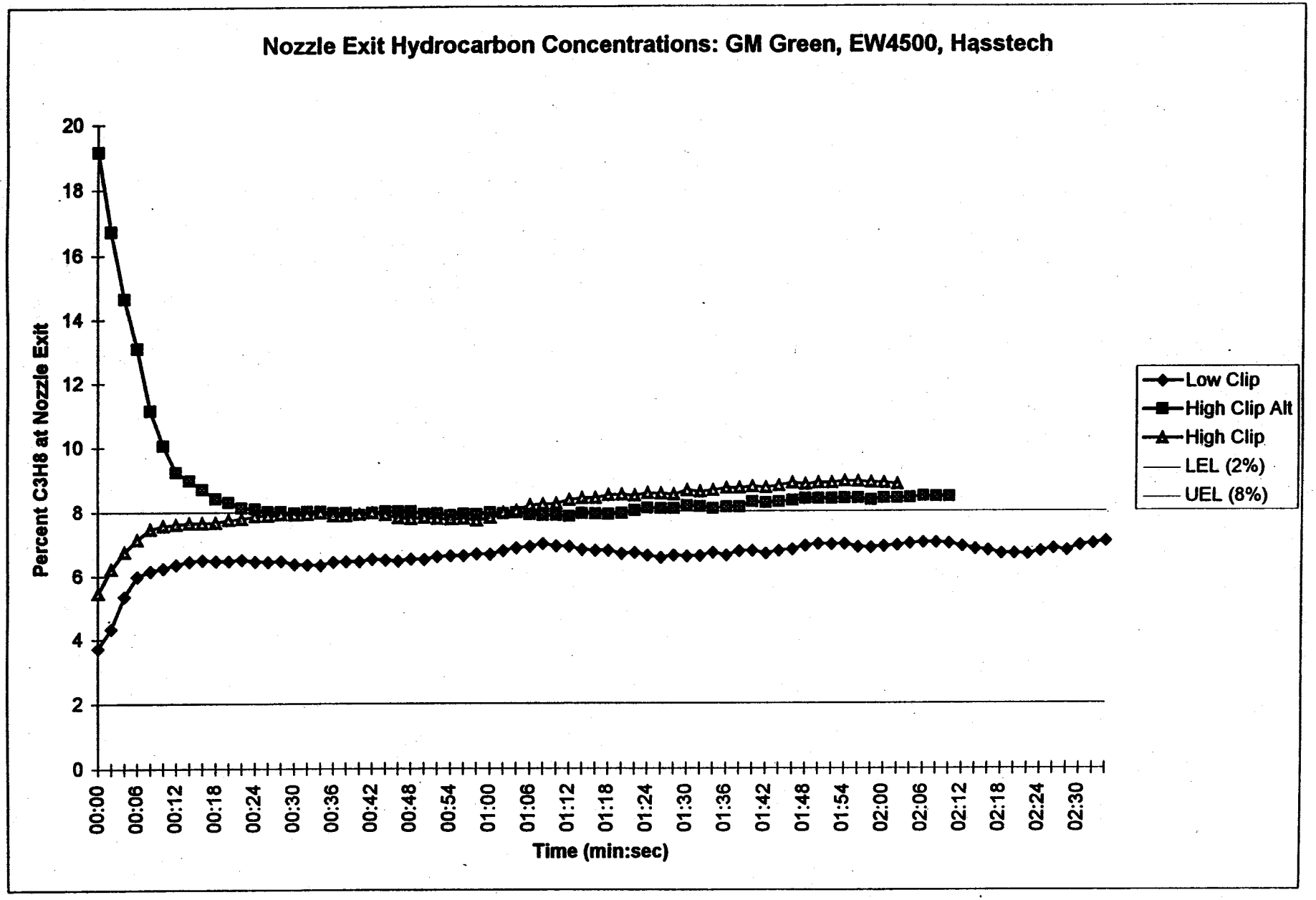

Nozzle Exit Hydrocarbon Concentrations: GM Green, EW4500, Hasstech
Percent C3H8 at Nozzle Exit
20
18
16
14
12
10
8
6
4
2
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
02:24
02:30
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-28

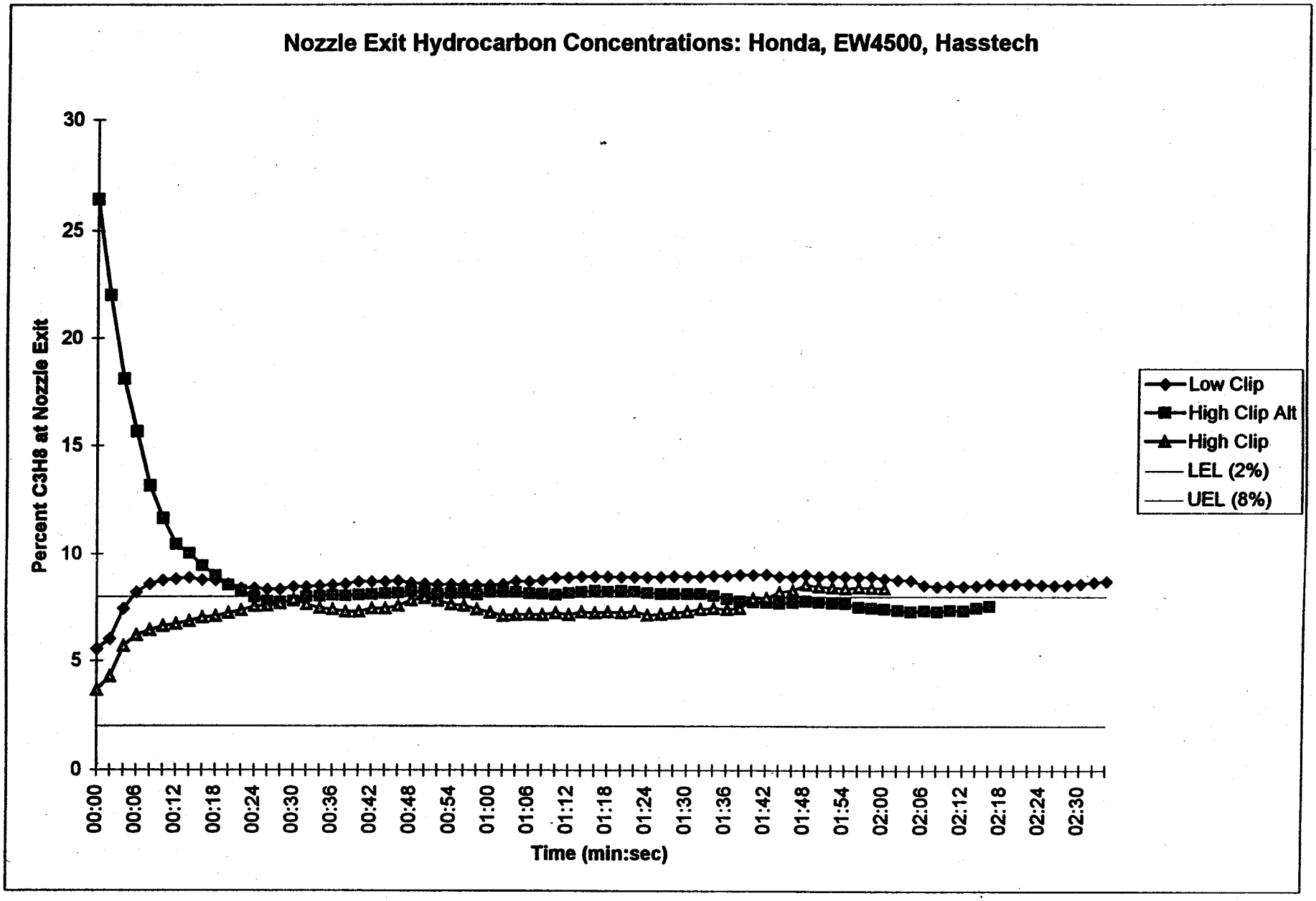

Nozzle Exit Hydrocarbon Concentrations: Honda, EW4500, Hasstech
Percent C3H8 at Nozzle Exit
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
02:24
02:30
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-29

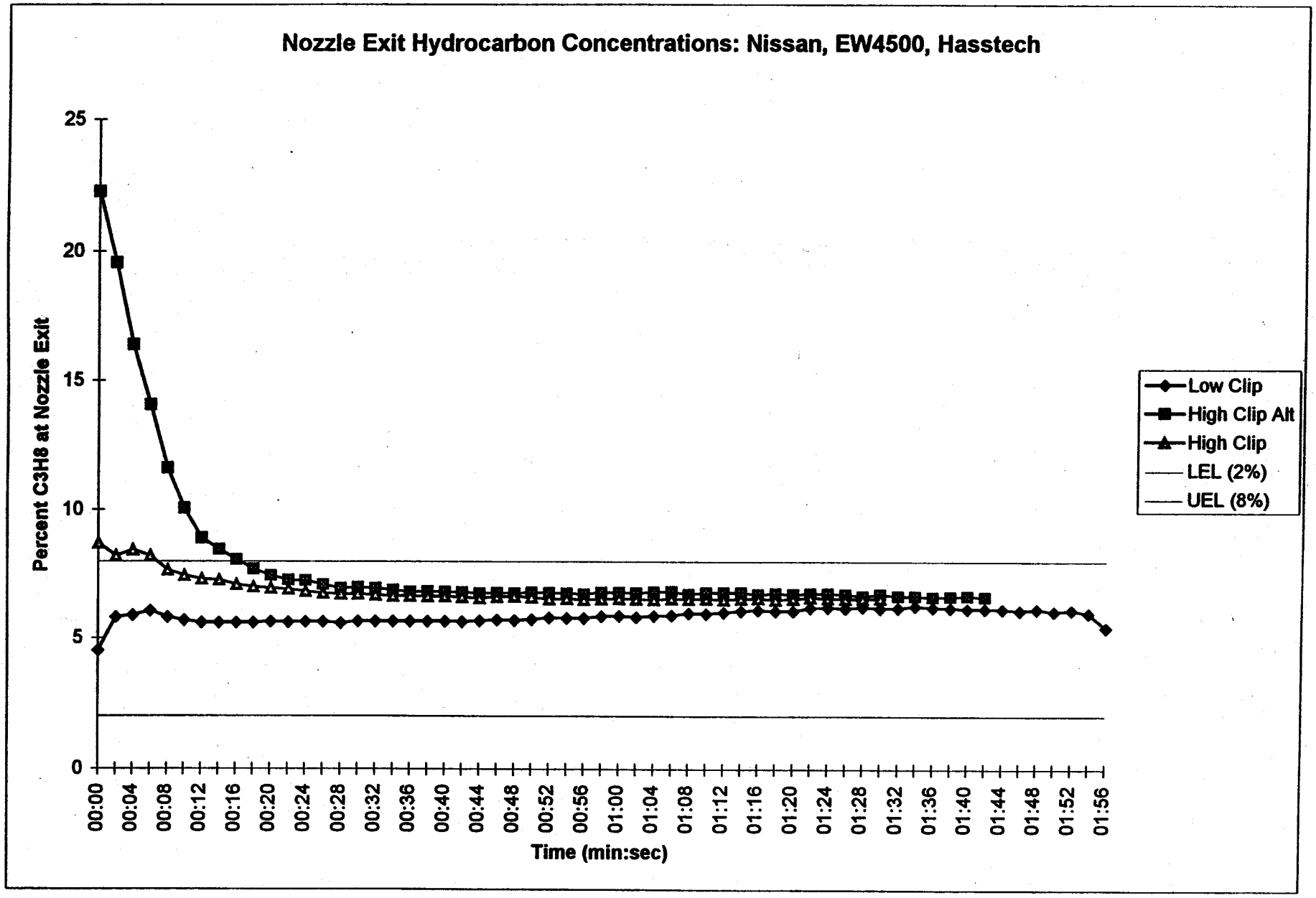

Nozzle Exit Hydrocarbon Concentrations: Nissan, EW4500, Hasstech
Percent C3H8 at Nozzle Exit
25
20
15
10
5
0
00:00
00:04
00:08
00:12
00:16
00:20
00:24
00:28
00:32
00:36
00:40
00:44
00:48
00:52
00:56
01:00
01:04
01:08
01:12
01:16
01:20
01:24
01:28
01:32
01:36
01:40
01:44
01:48
01:52
01:56
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-30

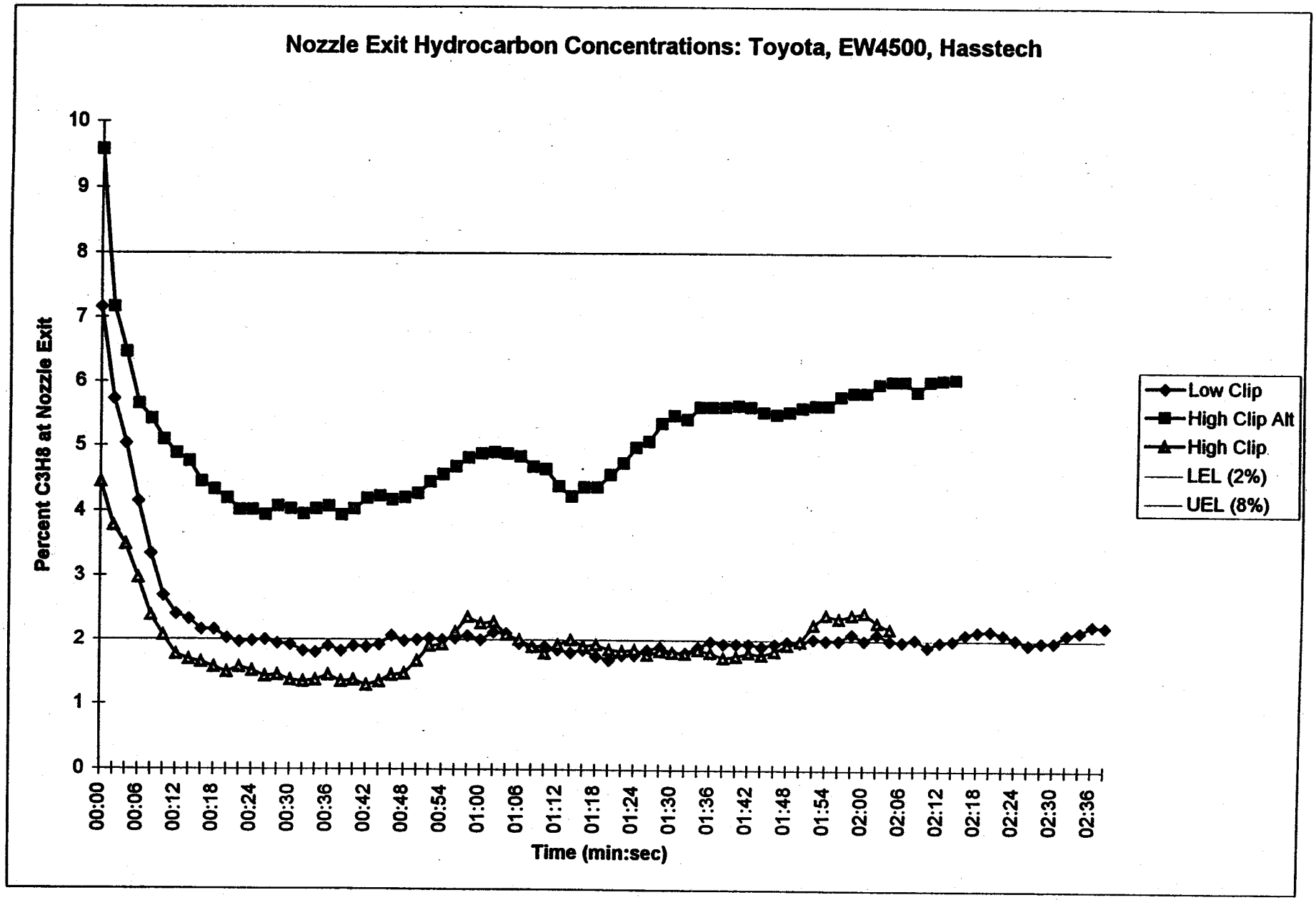

Nozzle Exit Hydrocarbon Concentrations: Toyota, EW4500, Hasstech
Percent C3H8 at Nozzle Exit
10
9
8
7
6
5
4
3
2
1
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
02:24
02:30
02:36
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

TABLE 6-7

Hasstech Vapor Recovery System w/ Husky V34 Nozzle, 6-25&26-97

ORVR SYSTEM	R/N	Dispensing Mode	Dispensing Rate*	NOZZLE EXIT HYDROCARBON CONCENTRATION - %C3H8 START Noz	START Dis	MAXIMUM Noz	MAXIMUM Dis	MINIMUM Noz	MINIMUM Dis	FINAL Noz	FINAL Dis	AVERAGE Noz	AVERAGE Dis	V/L@	%ER
Cry Grn	N	HC	7.84	3.7	3.7	5.9	4.1	1.8	2.3	2.0	2.3	2.3	2.9	1.92	100%
Cry Grn	N	HCA	7.69	6.7	6.7	27.0	12.8	3.1	5.6	3.3	5.2	6.0	8.3	1.95	91%
Cry Grn	N	LC	5.33	0.6	0.6	3.1	2.2	0.6	0.6	2.3	2.1	2.1	2.0	1.95	100%
Cry Wht	N	HC	7.82	3.0	3.1	6.1	3.9	1.9	2.6	2.0	2.6	2.6	3.0	1.88	100%
Cry Wht	N	HCA	7.84	9.9	9.9	24.1	14.4	2.1	4.3	2.4	4.3	4.3	7.3	1.88	92%
Cry Wht	N	LC	3.75	1.4	1.4	4.5	3.8	1.4	1.4	2.8	2.8	2.8	3.0	1.82	100%
GM Wht	N	HC	7.68	0.6	0.6	4.5	2.1	0.5	0.6	0.7	0.69	0.9	1.2	3.57	7%
GM Wht	N	HCA	7.82	6.0	6.0	25.4	11.6	0.6	2.8	0.6	2.8	2.8	5.7	3.56	12%
GM Wht	N	LC	4.00	0.5	0.5	2.2	1.3	0.3	0.7	0.7	0.7	0.7	0.9	3.51	0%
Ford	R	HC	7.74	0.6	0.6	3.6	3.1	0.6	0.6	3.6	3.1	3.1	2.4	3.57	100%
Ford	R	HCA	7.89	29.4	29.4	34.3	29.4	3.8	7.6	3.8	7.6	7.6	14.4	3.31	90%
Ford	R	LC	3.75	0.9	0.9	3.4	3.0	0.8	0.9	2.7	3.0	3.0	2.8	3.37	100%
GM Blk	R	HC	7.76	0.2	0.2	4.1	3.3	0.2	0.2	4.1	3.3	3.3	2.4	1.88	100%
GM Blk	R	HCA	NA	2.5	2.5	25.6	10.9	2.4	2.5	4.1	6.0	6.0	7.3	1.87	89%
GM Blk	R	LC	4.10	0.2	0.2	4.3	3.9	0.1	0.2	2.7	3.9	3.9	3.3	1.88	100%
GM Grn	R	HC	7.14	3.3	3.3	7.6	5.5	3.2	3.2	6.0	5.5	5.5	5.2	1.82	100%
GM Grn	R	HCA	7.02	4.3	4.4	25.3	11.9	4.1	4.2	6.1	6.7	6.7	7.8	1.74	91%
GM Grn	R	LC	5.93	0.7	0.7	6.5	5.6	0.7	0.7	5.7	5.6	5.6	5.0	1.85	100%
Honda	R	HC	7.69	1.3	1.3	7.8	6.9	1.1	1.2	7.6	6.9	6.9	5.6	1.94	100%
Honda	R	HCA	7.67	6.5	6.5	29.0	15.8	6.1	6.3	8.1	9.7	9.7	11.3	1.91	0%
Honda	R	LC	4.00	1.5	1.5	8.6	7.3	1.4	1.5	7.9	7.3	7.3	6.6	1.86	95%
Nissan	R	HC	7.66	0.5	0.5	7.3	6.3	0.5	0.5	7.0	6.3	6.3	4.7	1.89	100%
Nissan	R	HCA	7.38	4.6	4.6	23.8	12.6	4.4	4.6	7.0	8.2	8.2	9.2	1.92	83%
Nissan	R	LC	4.91	2.7	2.7	8.1	5.5	2.5	2.6	5.4	5.4	5.4	5.3	1.80	100%
Toyota	R	HC	7.69	0.7	0.7	8.5	5.3	0.6	0.7	6.1	5.2	5.2	4.7	3.60	96%
Toyota	R	HCA	7.27	6.7	6.7	25.3	13.2	5.4	6.4	6.2	7.2	7.1	8.7	3.55	88%
Toyota	R	LC	4.00	0.6	0.6	8.7	6.4	0.6	0.6	6.4	6.3	6.3	5.9	3.48	98%

R/N	-	Vapor Recirculation (R) or Non-Recirculating (N).
%ER	-	Percent of dispensing time nozzle concentration in flammable range (2% - 8%).
*	-	Rate in gpm.
@	-	V/L based on actual vapor volume.

FIGURE 6-31

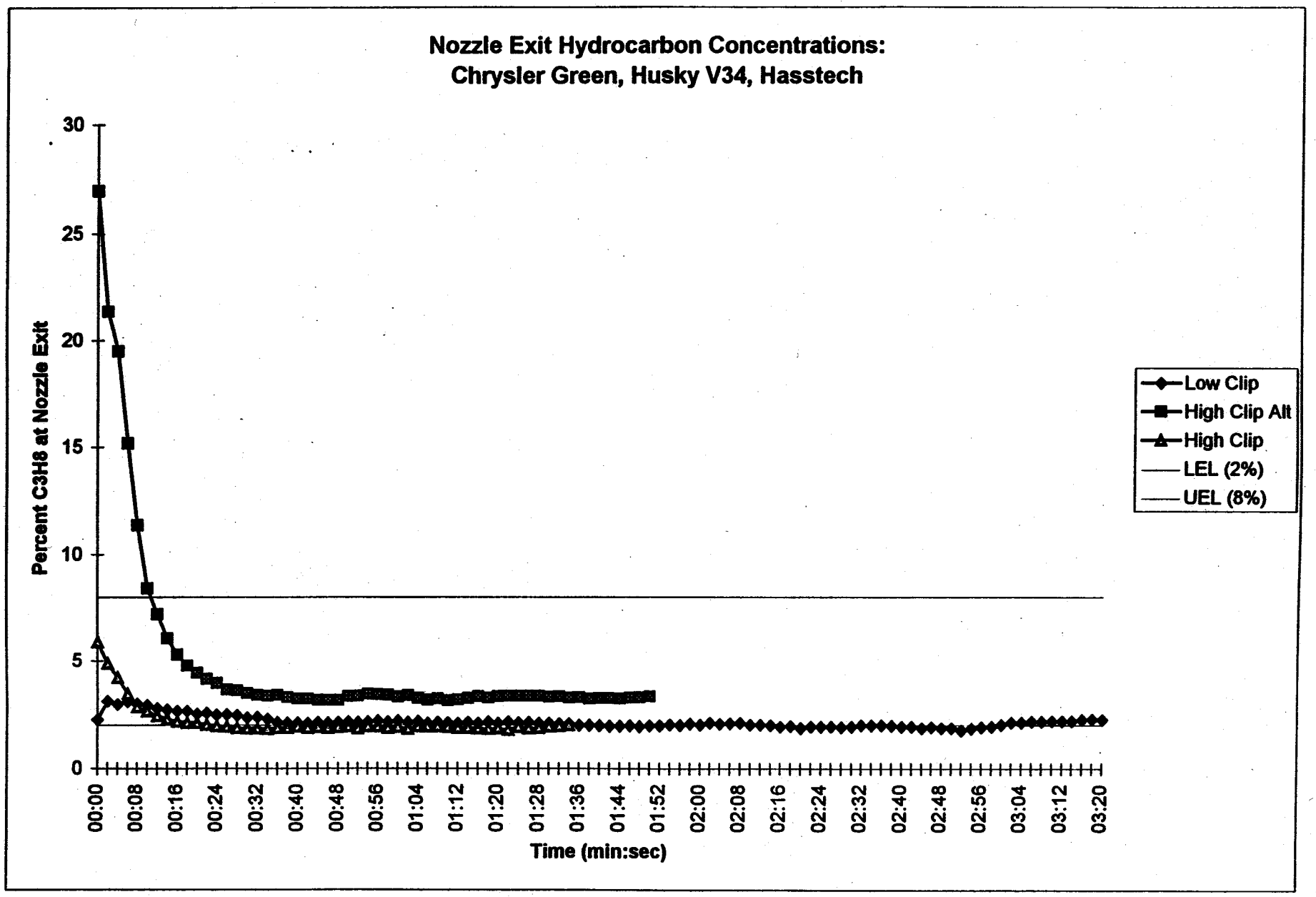

Nozzle Exit Hydrocarbon Concentrations:
Chrysler Green, Husky V34, Hasstech
Percent C3H8 at Nozzle Exit
30
25
20
15
10
5
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
02:56
03:04
03:12
03:20
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-32

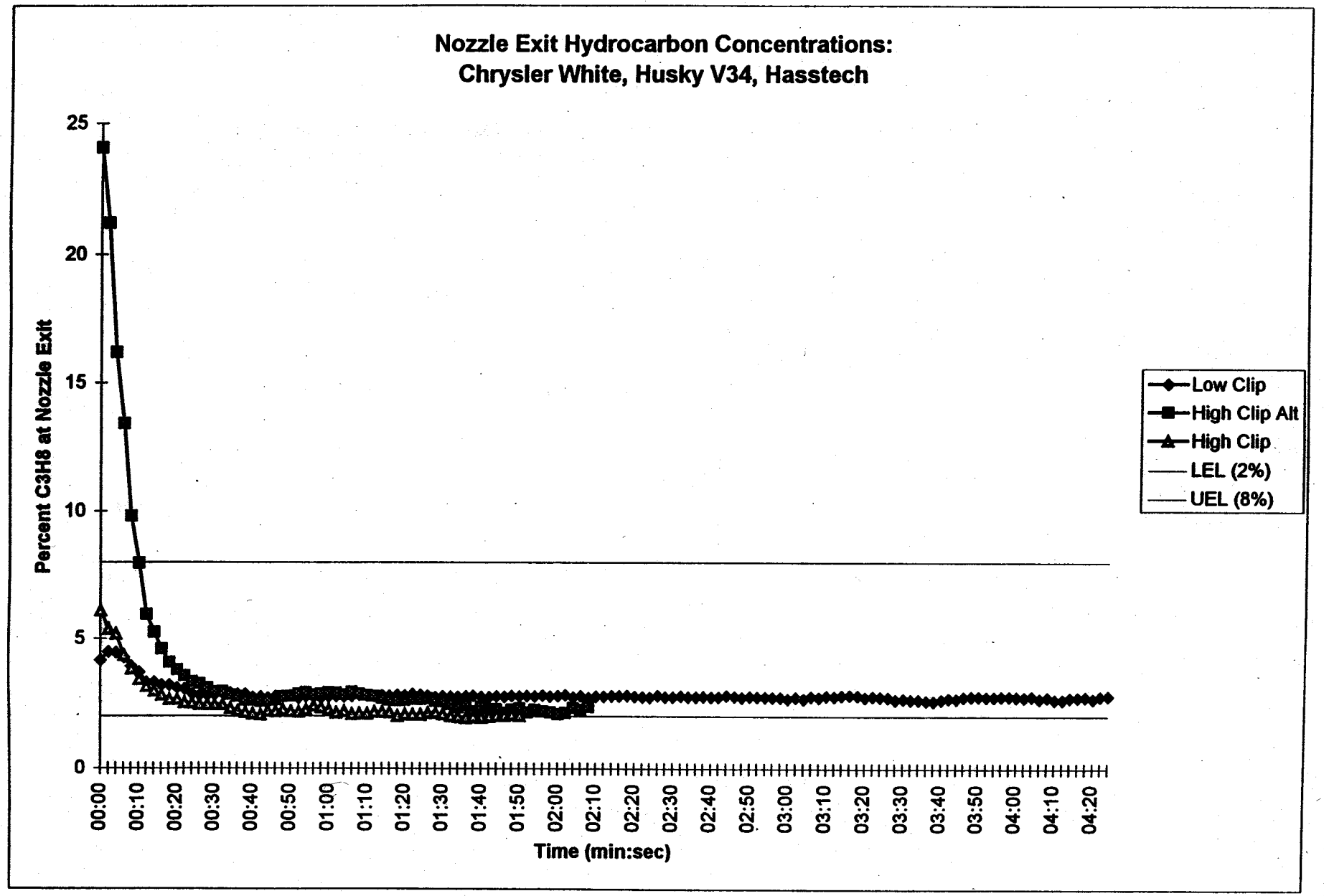

Nozzle Exit Hydrocarbon Concentrations:
Chrysler White, Husky V34, Hasstech
Percent C3H8 at Nozzle Exit
25
20
15
10
5
0
00:00
00:10
00:20
00:30
00:40
00:50
01:00
01:10
01:20
01:30
01:40
01:50
02:00
02:10
02:20
02:30
02:40
02:50
03:00
03:10
03:20
03:30
03:40
03:50
04:00
04:10
04:20
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-33

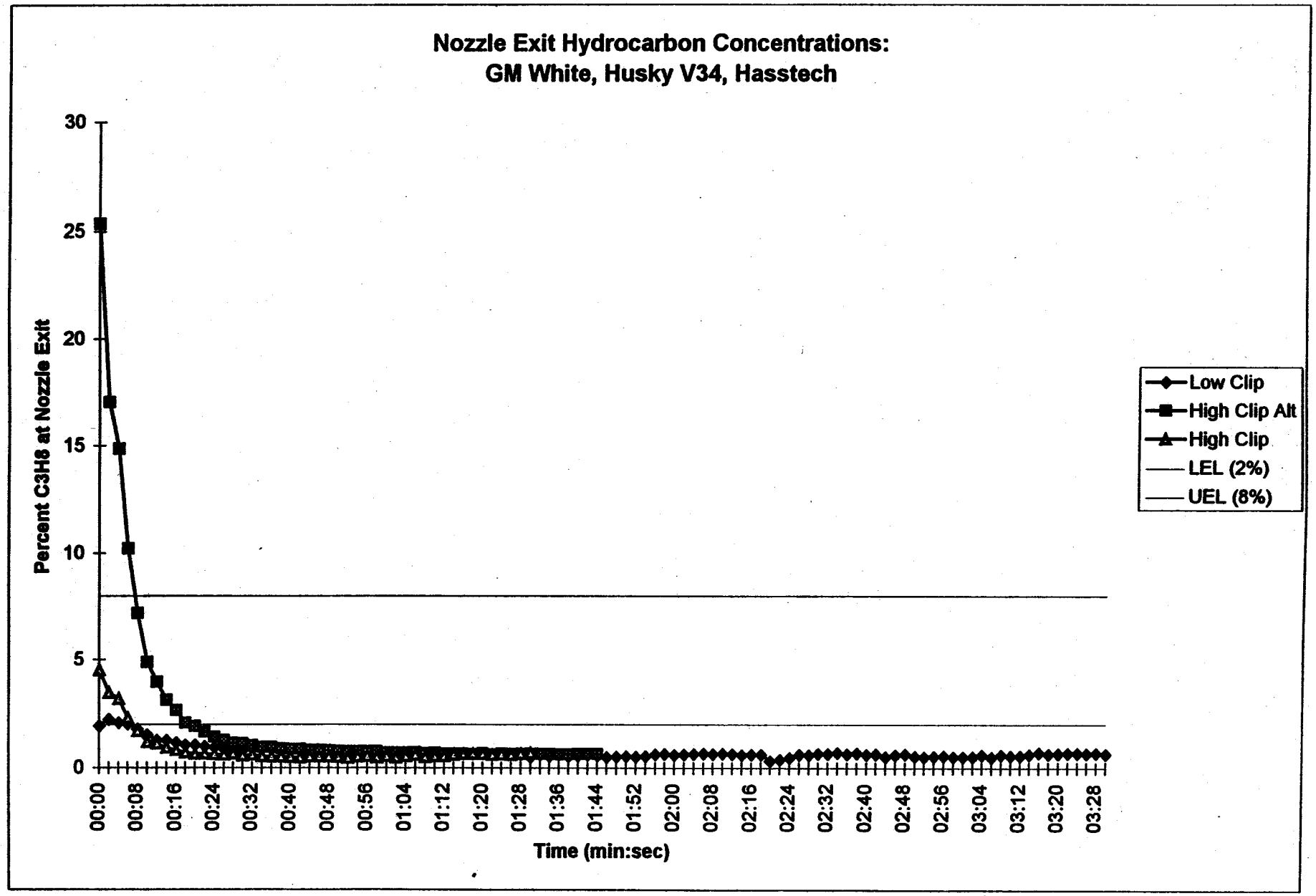

Nozzle Exit Hydrocarbon Concentrations:
GM White, Husky V34, Hasstech
Percent C3H8 at Nozzle Exit
30
25
20
15
10
5
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
02:56
03:04
03:12
03:20
03:28
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-34

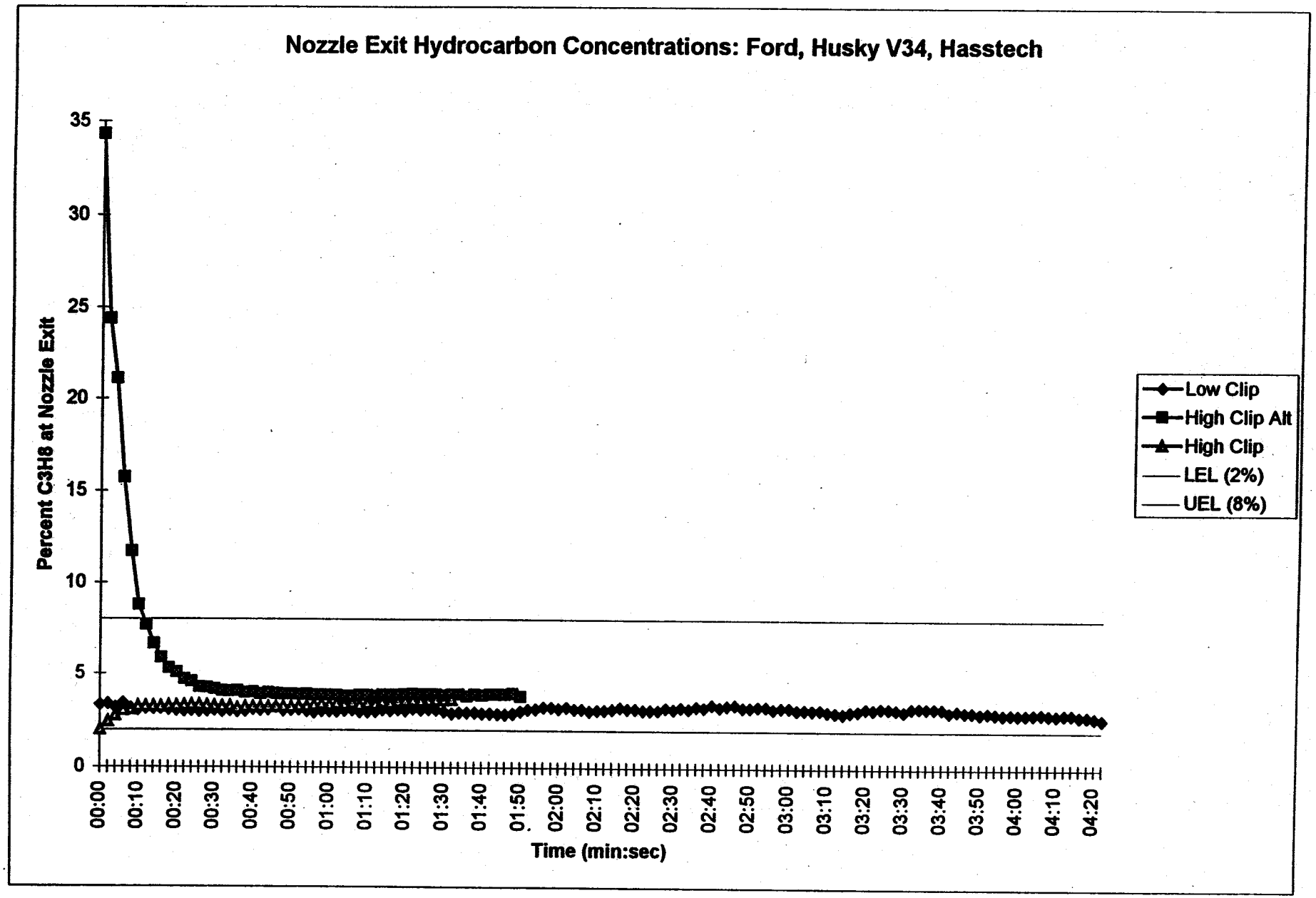

Nozzle Exit Hydrocarbon Concentrations: Ford, Husky V34, Hasstech
Percent C3H8 at Nozzle Exit
35
30
25
20
15
10
5
0
00:00
00:10
00:20
00:30
00:40
00:50
01:00
01:10
01:20
01:30
01:40
01:50
02:00
02:10
02:20
02:30
02:40
02:50
03:00
03:10
03:20
03:30
03:40
03:50
04:00
04:10
04:20
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-35

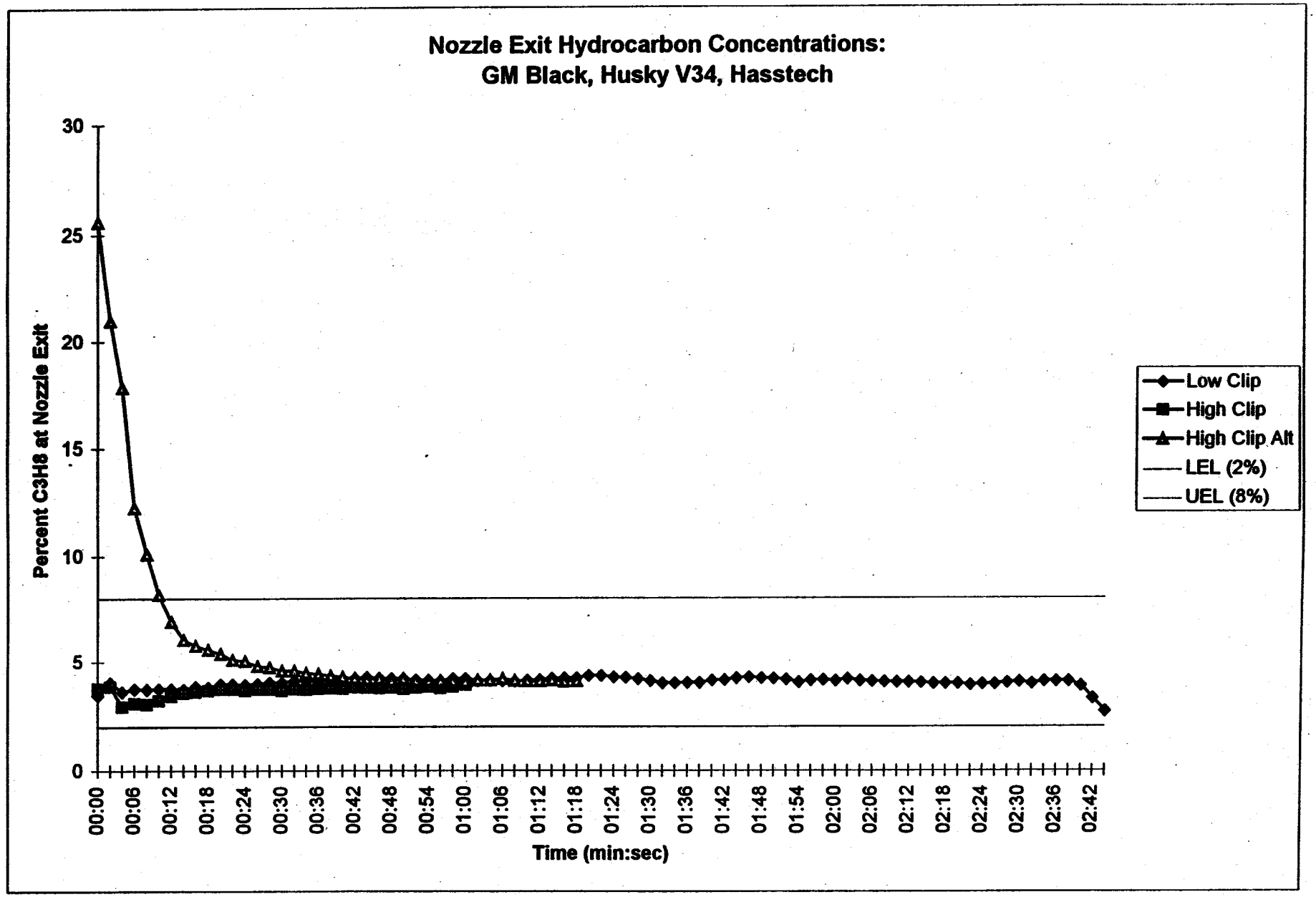

Nozzle Exit Hydrocarbon Concentrations:
GM Black, Husky V34, Hasstech
Percent C3H8 at Nozzle Exit
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
02:24
02:30
02:36
02:42
Time (min:sec)
Low Clip
High Clip
High Clip Alt
LEL (2%)
UEL (8%)

FIGURE 6-36

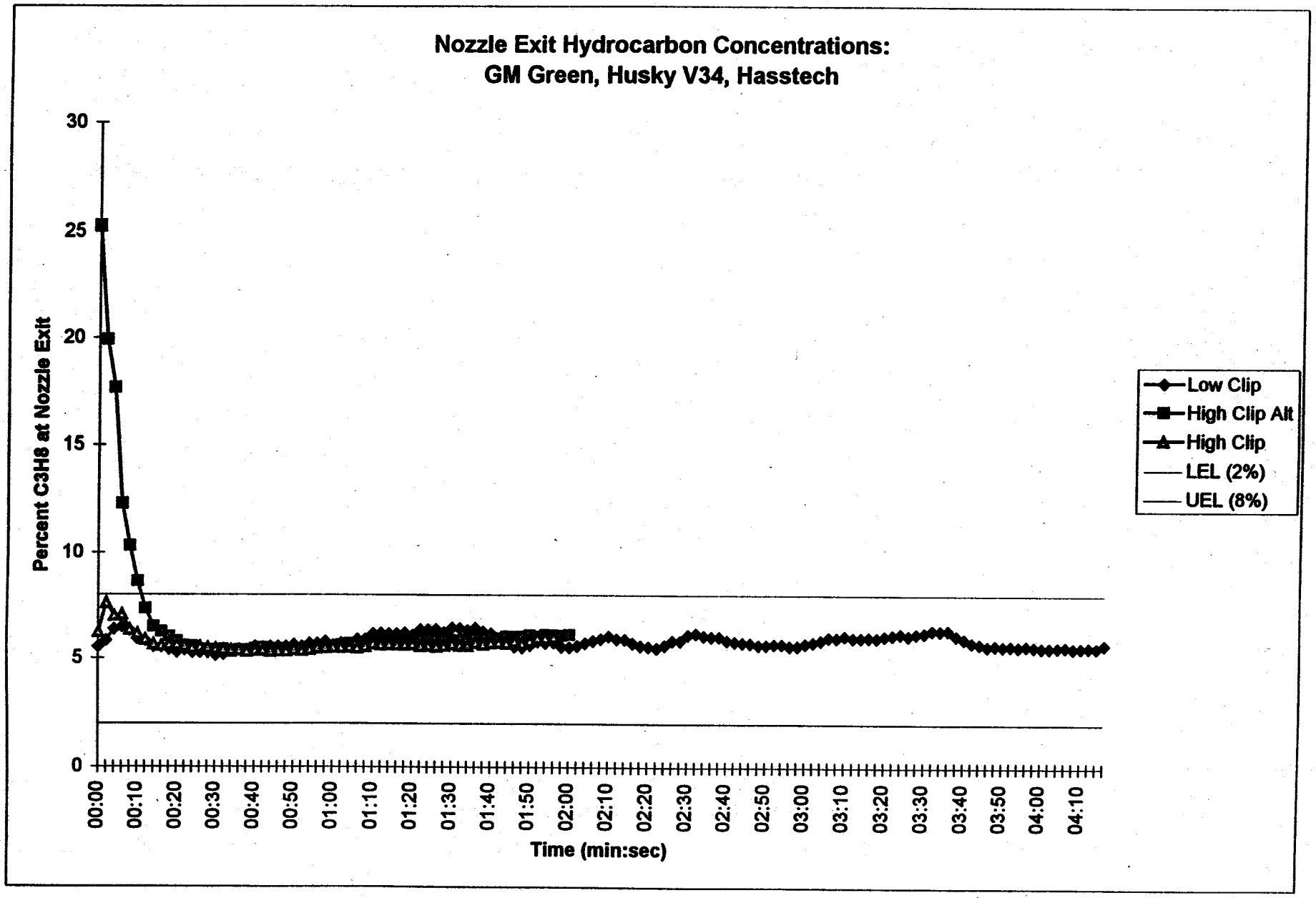

Nozzle Exit Hydrocarbon Concentrations:
GM Green, Husky V34, Hasstech
Percent C3H8 at Nozzle Exit
30
25
20
15
10
5
0
00:00
00:10
00:20
00:30
00:40
00:50
01:00
01:10
01:20
01:30
01:40
01:50
02:00
02:10
02:20
02:30
02:40
02:50
03:00
03:10
03:20
03:30
03:40
03:50
04:00
04:10
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-37

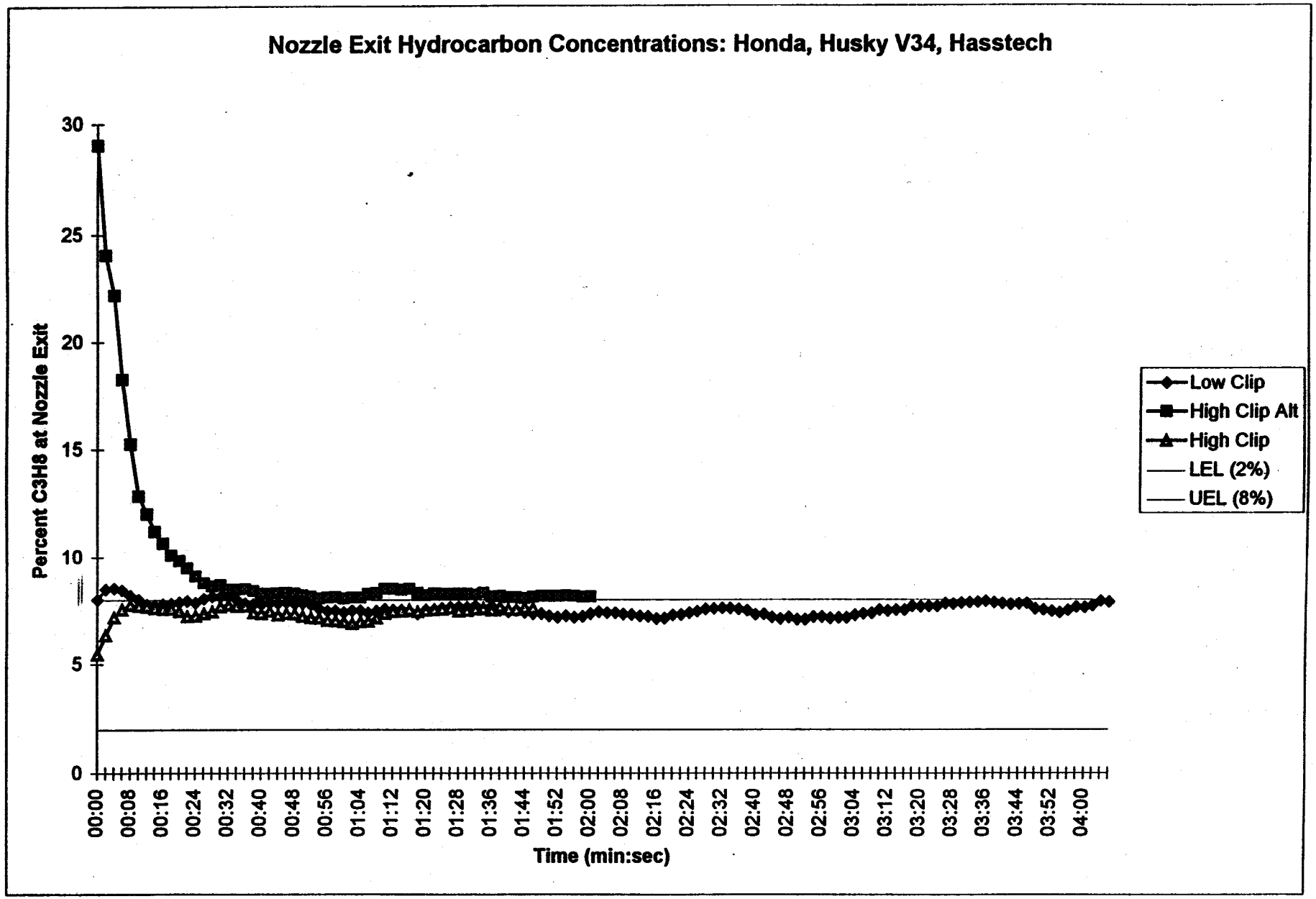

Nozzle Exit Hydrocarbon Concentrations: Honda, Husky V34, Hasstech
Percent C3H8 at Nozzle Exit
30
25
20
15
10
5
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
02:56
03:04
03:12
03:20
03:28
03:36
03:44
03:52
04:00
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-38

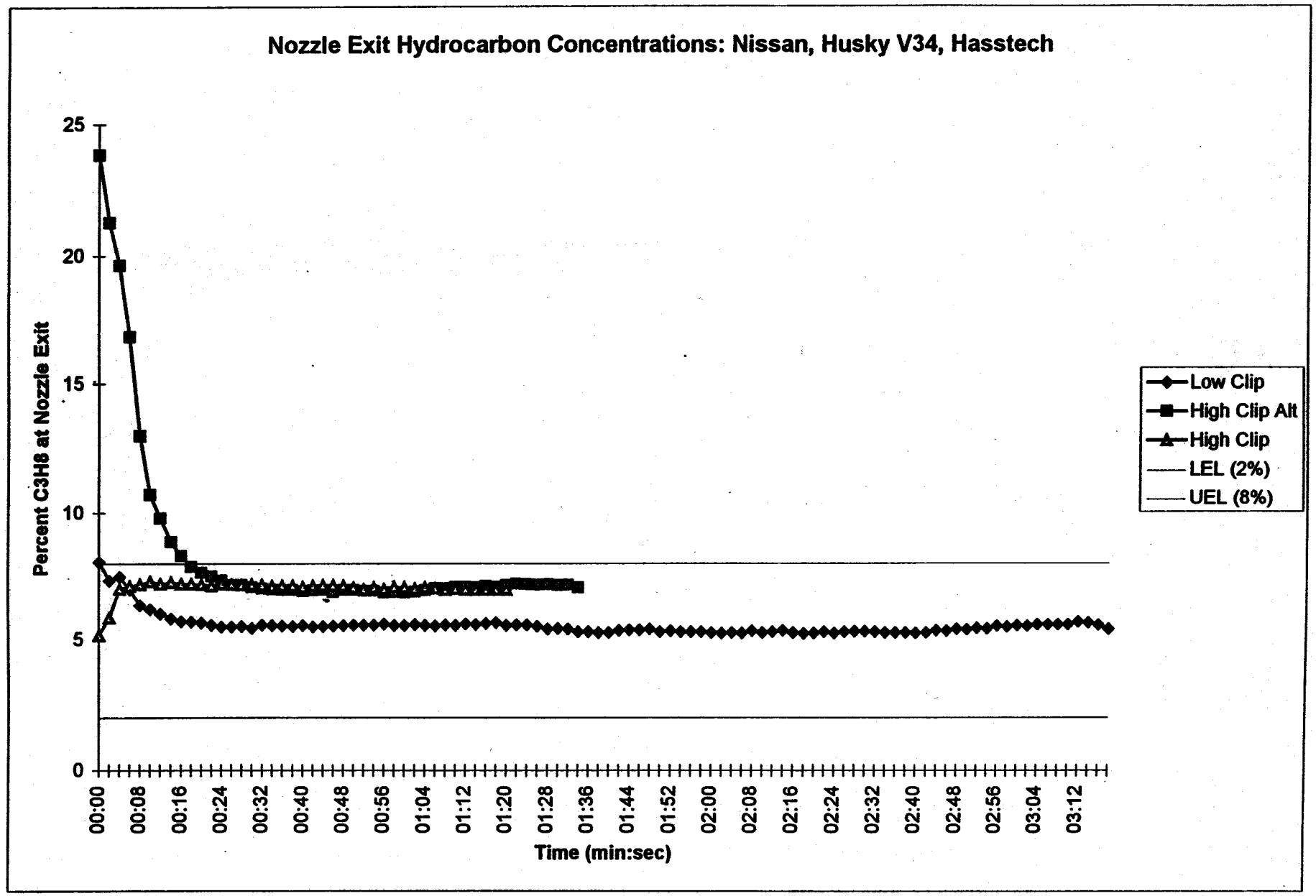

Nozzle Exit Hydrocarbon Concentrations: Nissan, Husky V34, Hasstech
Percent C3H8 at Nozzle Exit
25
20
15
10
5
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
02:56
03:04
03:12
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-39

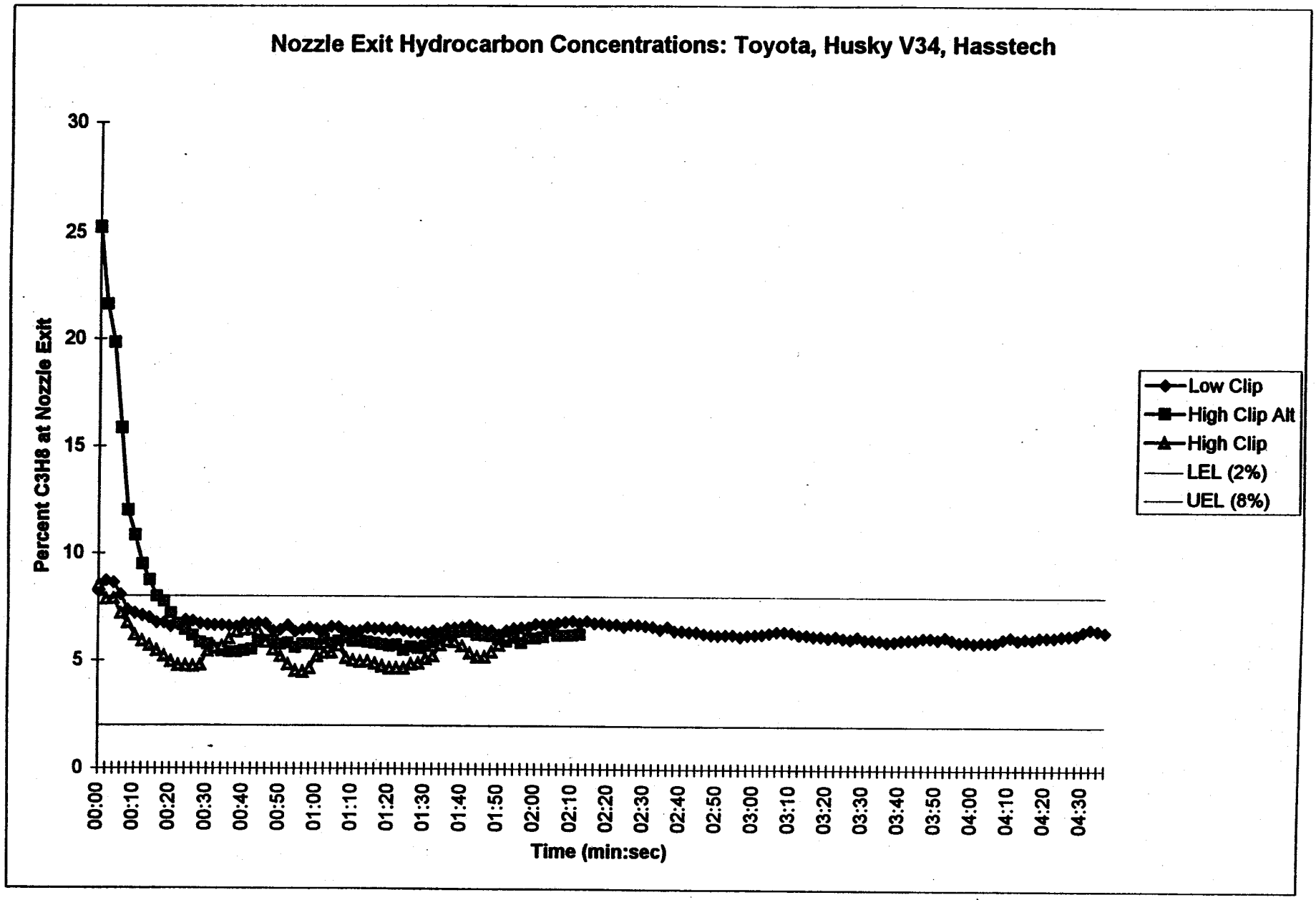

Nozzle Exit Hydrocarbon Concentrations: Toyota, Husky V34, Hasstech
Percent C3H8 at Nozzle Exit
30
25
20
15
10
5
0
00:00
00:10
00:20
00:30
00:40
00:50
01:00
01:10
01:20
01:30
01:40
01:50
02:00
02:10
02:20
02:30
02:40
02:50
03:00
03:10
03:20
03:30
03:40
03:50
04:00
04:10
04:20
04:30
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

TABLE 6-8

Gilbarco Vapor Recovery System w/ Husky V3 Nozzle, 7-15-97

ORVR SYSTEM	R/N	Dispensing Mode	Dispensing Rate*	NOZZLE EXIT HYDROCARBON CONCENTRATION - %C3H8 START Noz	START Dis	MAXIMUM Noz	MAXIMUM Dis	MINIMUM Noz	MINIMUM Dis	FINAL Noz	FINAL Dis	AVERAGE Noz	AVERAGE Dis	V/L@	%ER
Cry Grn	N	HC	8.04	3.1	3.1	4.4	3.5	0.8	1.6	1.1	1.6	1.6	2.4	1.08	18%
Cry Grn	N	HCA	8.06	32.3	32.3	37.5	34.0	2.6	10.9	2.6	10.9	10.8	20.9	1.27	76%
Cry Grn	N	LC	4.22	3.4	3.4	5.8	4.7	2.3	2.9	2.5	2.9	2.8	3.4	1.58	100%
Cry Wht	N	HC	8.27	7.1	7.1	10.2	8.5	4.0	5.2	4.3	5.2	5.2	6.4	1.04	93%
Cry Wht	N	HCA	7.92	40.5	40.5	41.5	40.7	5.3	13.3	6.4	13.3	13.2	23.6	1.04	61%
Cry Wht	N	LC	4.11	3.9	3.9	5.1	4.3	3.0	3.4	3.1	3.4	3.4	3.7	1.13	100%
GM Wht	N	HC	8.01	8.7	8.7	8.7	8.7	1.3	2.9	1.4	2.9	2.9	5.0	1.09	22%
GM Wht	N	HCA	7.97	21.4	21.4	25.8	22.8	2.4	7.7	2.4	7.7	7.7	14.0	1.06	79%
GM Wht	N	LC	3.82	6.7	6.7	8.2	7.5	0.4	1.6	0.4	1.6	1.6	3.5	1.08	17%
Ford	R	HC	8.00	7.2	7.2	10.2	8.2	5.2	6.0	5.8	6.0	6.0	6.7	1.07	96%
Ford	R	HCA	7.89	8.6	8.6	25.8	17.1	5.8	8.6	5.9	8.8	8.7	11.7	1.06	78%
Ford	R	LC	3.94	6.6	6.6	8.0	7.2	5.0	5.3	5.2	5.3	5.3	5.8	1.12	100%
GM Blk	R	HC	8.16	29.2	29.2	37.4	31.4	7.0	13.3	7.0	13.3	13.2	21.0	1.11	67%
GM Blk	R	HCA	7.90	38.0	38.0	38.9	38.2	7.9	18.3	7.9	18.3	18.2	28.4	1.07	20%
GM Blk	R	LC	3.48	0.7	0.7	8.0	6.2	0.7	0.7	7.8	6.2	6.2	4.0	0.98	94%
GM Grn	R	HC	7.89	10.2	10.2	12.6	11.0	8.5	9.1	8.9	9.1	9.0	9.7	1.09	0%
GM Grn	R	HCA	7.79	31.9	31.9	33.9	32.5	9.0	14.8	9.0	14.8	14.8	21.9	1.05	0%
GM Grn	R	LC	3.66	6.8	6.8	10.5	8.9	6.7	6.8	8.8	8.7	8.7	8.5	1.09	5%
Honda	R	HC	8.00	2.3	2.3	9.4	7.9	2.2	2.2	9.4	7.9	7.9	6.1	1.06	33%
Honda	R	HCA	7.94	42.7	42.7	42.8	42.7	9.8	17.4	9.8	17.4	20.2	28.6	1.04	0%
Honda	R	LC	3.82	5.2	5.2	10.3	9.6	5.2	5.2	10.3	9.6	9.6	8.7	1.08	2%
Nissan	R	HC	7.78	6.4	6.4	11.2	10.0	6.4	6.4	10.7	10.0	10.0	8.6	1.06	10%
Nissan	R	HCA	8.11	35.0	35.1	40.0	36.9	10.5	18.2	10.5	18.2	18.1	26.7	1.04	0%
Nissan	R	LC	4.31	2.0	2.0	11.9	10.2	2.0	2.0	10.3	10.2	10.1	7.7	1.10	14%
Toyota	R	HC	7.98	39.5	39.5	42.1	39.9	9.5	15.3	10.1	15.3	15.3	23.7	1.08	0%
Toyota	R	HCA	7.64	34.5	34.5	38.5	35.5	12.4	17.4	13.2	17.4	17.4	24.3	1.04	0%
Toyota	R	LC	4.00	2.1	2.1	8.6	6.8	2.1	2.1	8.6	6.8	6.8	5.8	1.11	85%

R/N	-	Vapor Recirulation (R) or Non-Recirculating (N).
%ER	-	Percent dispensing time nozzle concentration in flammable range (2% - 8%).
*	-	Rate in gpm.
@	-	V/L based on actual vapor volume.

FIGURE 6-40

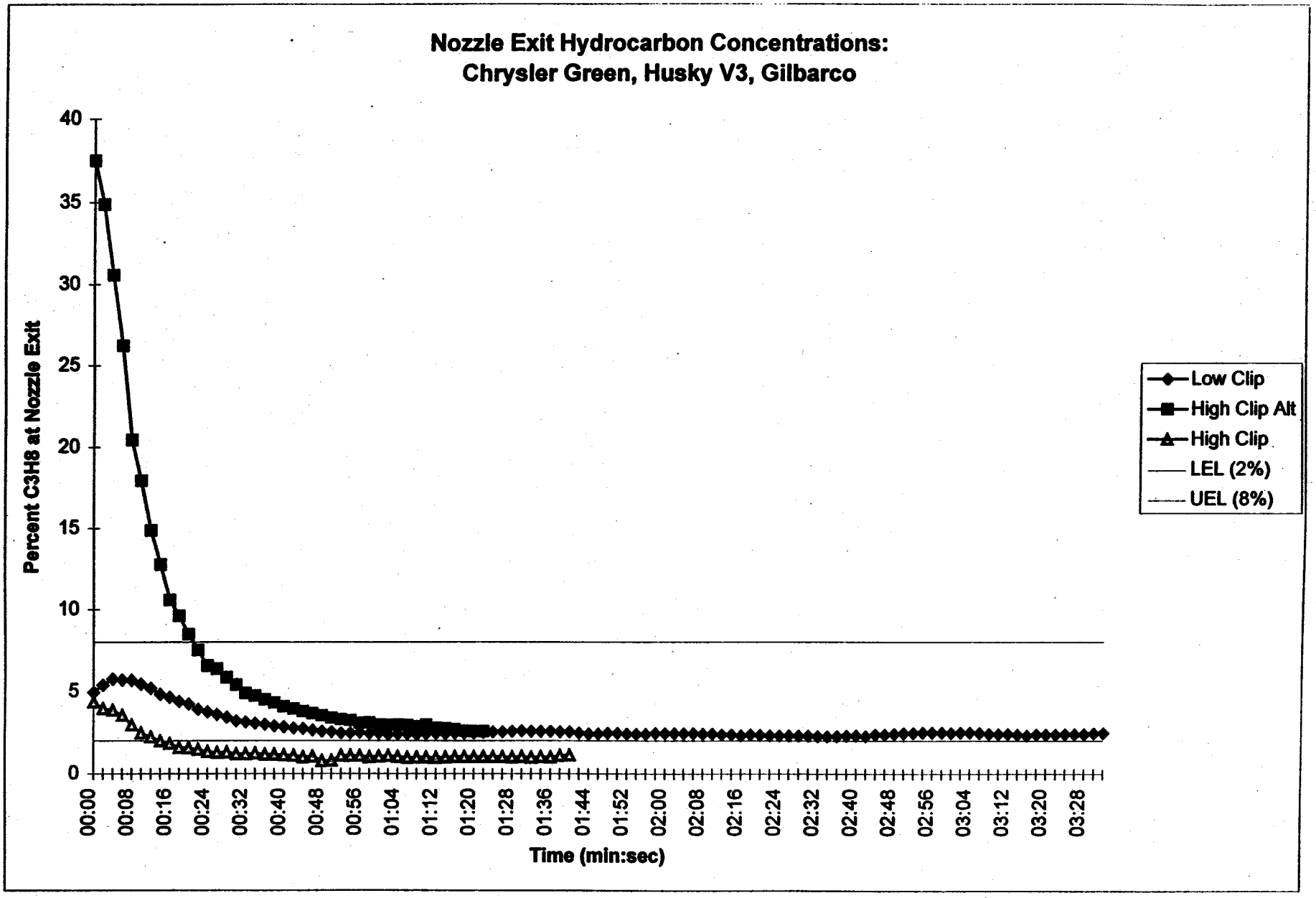

Nozzle Exit Hydrocarbon Concentrations:
Chrysler Green, Husky V3, Gilbarco
Percent C3H8 at Nozzle Exit
40
35
30
25
20
15
10
5
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
02:56
03:04
03:12
03:20
03:28
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-41

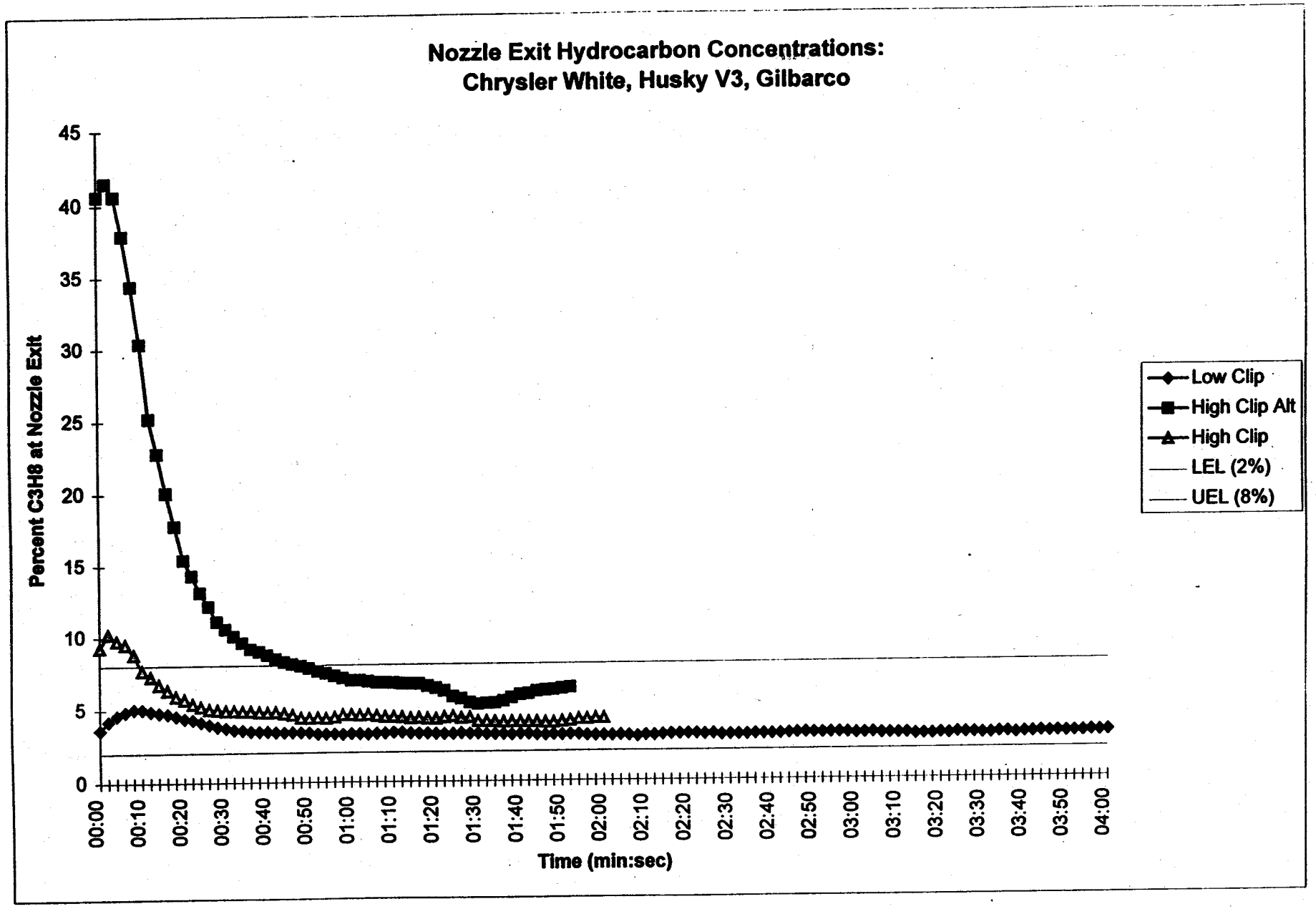

Nozzle Exit Hydrocarbon Concentrations:
Chrysler White, Husky V3, Gilbarco
Percent C3H8 at Nozzle Exit
45
40
35
30
25
20
15
10
5
0
00:00
00:10
00:20
00:30
00:40
00:50
01:00
01:10
01:20
01:30
01:40
01:50
02:00
02:10
02:20
02:30
02:40
02:50
03:00
03:10
03:20
03:30
03:40
03:50
04:00
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-42

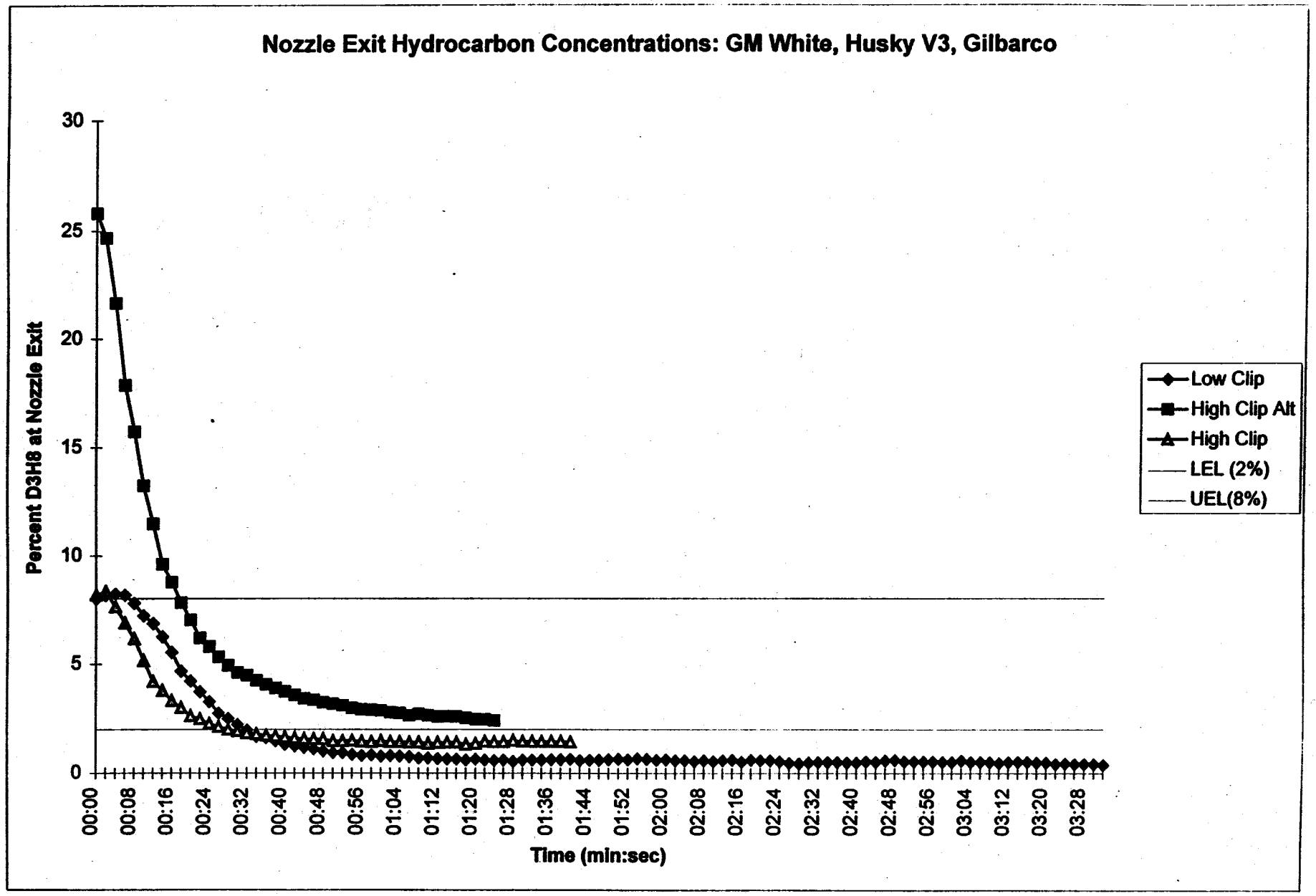

Nozzle Exit Hydrocarbon Concentrations: GM White, Husky V3, Gilbarco
Percent D3H8 at Nozzle Exit
30
25
20
15
10
5
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
02:56
03:04
03:12
03:20
03:28
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL(8%)

FIGURE 6-43

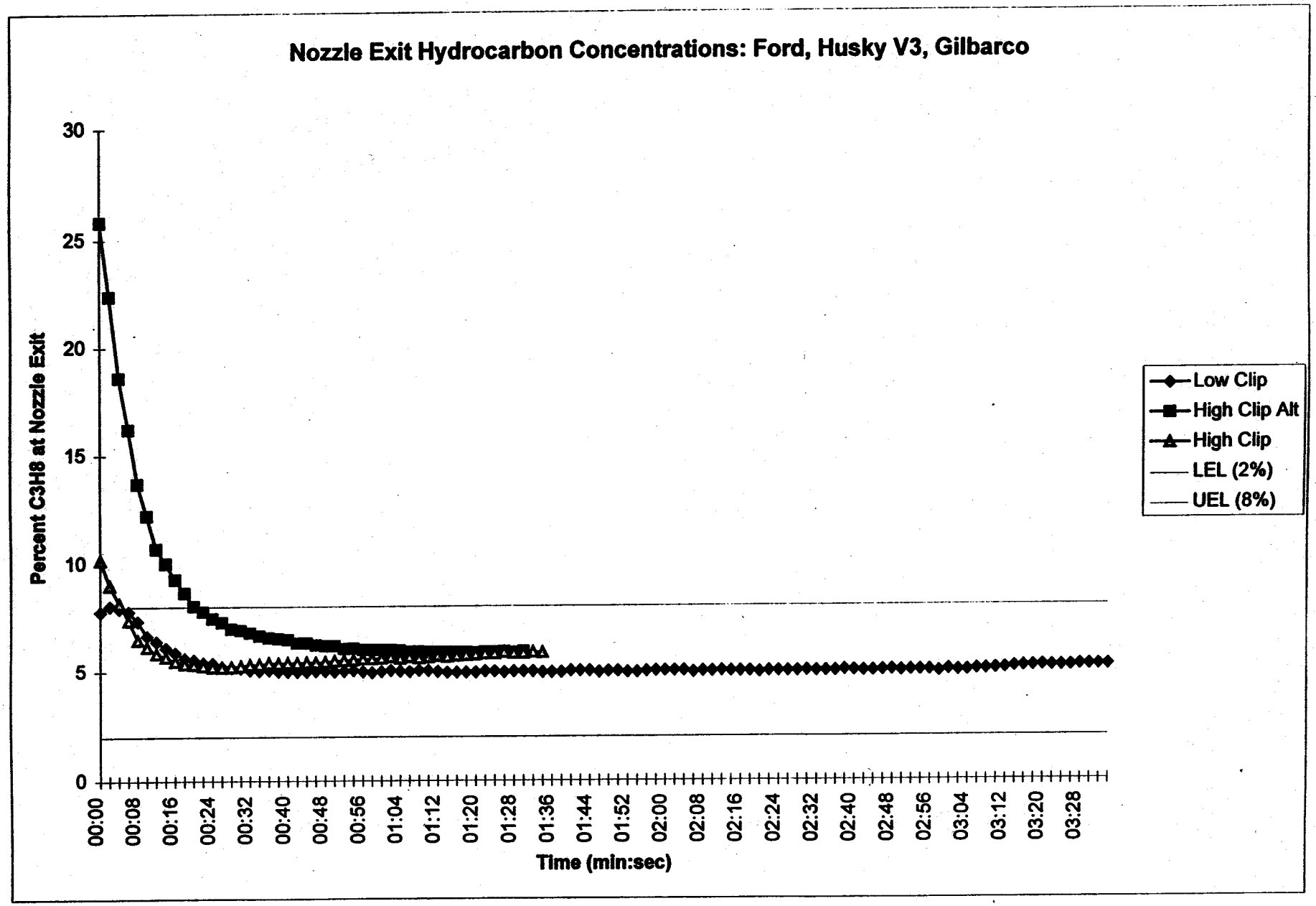

Nozzle Exit Hydrocarbon Concentrations: Ford, Husky V3, Gilbarco
Percent C3H8 at Nozzle Exit
30
25
20
15
10
5
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
02:56
03:04
03:12
03:20
03:28
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-44

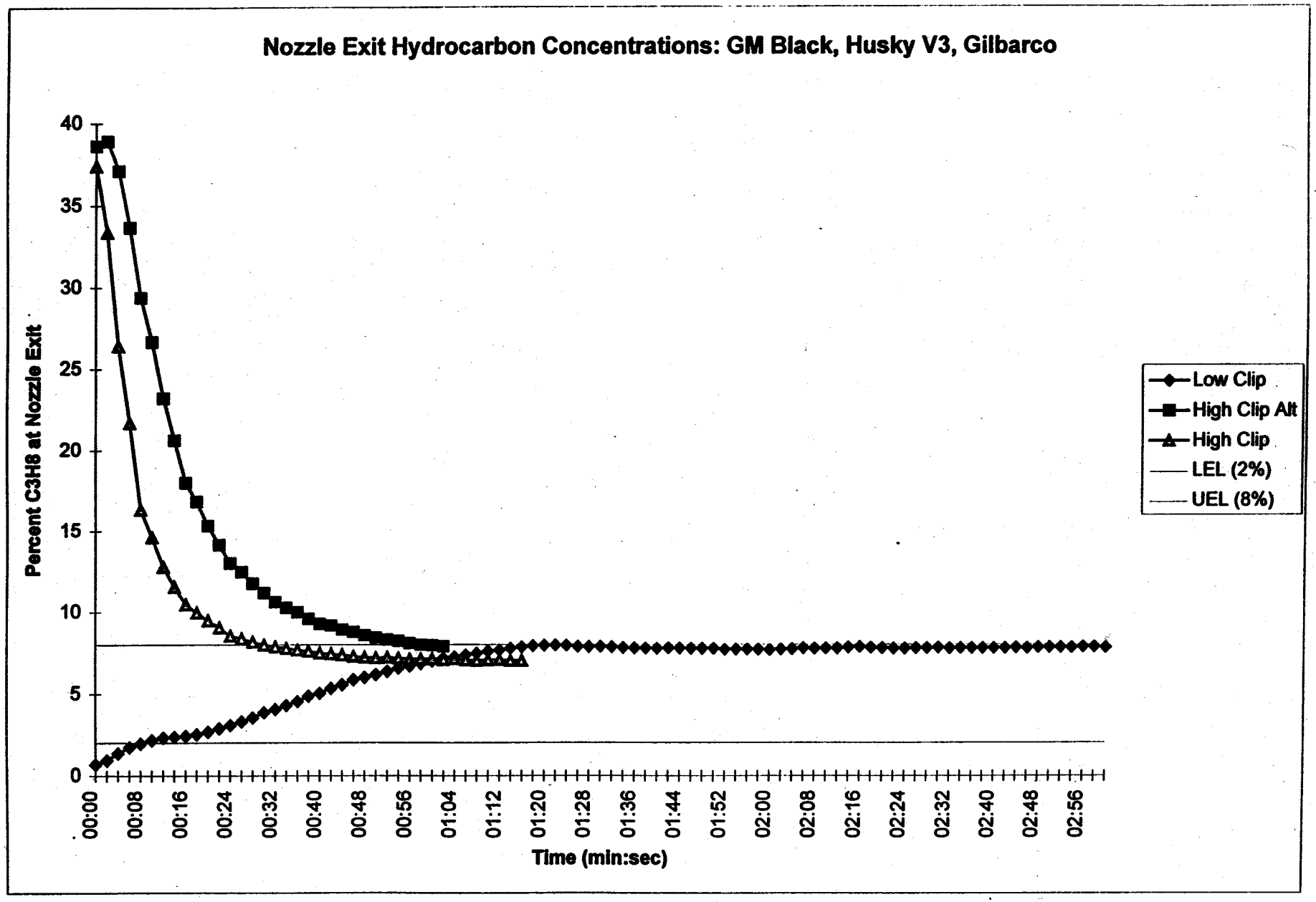

Nozzle Exit Hydrocarbon Concentrations: GM Black, Husky V3, Gilbarco
Percent C3H8 at Nozzle Exit
40
35
30
25
20
15
10
5
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
02:56
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-45

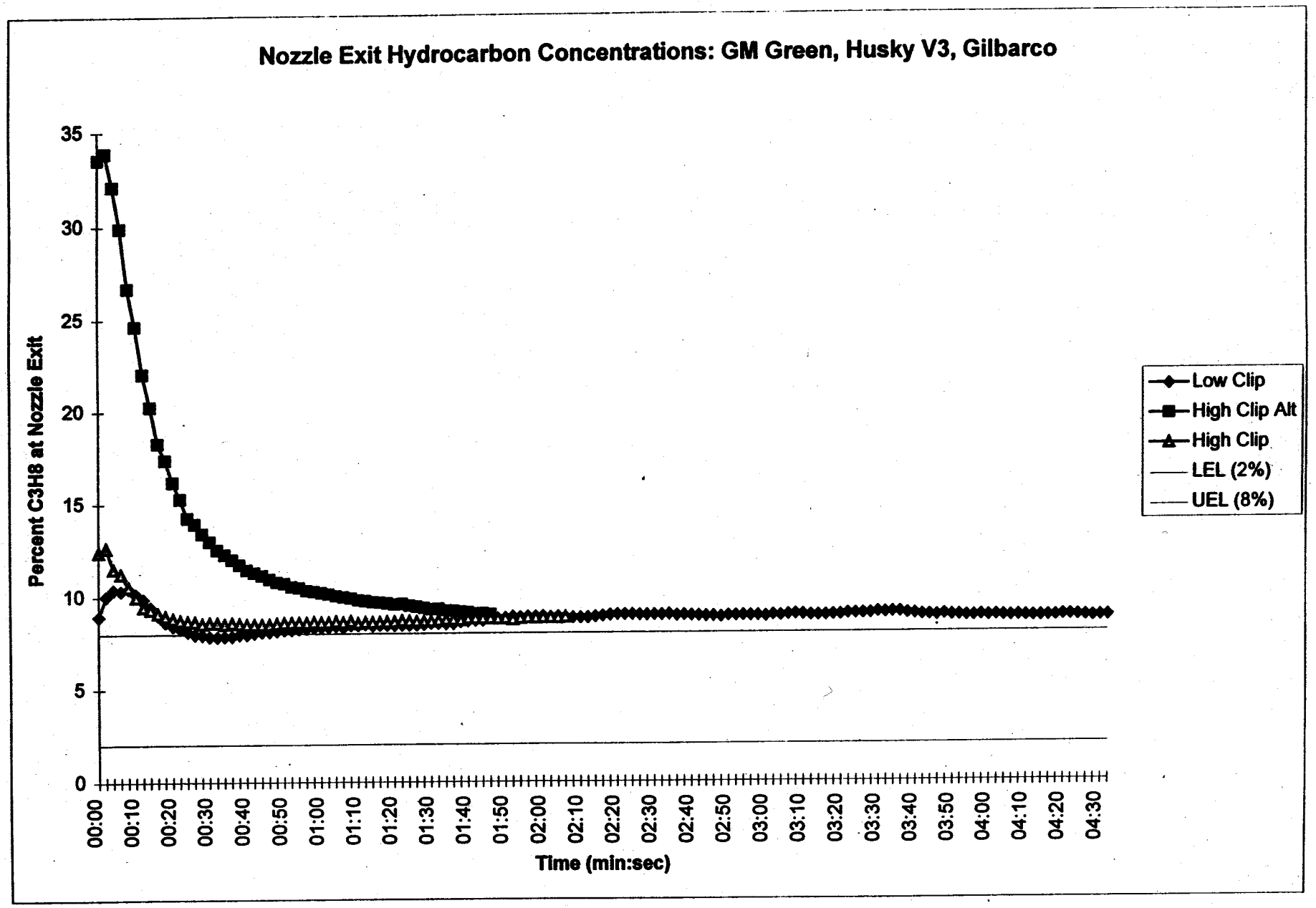

Nozzle Exit Hydrocarbon Concentrations: GM Green, Husky V3, Gilbarco
Percent C3H8 at Nozzle Exit
35
30
25
20
15
10
5
0
00:00
00:10
00:20
00:30
00:40
00:50
01:00
01:10
01:20
01:30
01:40
01:50
02:00
02:10
02:20
02:30
02:40
02:50
03:00
03:10
03:20
03:30
03:40
03:50
04:00
04:10
04:20
04:30
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-46

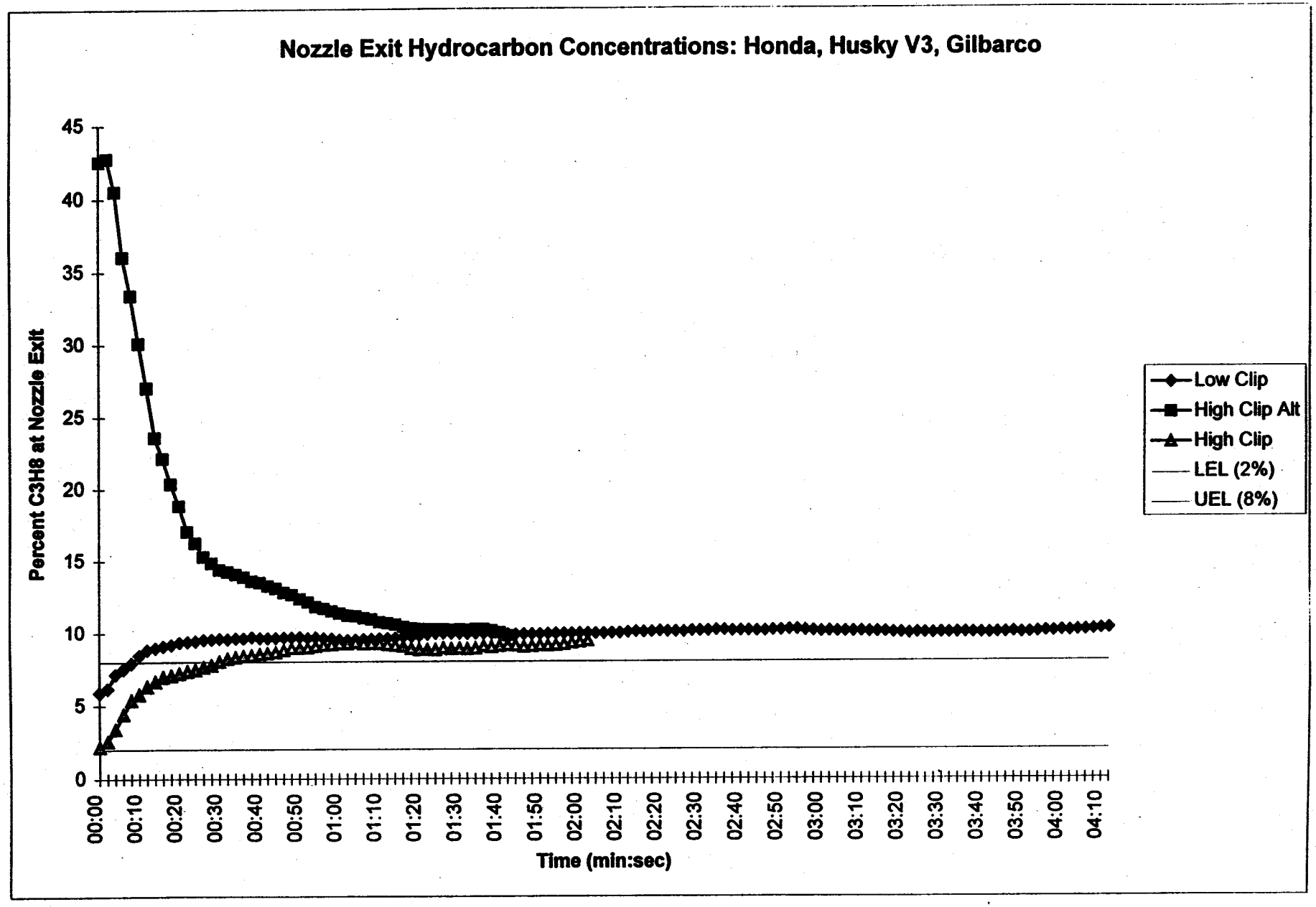

Nozzle Exit Hydrocarbon Concentrations: Honda, Husky V3, Gilbarco
Percent C3H8 at Nozzle Exit
45
40
35
30
25
20
15
10
5
0
00:00
00:10
00:20
00:30
00:40
00:50
01:00
01:10
01:20
01:30
01:40
01:50
02:00
02:10
02:20
02:30
02:40
02:50
03:00
03:10
03:20
03:30
03:40
03:50
04:00
04:10
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-47

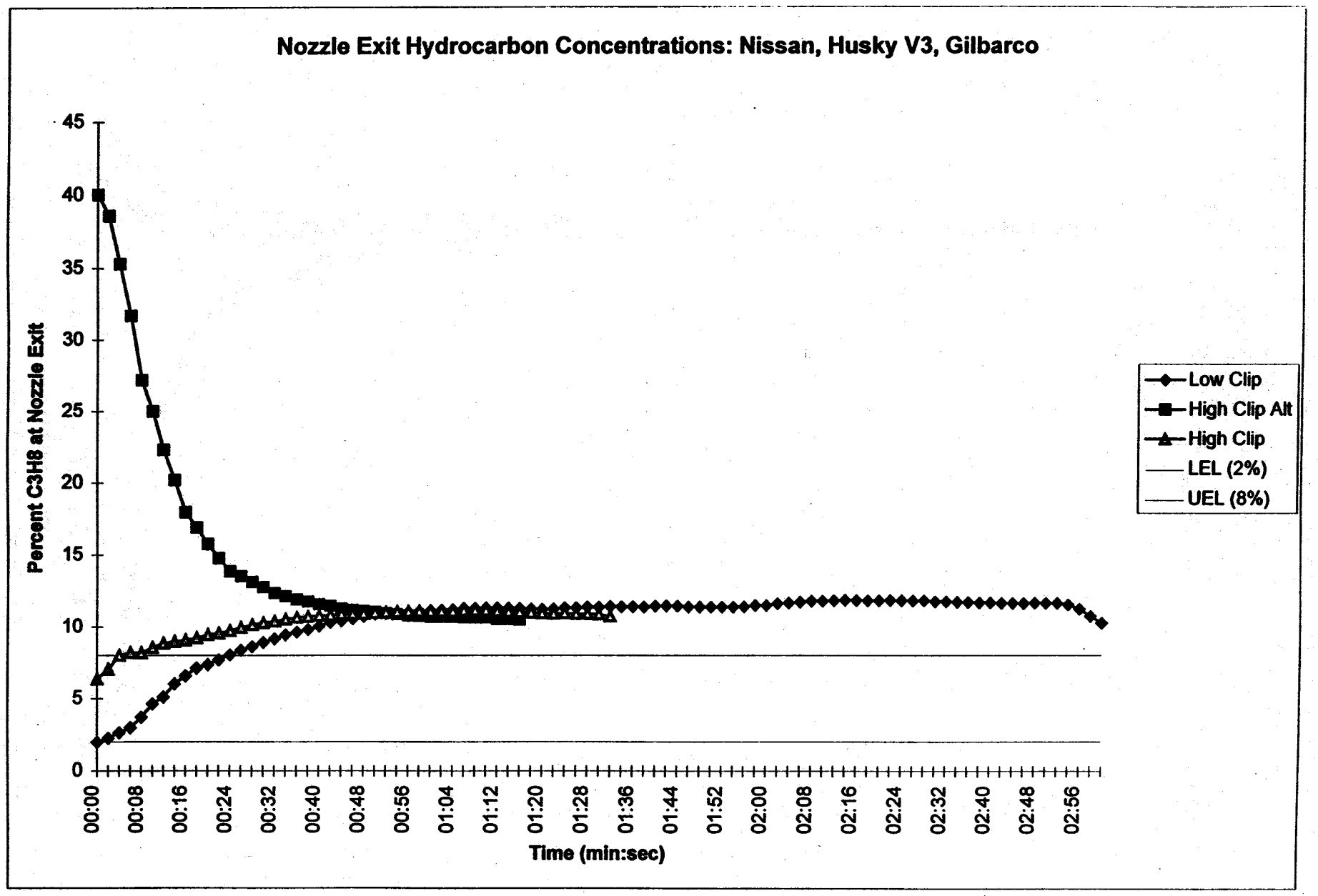

Nozzle Exit Hydrocarbon Concentrations: Nissan, Husky V3, Gilbarco
Percent C3H8 at Nozzle Exit
45
40
35
30
25
20
15
10
5
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
02:56
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-48

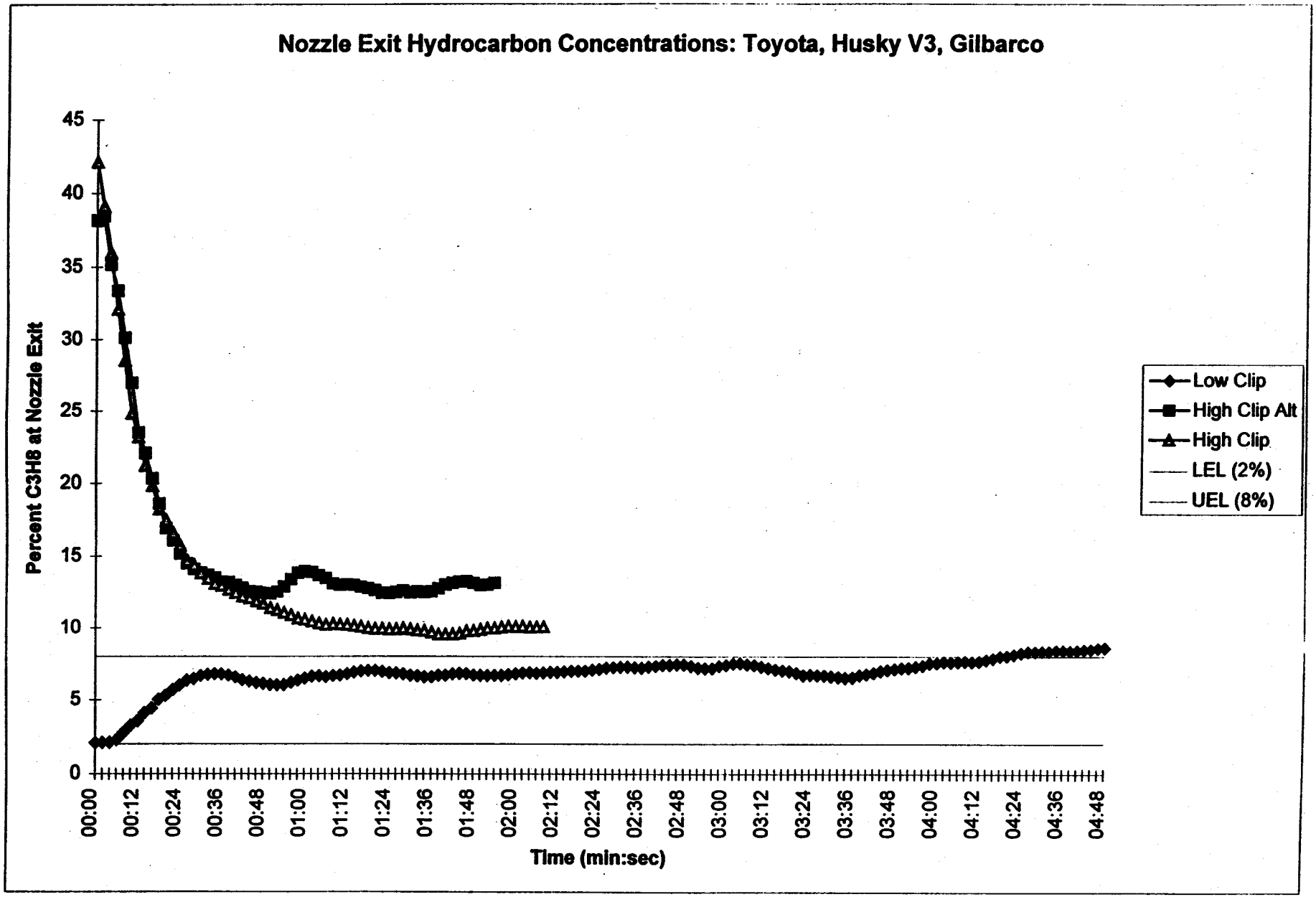

Nozzle Exit Hydrocarbon Concentrations: Toyota, Husky V3, Gilbarco
Percent C3H8 at Nozzle Exit
45
40
35
30
25
20
15
10
5
0
00:00
00:12
00:24
00:36
00:48
01:00
01:12
01:24
01:36
01:48
02:00
02:12
02:24
02:36
02:48
03:00
03:12
03:24
03:36
03:48
04:00
04:12
04:24
04:36
04:48
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

TABLE 6-9

Gilbarco Vapor Recovery System w/ Emco Wheaton 4500 Nozzle, 7-15-97

				NOZZLE EXIT HYDROCARBON CONCENTRATION - %C3H8											
ORVR		Dispensing		START		MAXIMUM		MINIMUM		FINAL		AVERAGE		V/L@	
SYSTEM	R/N	Mode	Rate*	Noz	Dis	Noz	Dis	Noz	Dis	Noz	Dis	Noz	Dis		%ER
Cry Grn	N	HC	6.83	8.8	8.8	10.3	9.3	3.3	4.9	3.4	4.9	4.9	6.7	1.06	94%
Cry Grn	N	HCA	7.08	20.8	20.8	24.5	22.1	1.8	5.3	1.8	5.3	5.3	10.9	1.07	69%
Cry Grn	N	LC	6.14	6.1	6.1	7.0	6.4	2.7	3.7	2.8	3.7	3.7	4.8	1.06	100%
Cry Wht	N	HC	6.85	8.2	8.2	9.7	9.0	4.1	5.0	4.1	5.0	5.0	6.3	1.03	93%
Cry Wht	N	HCA	7.01	33.1	33.1	35.7	33.7	3.8	8.6	4.1	8.6	8.5	16.6	1.04	84%
Cry Wht	N	LC	6.13	9.6	9.6	10.0	9.7	5.9	6.7	5.9	6.7	6.7	7.6	1.03	93%
GM Wht	N	HC	7.06	6.5	6.5	7.8	6.9	1.2	3.0	1.5	3.0	3.0	4.5	1.05	66%
GM Wht	N	HCA	6.96	34.3	34.3	36.9	35.1	1.5	8.8	1.5	8.8	8.7	18.9	1.07	60%
GM Wht	N	LC	6.02	6.2	6.2	6.6	6.3	1.0	2.2	1.0	2.2	2.2	3.8	1.07	25%
Ford	R	HC	7.08	3.9	3.9	6.8	6.4	3.9	3.9	6.8	6.4	6.4	5.7	1.03	100%
Ford	R	HCA	6.56	33.0	33.0	34.8	33.5	6.7	11.1	6.7	11.1	11.0	18.5	1.04	73%
Ford	R	LC	6.13	8.9	8.9	10.4	9.4	5.9	6.6	6.4	6.6	6.6	7.3	1.06	95%
GM Blk	R	HC	7.10	6.8	6.8	8.5	8.0	6.8	6.8	8.1	8.0	8.0	7.6	1.05	100%
GM Blk	R	HCA	7.00	31.9	31.9	32.9	32.1	6.9	12.2	7.0	12.2	12.1	19.8	1.05	67%
GM Blk	R	LC	6.18	6.0	6.0	7.6	6.6	5.8	6.0	5.9	6.2	6.2	6.3	1.07	40%
GM Grn	R	HC	7.12	9.3	9.3	11.1	10.1	9.3	9.3	9.7	9.7	9.7	9.8	1.05	0%
GM Grn	R	HCA	6.91	39.0	39.0	40.7	39.3	10.7	14.9	11.1	14.9	14.9	22.3	1.03	0%
GM Grn	R	LC	5.82	1.8	1.8	10.1	8.6	1.7	1.8	10.1	8.6	8.6	6.5	1.05	17%
Honda	R	HC	7.50	2.4	2.4	10.0	8.7	2.3	2.3	9.6	8.7	8.7	6.9	1.03	12%
Honda	R	HCA	5.95	39.5	39.5	41.6	40.0	11.0	16.0	13.0	16.0	16.0	23.7	1.04	0%
Honda	R	LC	7.02	7.0	7.0	8.8	8.2	6.4	6.8	8.8	8.2	8.2	7.7	1.09	22%
Nissan	R	HC	NA	5.5	5.5	11.1	9.7	5.5	5.5	10.2	9.7	9.7	8.3	1.03	8%
Nissan	R	HCA	6.76	33.4	33.4	36.1	34.3	11.9	16.5	11.9	16.5	16.5	23.0	1.08	0%
Nissan	R	LC	5.90	6.2	6.2	11.6	10.5	6.1	6.1	9.3	10.5	10.5	9.1	1.05	5%
Toyota	R	HC	7.00	7.9	7.9	7.9	7.9	3.1	5.0	3.4	5.0	5.0	5.7	1.03	100%
Toyota	R	HCA	7.00	37.7	37.7	40.4	38.4	4.6	11.2	4.6	11.2	11.1	21.7	1.06	76%
Toyota	R	LC	6.07	3.6	3.6	6.8	5.5	3.6	3.6	5.3	5.1	5.1	5.0	1.05	100%

R/N	-	Vapor Recirculation (R) or Non-Recirculating (N)
%ER	-	Percent dispensing time nozzle concentration in flammable range (2% - 8%).
*	-	Rate in gpm.
@	-	V/L based on actual vapor volume.

FIGURE 6-49

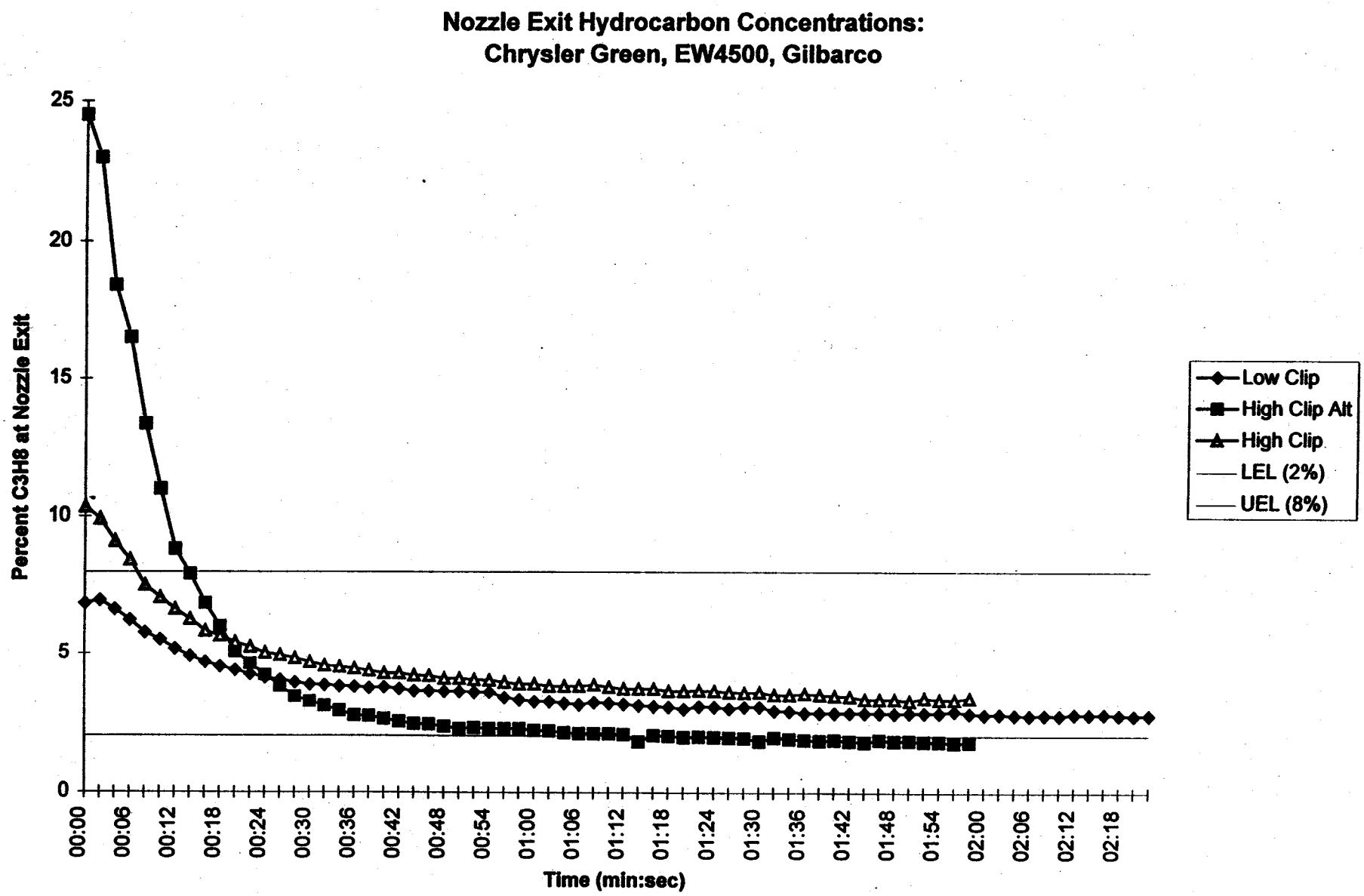

Nozzle Exit Hydrocarbon Concentrations:
Chrysler Green, EW4500, Gilbarco
Percent C3H8 at Nozzle Exit
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-50

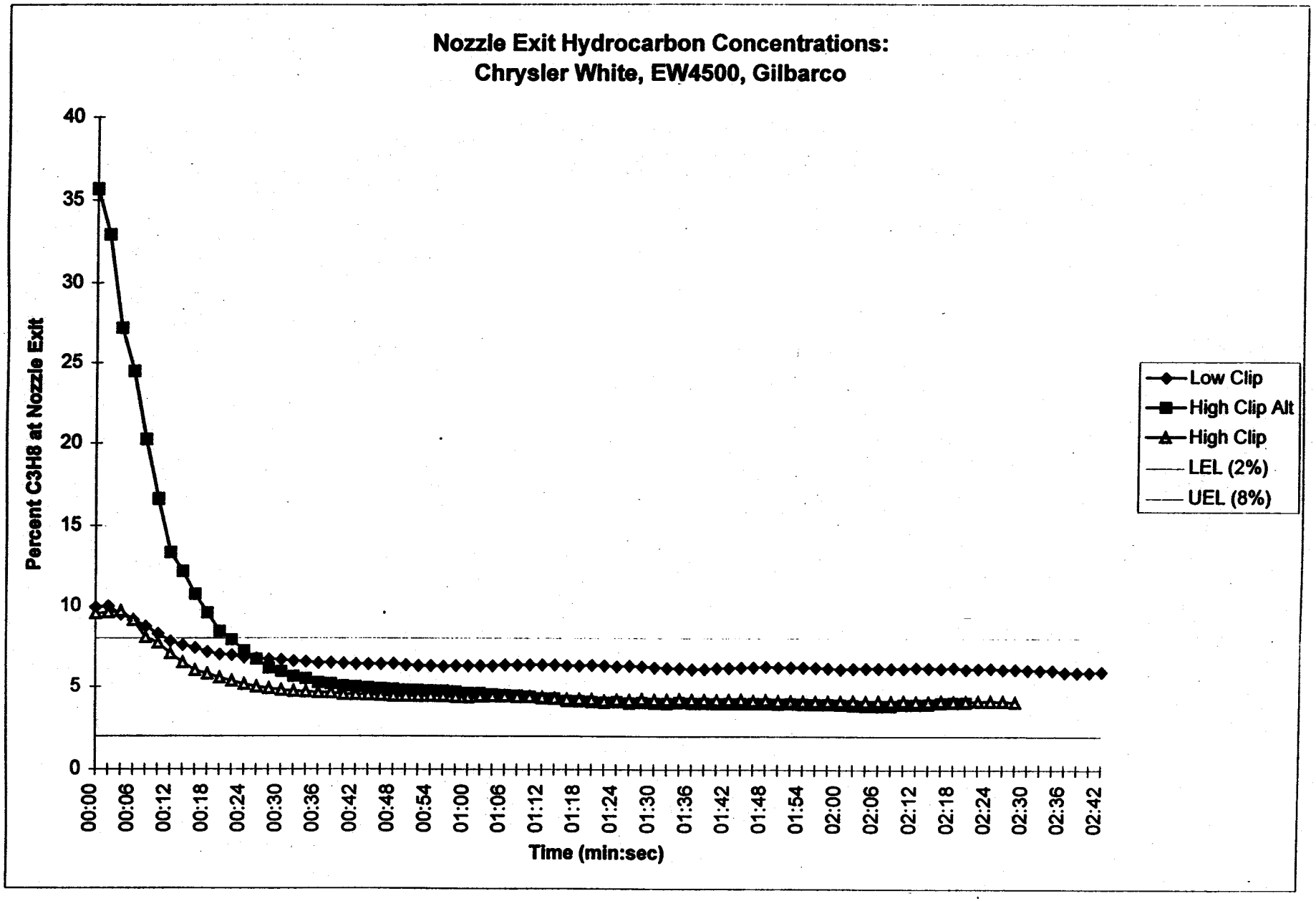

Nozzle Exit Hydrocarbon Concentrations:
Chrysler White, EW4500, Gilbarco
Percent C3H8 at Nozzle Exit
40
35
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
02:24
02:30
02:36
02:42
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-51

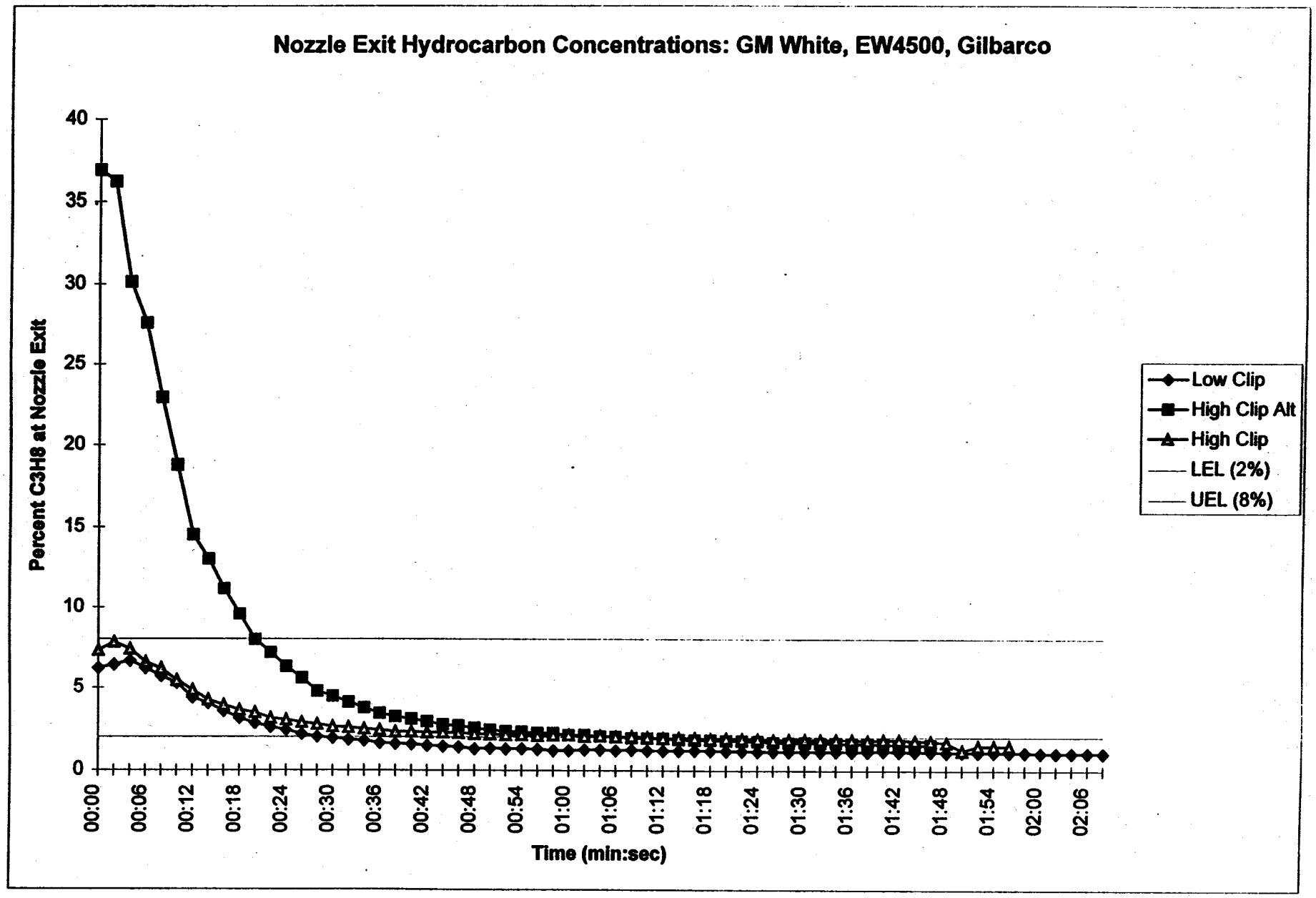

Nozzle Exit Hydrocarbon Concentrations: GM White, EW4500, Gilbarco
Percent C3H8 at Nozzle Exit
40
35
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-52

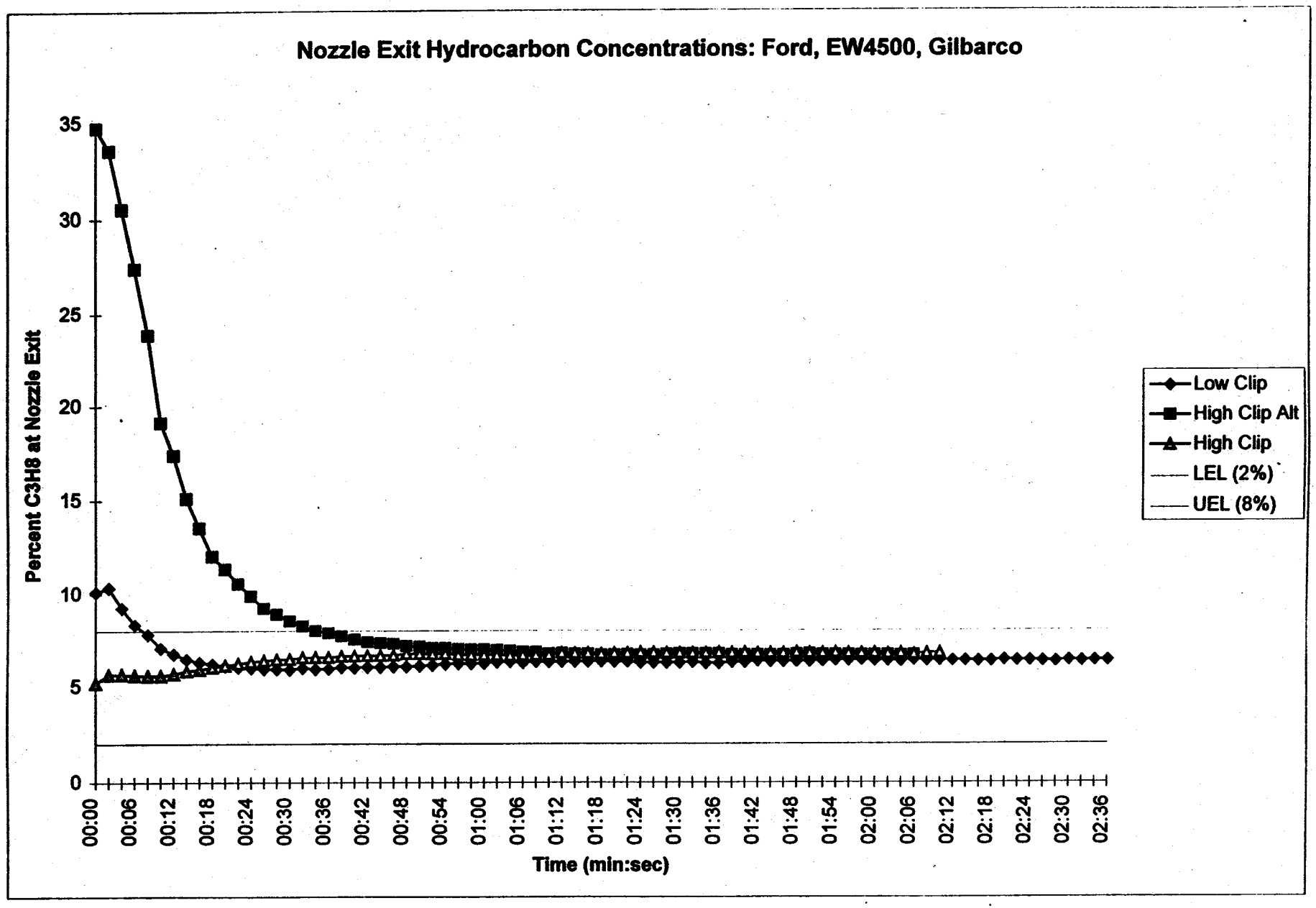

Nozzle Exit Hydrocarbon Concentrations: Ford, EW4500, Gilbarco
Percent C3H8 at Nozzle Exit
35
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
02:24
02:30
02:36
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-53

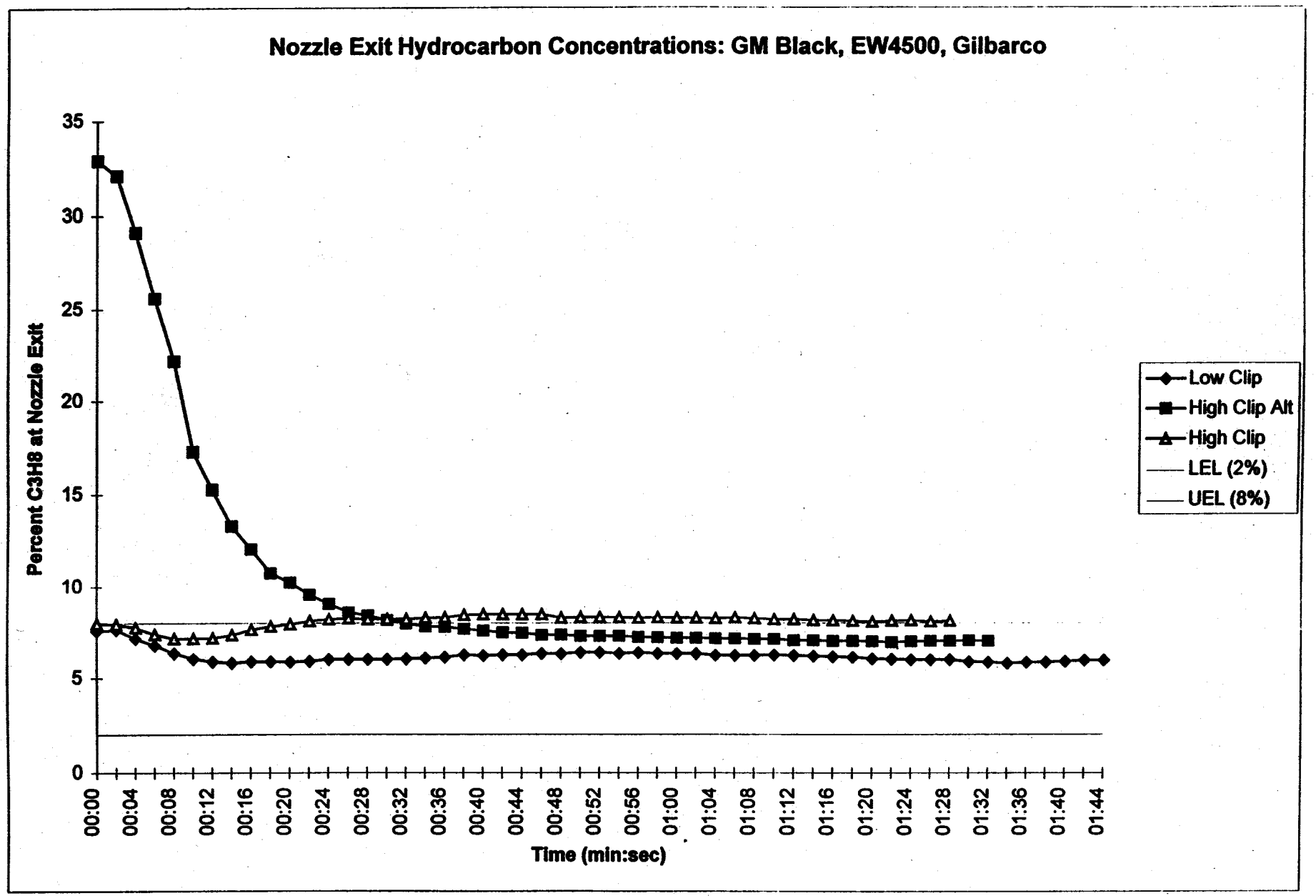

Nozzle Exit Hydrocarbon Concentrations: GM Black, EW4500, Gilbarco
Percent C3H8 at Nozzle Exit
35
30
25
20
15
10
5
0
00:00
00:04
00:08
00:12
00:16
00:20
00:24
00:28
00:32
00:36
00:40
00:44
00:48
00:52
00:56
01:00
01:04
01:08
01:12
01:16
01:20
01:24
01:28
01:32
01:36
01:40
01:44
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-54

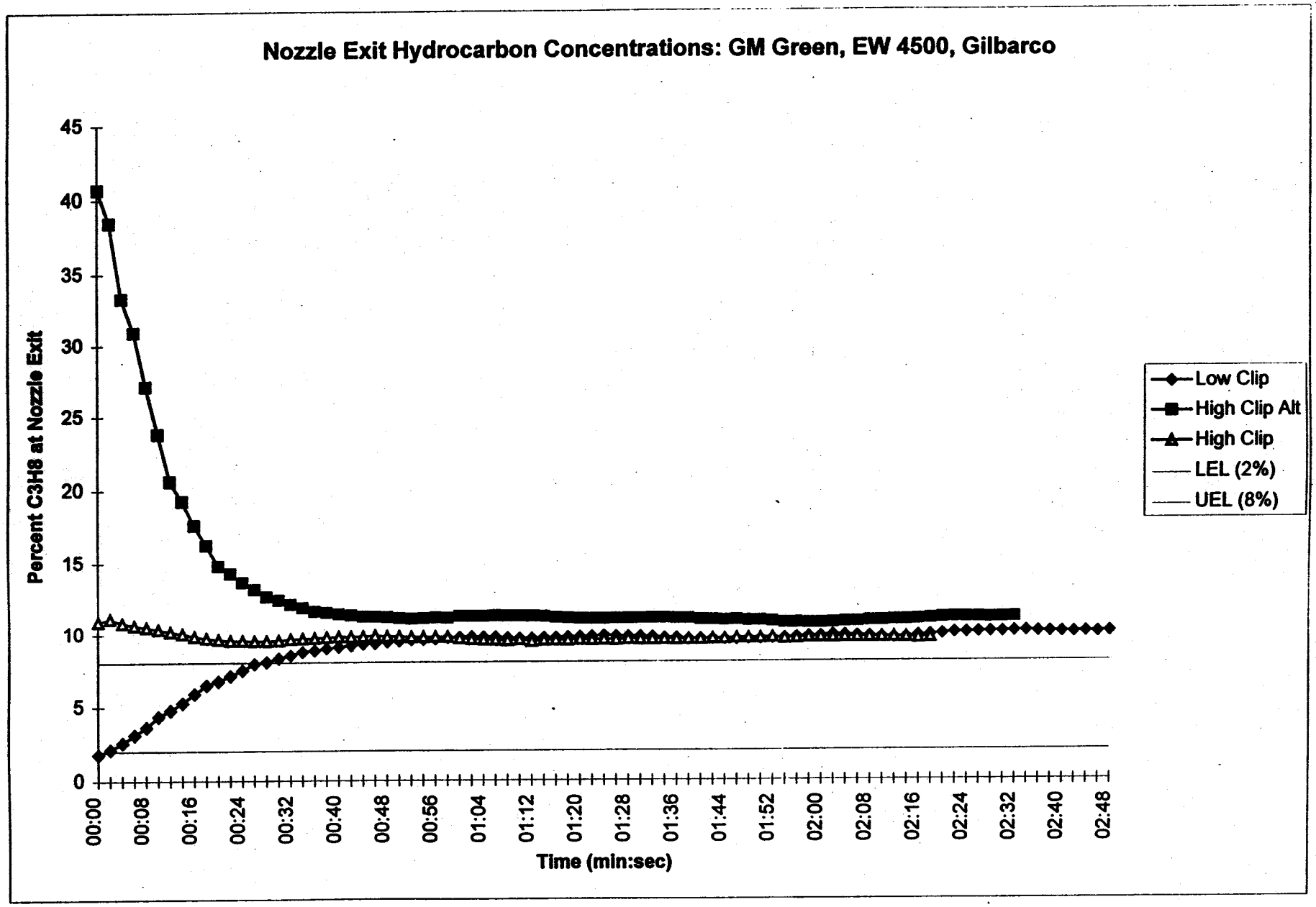

Nozzle Exit Hydrocarbon Concentrations: GM Green, EW 4500, Gilbarco
Percent C3H8 at Nozzle Exit
45
40
35
30
25
20
15
10
5
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-55

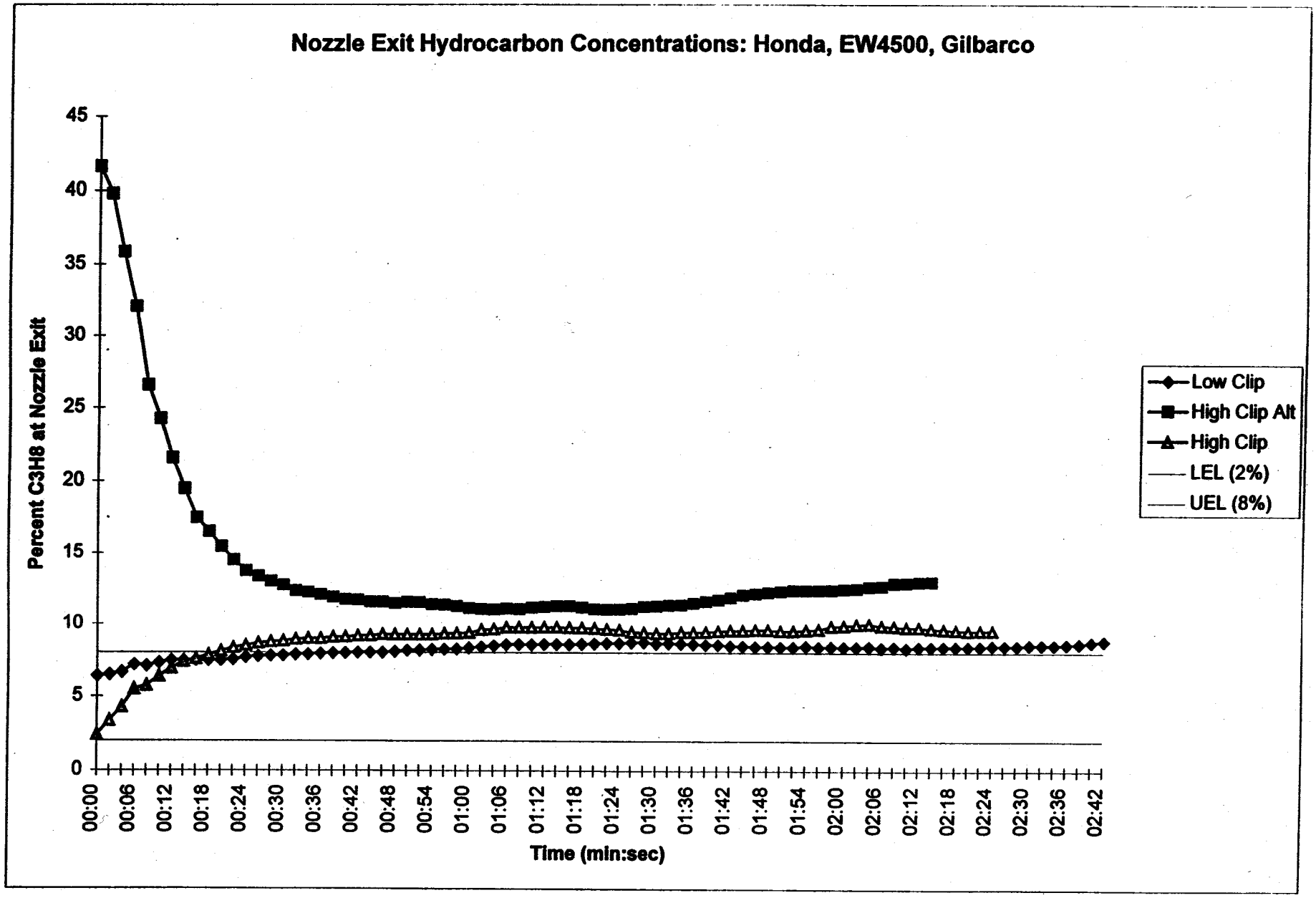

Nozzle Exit Hydrocarbon Concentrations: Honda, EW4500, Gilbarco
Percent C3H8 at Nozzle Exit
45
40
35
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
02:24
02:30
02:36
02:42
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-56

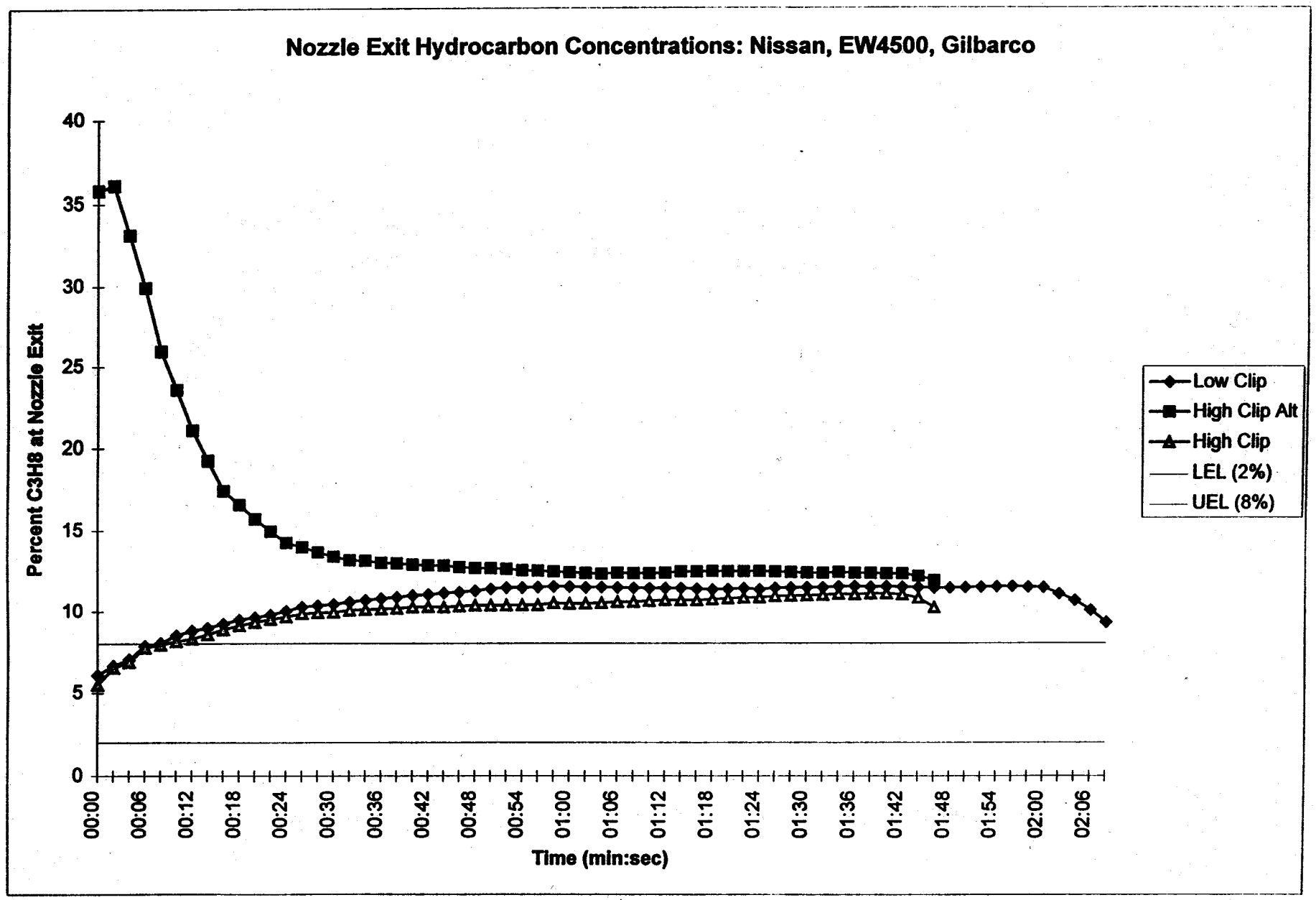

Nozzle Exit Hydrocarbon Concentrations: Nissan, EW4500, Gilbarco
Percent C3H8 at Nozzle Exit
40
35
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-57

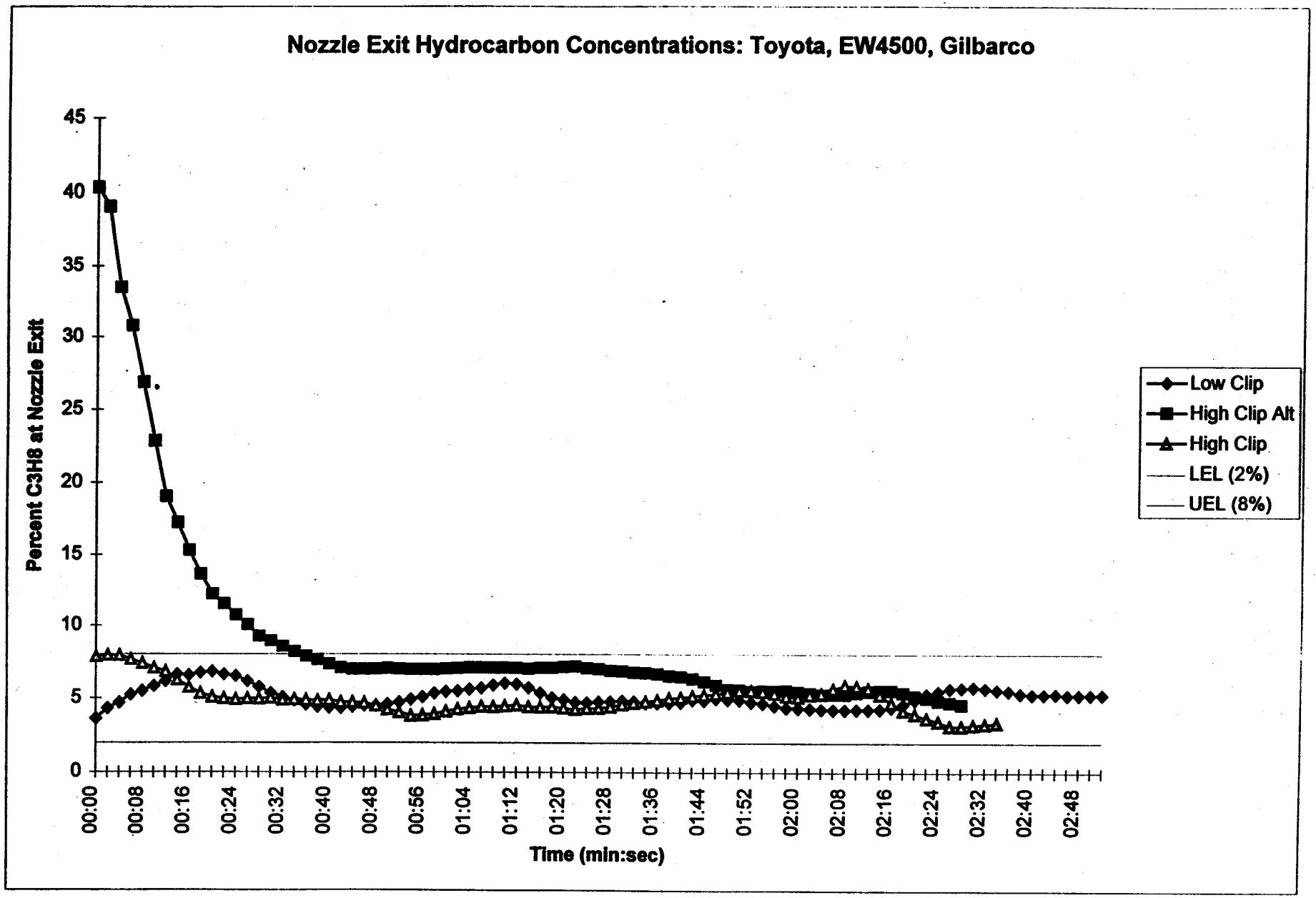

Nozzle Exit Hydrocarbon Concentrations: Toyota, EW4500, Gilbarco
Percent C3H8 at Nozzle Exit
45
40
35
30
25
20
15
10
5
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

TABLE 6-10

Gilbarco Vapor Recovery System w/ OPW 11VAI-27 Nozzle, 7-15-97

ORVR SYSTEM	R/N	Dispensing Mode	Dispensing Rate*	NOZZLE EXIT HYDROCARBON CONCENTRATION - %C3H8 START Noz	START Dis	MAXIMUM Noz	MAXIMUM Dis	MINIMUM Noz	MINIMUM Dis	FINAL Noz	FINAL Dis	AVERAGE Noz	AVERAGE Dis	V/L@	%ER
Cry Grn	N	HC	8.69	1.3	1.3	2.3	1.9	1.3	1.3	1.5	1.7	1.7	1.7	0.99	10%
Cry Grn	N	HCA	8.25	39.7	39.7	42.3	40.4	3.6	10.6	3.6	10.6	10.5	21.2	1.06	80%
Cry Grn	N	LC	4.46	4.1	4.1	4.8	4.4	2.7	3.0	2.8	2.6	3.0	3.4	1.06	100%
Cry Wht	N	HC	8.68	5.7	5.7	6.2	5.8	1.0	2.2	1.0	2.2	2.2	3.7	1.01	22%
Cry Wht	N	HCA	8.54	39.5	39.5	41.9	39.9	2.3	9.1	2.4	9.1	9.0	19.9	1.06	84%
Cry Wht	N	LC	4.00	3.9	3.9	5.4	4.4	2.2	2.7	2.2	2.7	2.7	3.2	1.13	100%
GM Wht	N	HC	8.78	11.1	11.1	11.1	11.1	2.8	4.2	3.0	4.2	4.2	6.2	1.12	28%
GM Wht	N	HCA	8.64	37.7	37.7	40.6	38.5	1.4	9.6	1.4	9.6	9.5	21.0	1.09	94%
GM Wht	N	LC	4.25	5.7	5.7	29.9	9.5	1.3	3.0	3.8	9.0	9.0	5.4	1.45	NA
Ford	R	HC	8.81	12.5	12.5	13.0	12.6	5.7	7.2	5.4	4.1	7.2	9.4	1.03	87%
Ford	R	HCA	8.43	44.2	44.2	46.8	44.7	6.0	13.7	6.0	13.7	13.6	25.3	1.07	71%
Ford	R	LC	4.34	8.1	8.1	8.6	8.2	5.0	5.7	5.7	5.7	5.7	6.3	1.10	98%
GM Blk	R	HC	8.61	1.2	1.2	5.4	4.1	1.1	1.2	5.4	4.1	4.1	2.7	1.03	100%
GM Blk	R	HCA	8.63	42.4	42.4	44.8	43.0	6.8	15.8	6.8	15.8	15.6	27.5	1.08	71%
GM Blk	R	LC	4.13	7.8	7.8	7.8	7.8	4.9	6.0	7.0	6.6	6.6	6.4	1.14	100%
GM Grn	R	HC	8.80	3.9	3.9	8.3	7.3	3.9	3.9	8.1	7.3	7.3	6.1	1.05	37%
GM Grn	R	HCA	8.02	41.8	41.8	44.8	42.4	9.4	15.0	9.6	15.0	14.9	24.2	1.05	0%
GM Grn	R	LC	4.20	7.7	7.7	9.2	8.5	7.7	7.7	8.1	8.4	8.4	8.3	1.10	0%
Honda	R	HC	8.82	5.1	5.1	13.3	11.7	5.1	5.1	13.0	11.7	11.7	9.4	1.00	7%
Honda	R	HCA	8.57	44.9	44.9	46.2	45.1	12.3	18.7	14.4	18.7	18.7	27.6	1.03	0%
Honda	R	LC	4.23	7.0	7.0	12.3	10.6	6.6	6.9	10.8	10.6	10.6	9.3	1.10	3%
Nissan	R	HC	8.78	1.8	1.8	9.2	7.3	1.8	1.8	9.1	7.3	7.3	5.1	0.94	32%
Nissan	R	HCA	NA	41.6	41.6	43.3	42.0	10.8	18.0	10.8	18.0	18.0	28.0	1.10	0%
Nissan	R	LC	4.12	2.6	2.6	11.9	10.2	2.6	2.6	11.3	10.2	10.2	7.9	1.11	31%
Toyota	R	HC	8.52	7.5	7.5	8.1	7.7	2.7	4.0	3.1	4.0	3.9	5.3	1.06	100%
Toyota	R	HCA	NA	53.7	53.7	53.7	53.7	3.4	12.6	5.1	12.6	12.5	26.6	1.06	75%
Toyota	R	LC	4.26	11.1	11.1	12.1	11.4	2.4	4.6	3.9	4.6	4.6	6.8	1.10	93%

R/N - Vapor Recirculating (R) or Non-Recirculation (N).
%ER - Percent dispensing time nozzle concentration in flammable range (2% - 8%).
* - Rate in gpm.
@ - V/L based on actual vapor volume.

FIGURE 6-58

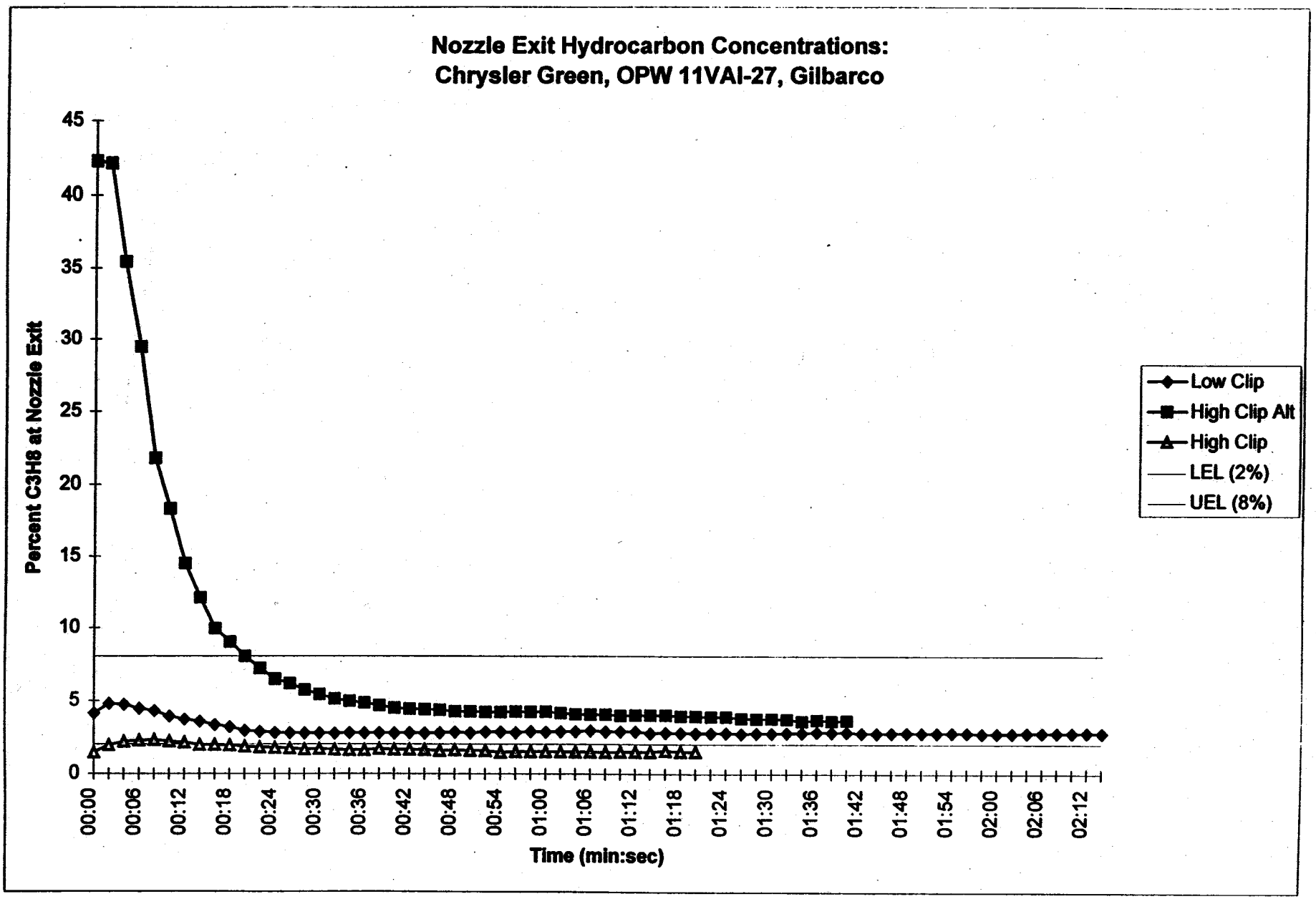

Nozzle Exit Hydrocarbon Concentrations:
Chrysler Green, OPW 11VAI-27, Gilbarco
Percent C3H8 at Nozzle Exit
45
40
35
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-59

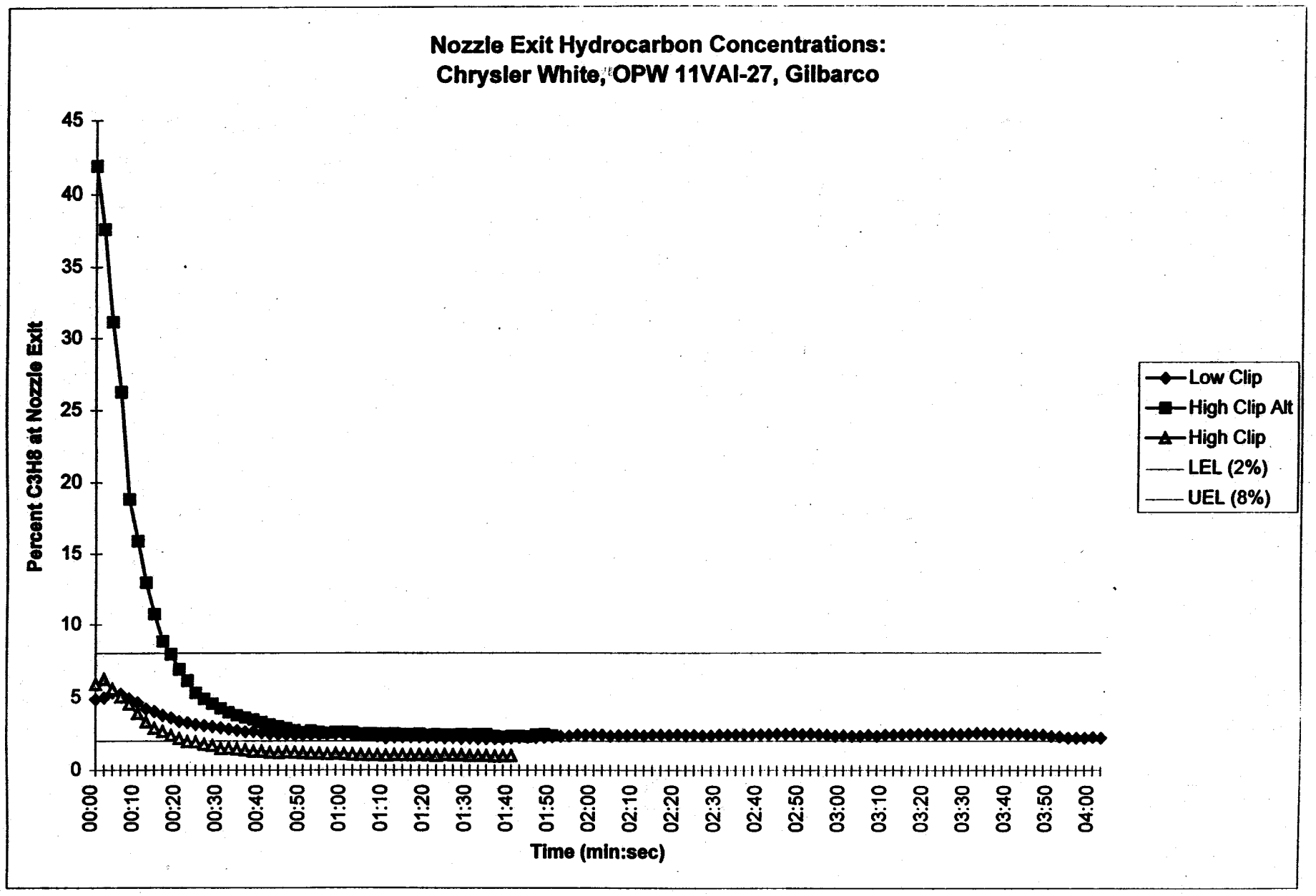

Nozzle Exit Hydrocarbon Concentrations:
Chrysler White, OPW 11VAI-27, Gilbarco
Percent C3H8 at Nozzle Exit
45
40
35
30
25
20
15
10
5
0
00:00
00:10
00:20
00:30
00:40
00:50
01:00
01:10
01:20
01:30
01:40
01:50
02:00
02:10
02:20
02:30
02:40
02:50
03:00
03:10
03:20
03:30
03:40
03:50
04:00
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-60

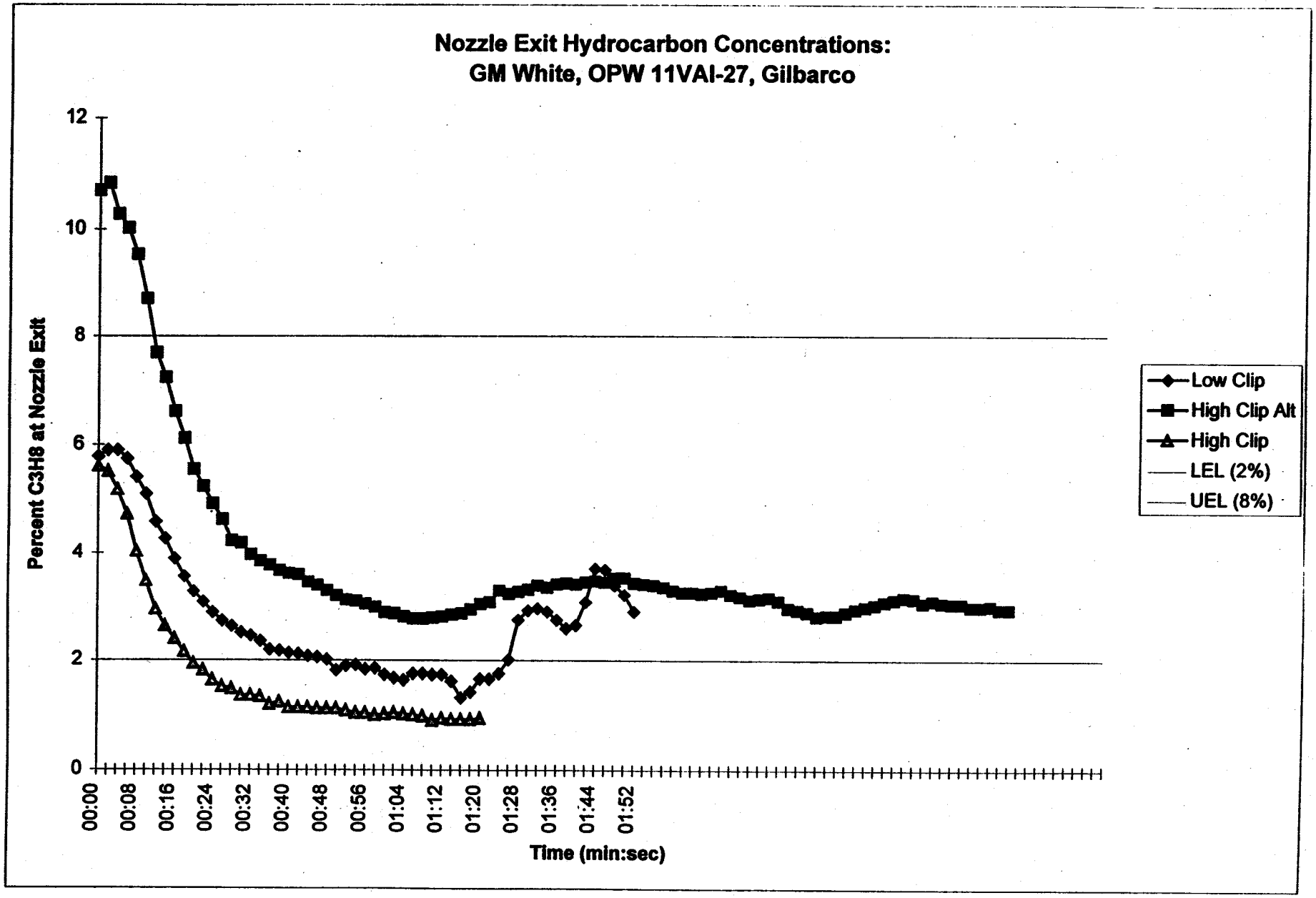

Nozzle Exit Hydrocarbon Concentrations:
GM White, OPW 11VAI-27, Gilbarco
Percent C3H8 at Nozzle Exit
12
10
8
6
4
2
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-61

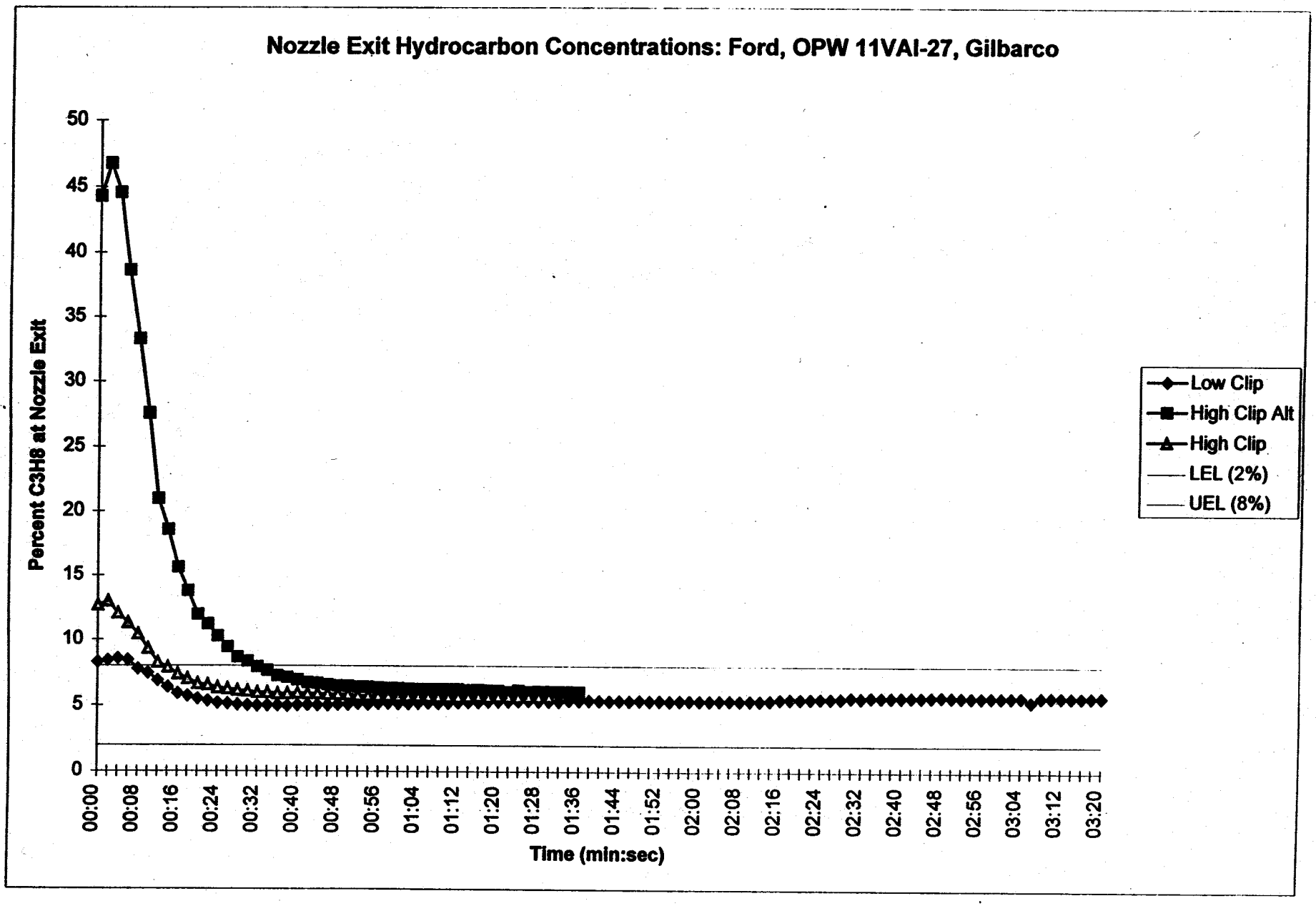

Nozzle Exit Hydrocarbon Concentrations: Ford, OPW 11VAI-27, Gilbarco
Percent C3H8 at Nozzle Exit
50
45
40
35
30
25
20
15
10
5
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
02:56
03:04
03:12
03:20
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-62

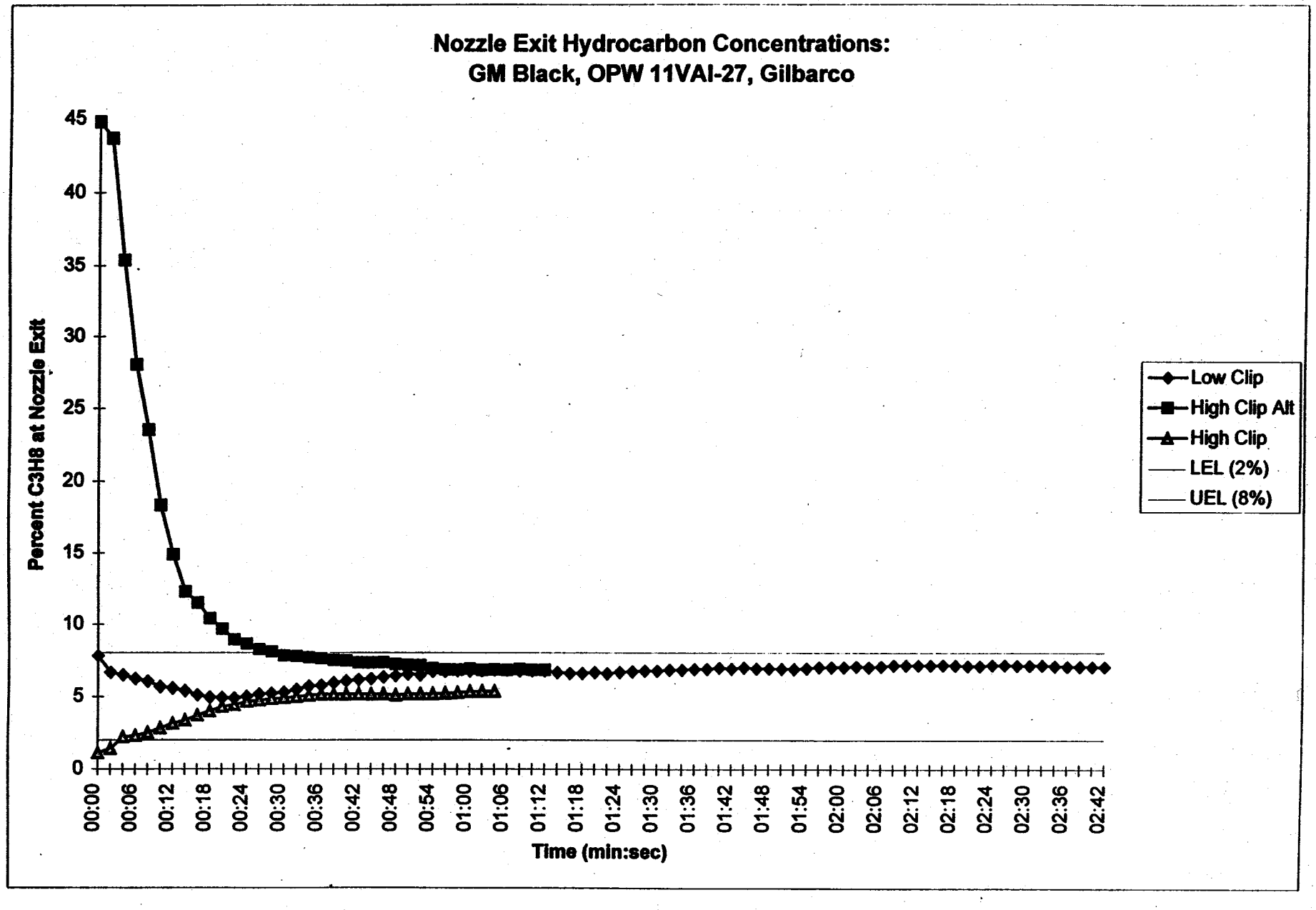

Nozzle Exit Hydrocarbon Concentrations:
GM Black, OPW 11VAI-27, Gilbarco
Percent C3H8 at Nozzle Exit
45
40
35
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
02:24
02:30
02:36
02:42
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-63

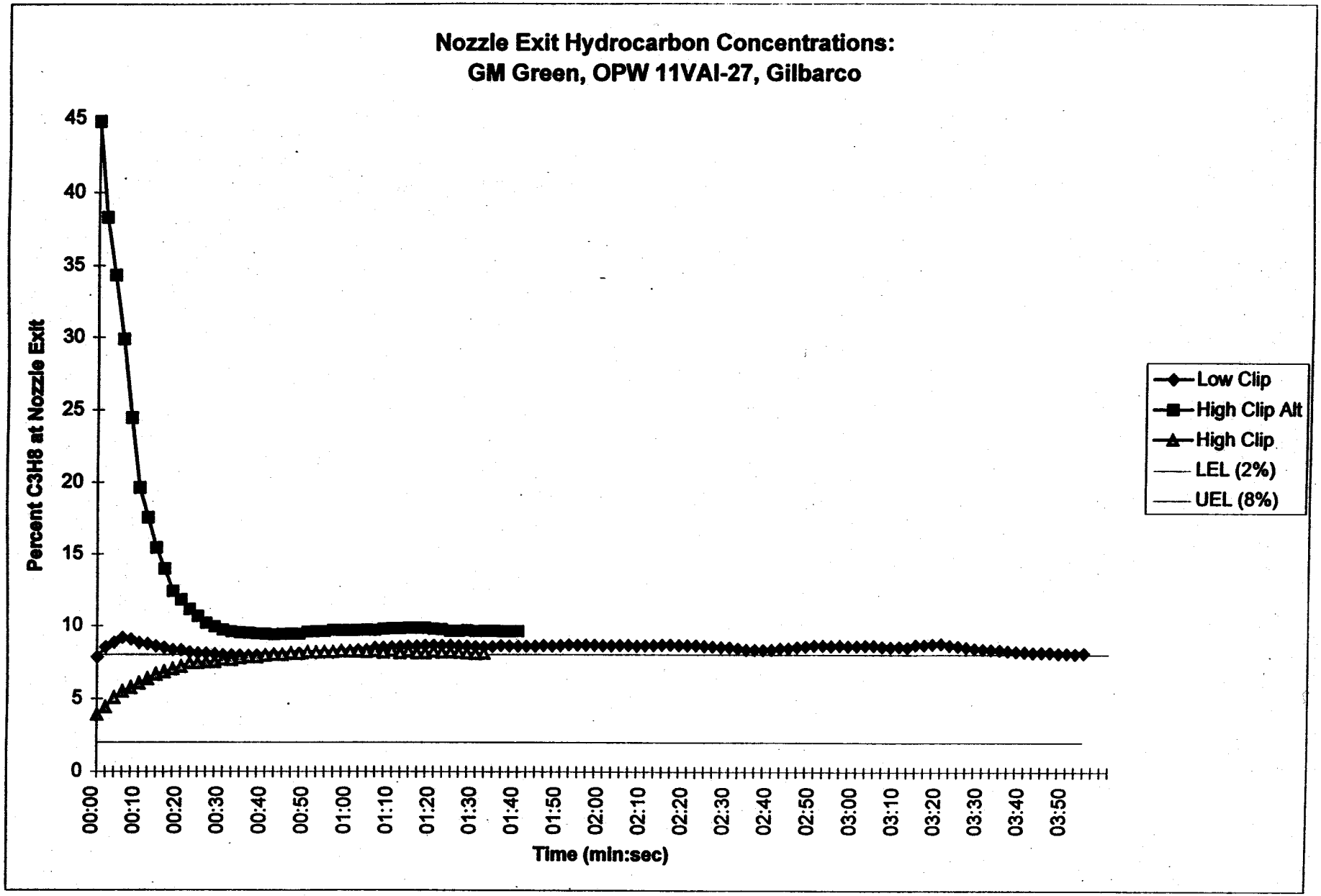

Nozzle Exit Hydrocarbon Concentrations:
GM Green, OPW 11VAI-27, Gilbarco
Percent C3H8 at Nozzle Exit
45
40
35
30
25
20
15
10
5
0
00:00
00:10
00:20
00:30
00:40
00:50
01:00
01:10
01:20
01:30
01:40
01:50
02:00
02:10
02:20
02:30
02:40
02:50
03:00
03:10
03:20
03:30
03:40
03:50
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-64

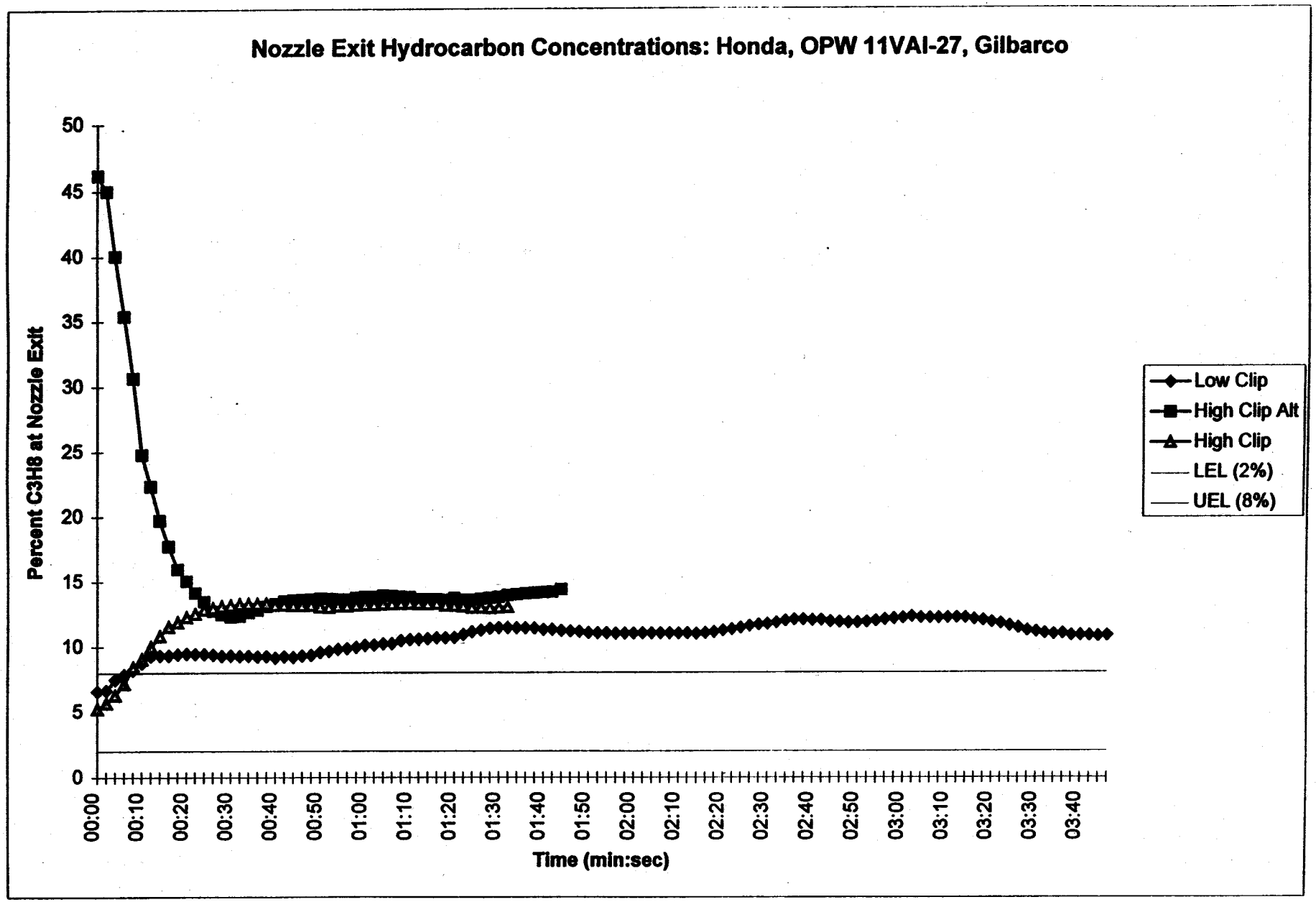

Nozzle Exit Hydrocarbon Concentrations: Honda, OPW 11VAI-27, Gilbarco
Percent C3H8 at Nozzle Exit
50
45
40
35
30
25
20
15
10
5
0
00:00
00:10
00:20
00:30
00:40
00:50
01:00
01:10
01:20
01:30
01:40
01:50
02:00
02:10
02:20
02:30
02:40
02:50
03:00
03:10
03:20
03:30
03:40
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-65

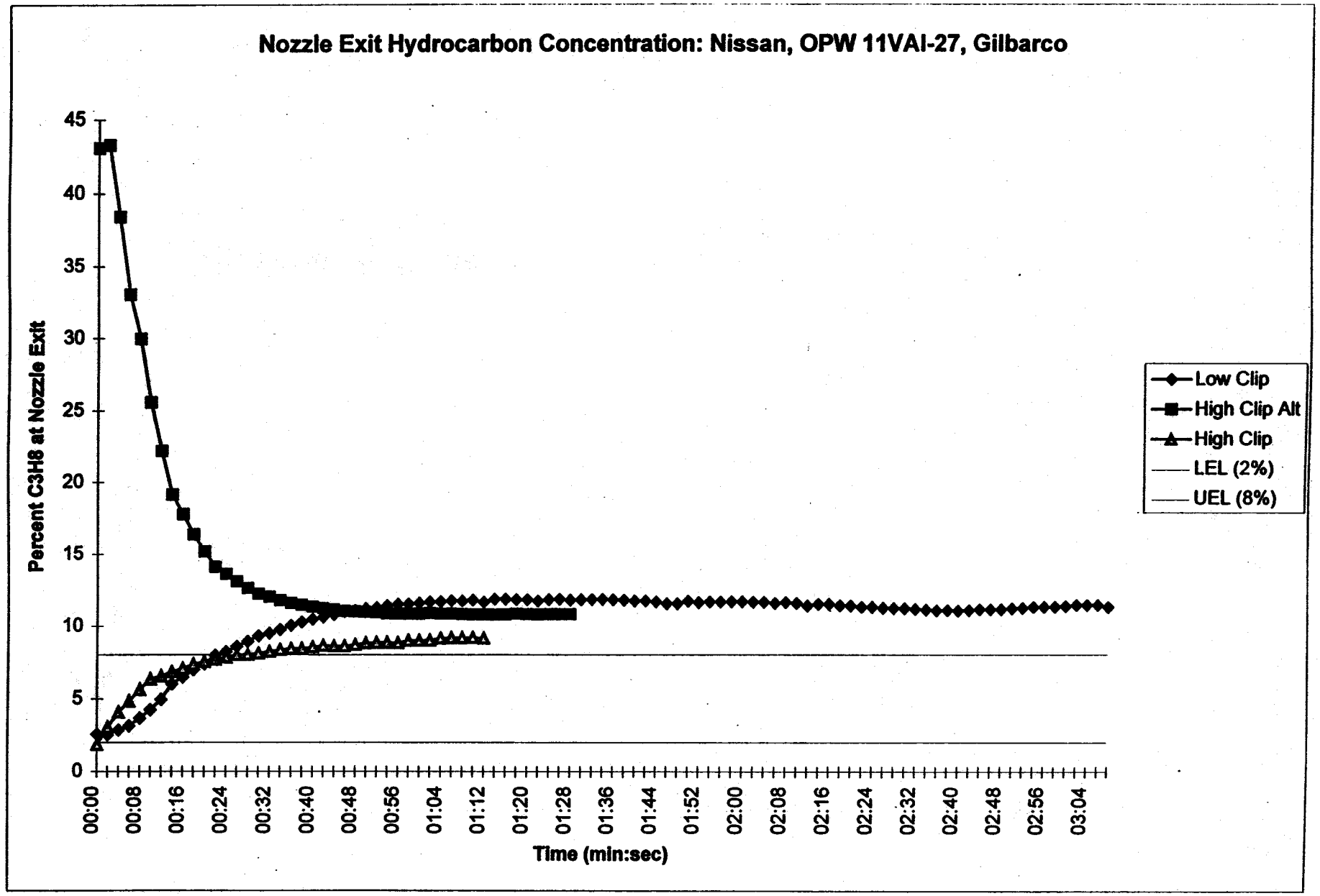

Nozzle Exit Hydrocarbon Concentration: Nissan, OPW 11VAI-27, Gilbarco
Percent C3H8 at Nozzle Exit
45
40
35
30
25
20
15
10
5
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
02:56
03:04
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-66

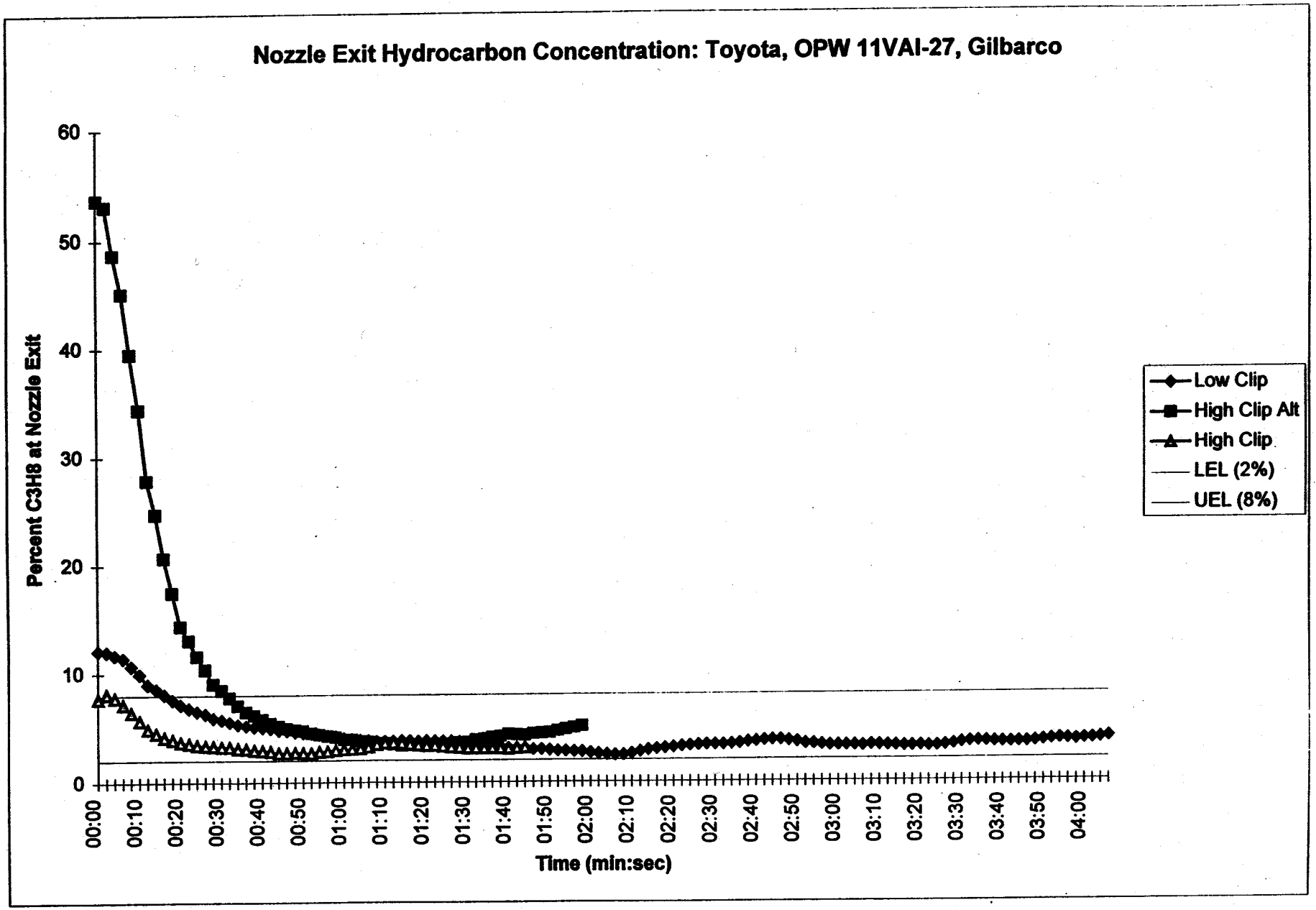

Nozzle Exit Hydrocarbon Concentration: Toyota, OPW 11VAI-27, Gilbarco
Percent C3H8 at Nozzle Exit
60
50
40
30
20
10
0
00:00
00:10
00:20
00:30
00:40
00:50
01:00
01:10
01:20
01:30
01:40
01:50
02:00
02:10
02:20
02:30
02:40
02:50
03:00
03:10
03:20
03:30
03:40
03:50
04:00
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

TABLE 6-11

Gilbarco Vapor Recovery System w/ Husky 6250 Nozzle, 7-15-97

ORVR SYSTEM	R/N	Dispensing Mode	Dispensing Rate*	NOZZLE EXIT HYDROCARBON CONCENTRATION - %C3H8 START Noz	START Dis	MAXIMUM Noz	MAXIMUM Dis	MINIMUM Noz	MINIMUM Dis	FINAL Noz	FINAL Dis	AVERAGE Noz	AVERAGE Dis	V/L@	%ER
Cry Grn	N	HC	7.94	5.2	5.2	7.2	5.9	2.1	3.3	2.2	3.3	3.2	4.3	1.08	100%
Cry Grn	N	HCA	7.79	51.2	51.2	52.4	51.4	0.9	10.4	0.9	10.4	10.3	25.2	1.01	26%
Cry Grn	N	LC	5.82	0.8	0.8	1.3	1.1	0.5	0.7	0.6	0.7	0.6	0.8	1.06	0%
Cry Wht	N	HC	7.52	11.5	11.5	26.6	18.4	3.5	7.9	3.5	7.9	8.2	12.4	1.10	66%
Cry Wht	N	HCA	7.79	43.5	43.5	44.5	43.5	0.6	7.9	0.7	7.9	7.2	20.7	1.07	31%
Cry Wht	N	LC	5.80	1.7	1.7	3.2	2.4	0.5	0.9	0.6	0.9	0.9	1.4	1.07	6%
GM Wht	N	HC	7.76	4.4	4.4	5.6	4.9	1.1	2.2	1.1	2.2	2.2	3.3	1.07	27%
GM Wht	N	HCA	7.17	42.2	42.2	44.5	43.0	0.8	9.5	0.8	9.5	9.4	22.0	1.05	31%
GM Wht	N	LC	5.46	0.8	0.8	1.5	1.2	0.5	0.6	0.5	0.6	0.6	0.8	1.07	0%
Ford	R	HC	7.63	1.3	1.3	5.0	3.0	0.7	1.3	0.7	1.4	1.4	2.0	1.06	23%
Ford	R	HCA	7.76	50.0	50.0	51.5	50.4	1.0	10.4	1.0	10.4	10.3	24.8	1.02	40%
Ford	R	LC	5.68	3.7	3.7	3.9	3.7	0.4	0.9	0.4	0.9	1.0	1.9	1.09	17%
GM Blk	R	HC	7.65	1.9	1.9	5.4	3.5	1.2	1.9	1.2	2.0	1.9	2.5	1.10	33%
GM Blk	R	HCA	7.30	52.3	52.3	53.3	52.3	1.0	13.3	1.0	13.3	11.6	27.9	1.08	38%
GM Blk	R	LC	5.71	0.8	0.8	1.5	1.1	0.3	0.6	0.3	0.6	0.5	0.8	1.08	0%
GM Grn	R	HC	7.77	0.8	0.8	2.1	1.4	0.8	0.8	1.4	1.1	1.1	1.1	1.07	0%
GM Grn	R	HCA	7.18	51.2	51.2	52.7	51.5	0.8	9.6	0.8	9.6	9.5	23.8	1.03	28%
GM Grn	R	LC	5.59	0.5	0.5	4.6	3.5	0.5	0.5	3.8	3.5	3.5	2.9	1.07	100%
Honda	R	HC	7.82	3.1	3.1	5.6	4.3	1.6	2.3	1.6	2.3	2.3	3.2	1.08	53%
Honda	R	HCA	7.67	49.3	49.3	53.6	50.4	0.8	9.6	0.8	9.6	9.5	23.5	1.05	29%
Honda	R	LC	5.49	0.6	0.6	1.7	1.1	0.3	0.6	0.4	0.6	0.6	0.7	1.07	0%
Nissan	R	HC	7.42	2.3	2.3	3.1	2.5	0.4	1.1	0.4	1.1	1.1	1.7	1.08	15%
Nissan	R	HCA	7.63	39.3	39.4	47.3	42.0	2.2	12.0	2.2	12.0	11.9	24.2	1.07	74%
Nissan	R	LC	5.61	0.7	0.7	1.2	0.9	0.4	0.6	0.4	0.6	0.6	0.7	1.06	0%
Toyota	R	HC	7.40	2.5	2.5	3.8	3.1	0.9	1.3	1.2	1.3	1.3	1.8	0.91	0%
Toyota	R	HCA	7.60	48.3	48.3	49.6	48.6	0.7	8.6	0.7	8.6	7.9	22.5	1.07	35%
Toyota	R	LC	5.45	0.5	0.5	2.3	1.3	0.3	0.5	0.3	0.5	0.5	0.8	1.08	5%

R/N - Vapor Recirculation (R) or Non-Recirculating.
%ER - Percent dispensing time nozzle concentration in flammable range (2% - 8%).
* - Rate in gpm.
@ - V/L based on actual vapor volume.

FIGURE 6-67

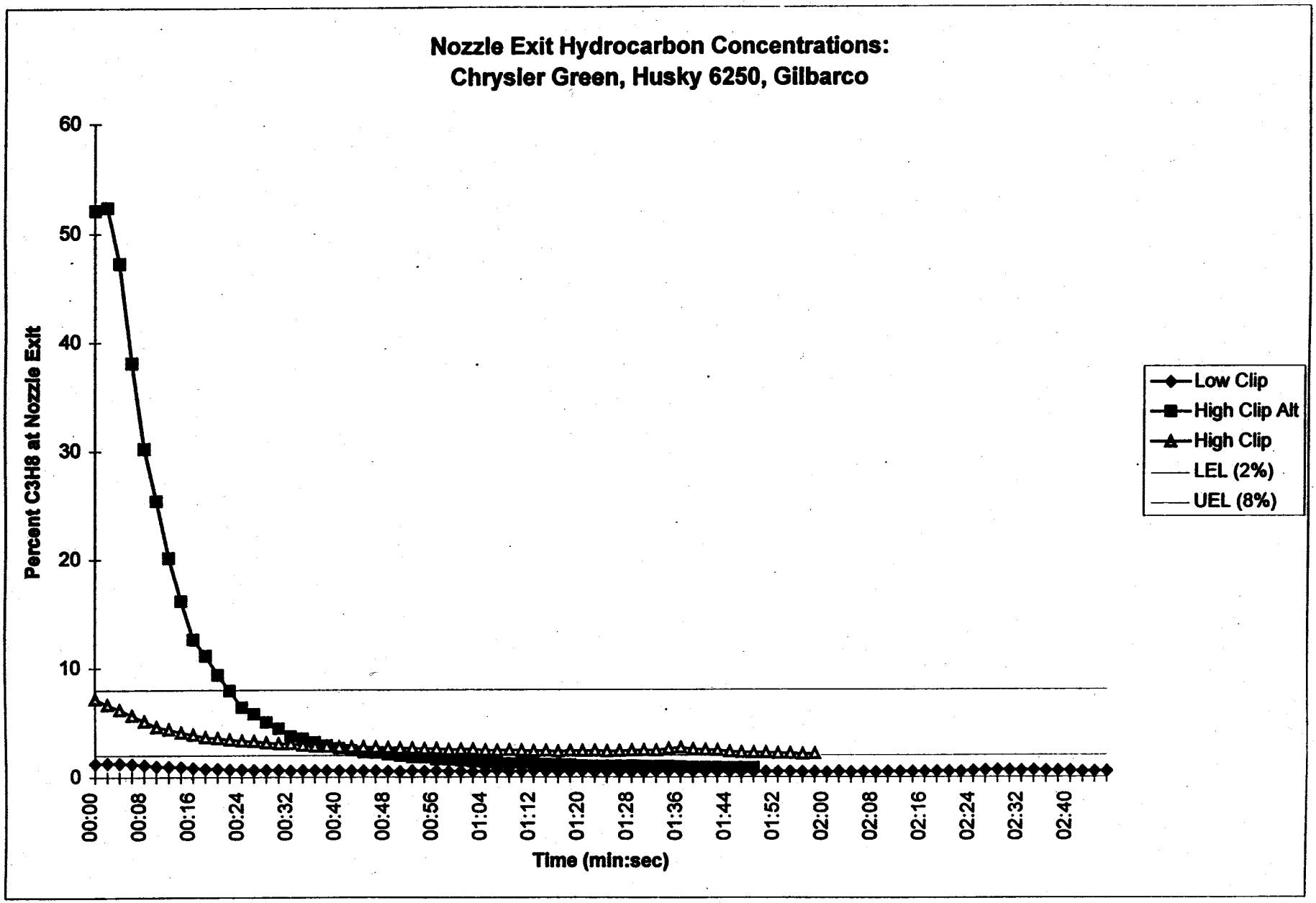

Nozzle Exit Hydrocarbon Concentrations:
Chrysler Green, Husky 6250, Gilbarco
Percent C3H8 at Nozzle Exit
60
50
40
30
20
10
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-68

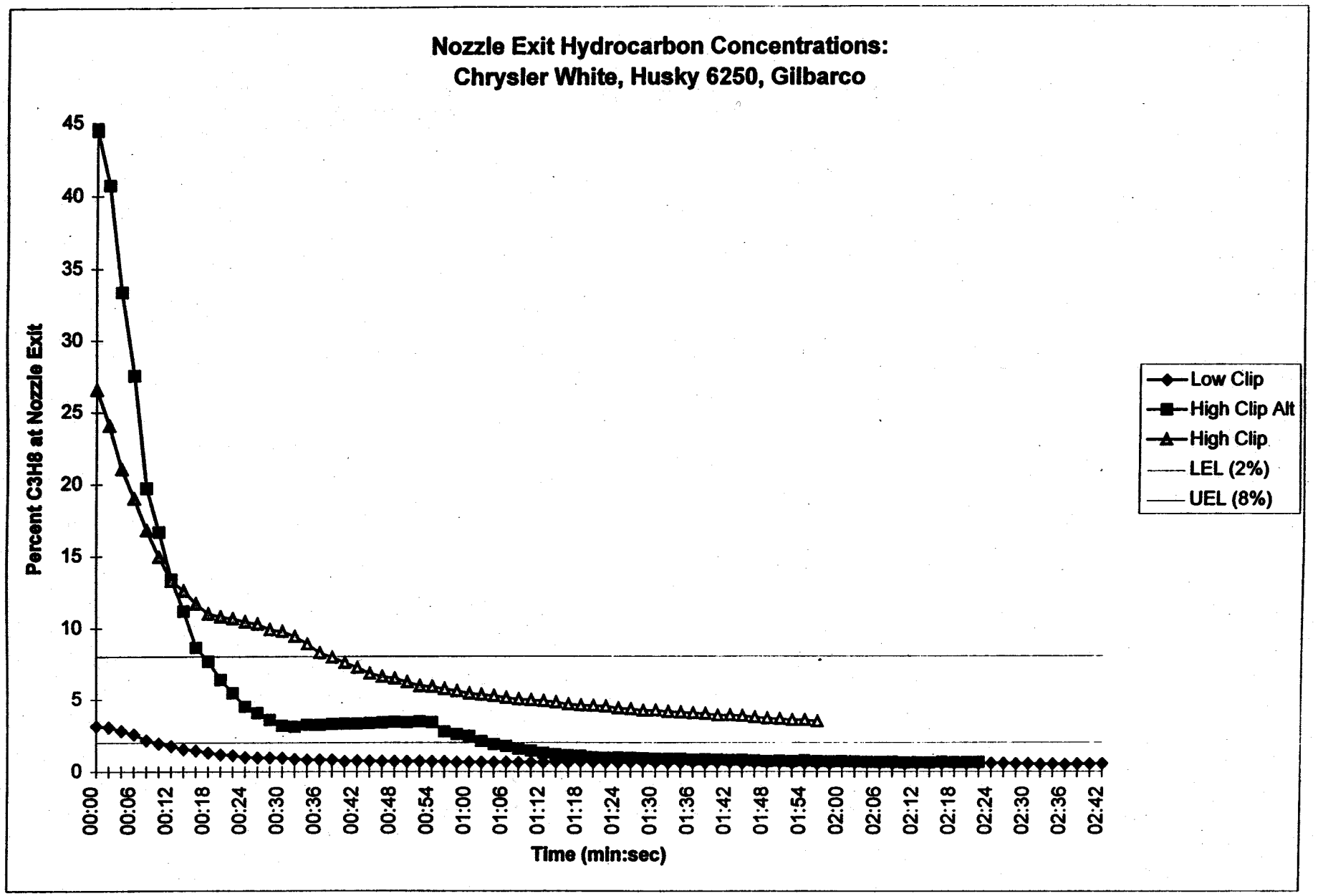

Nozzle Exit Hydrocarbon Concentrations:
Chrysler White, Husky 6250, Gilbarco
Percent C3H8 at Nozzle Exit
45
40
35
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
02:24
02:30
02:36
02:42
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-69

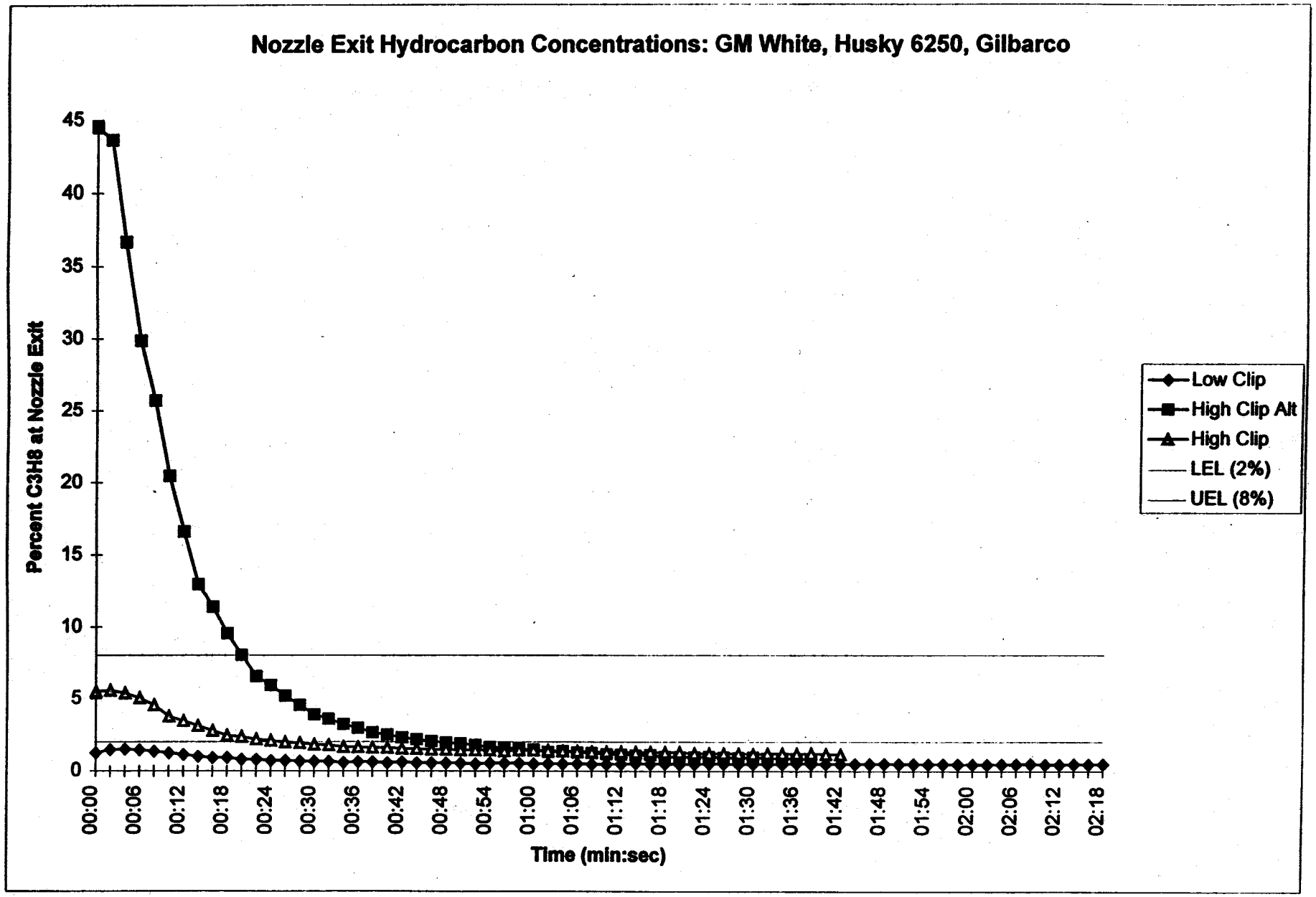

Nozzle Exit Hydrocarbon Concentrations: GM White, Husky 6250, Gilbarco
Percent C3H8 at Nozzle Exit
45
40
35
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-70

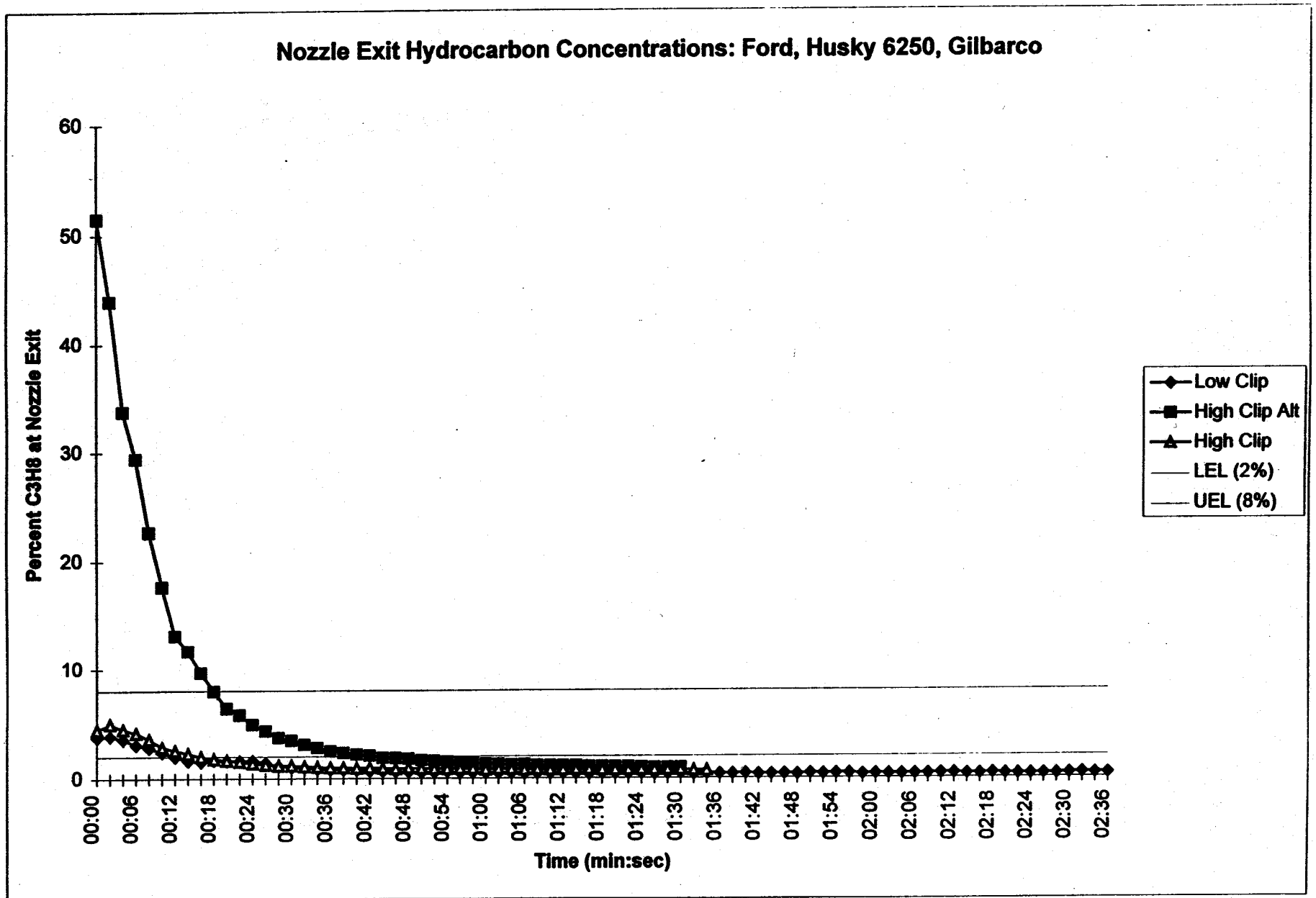

Nozzle Exit Hydrocarbon Concentrations: Ford, Husky 6250, Gilbarco
Percent C3H8 at Nozzle Exit
60
50
40
30
20
10
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
02:24
02:30
02:36
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-71

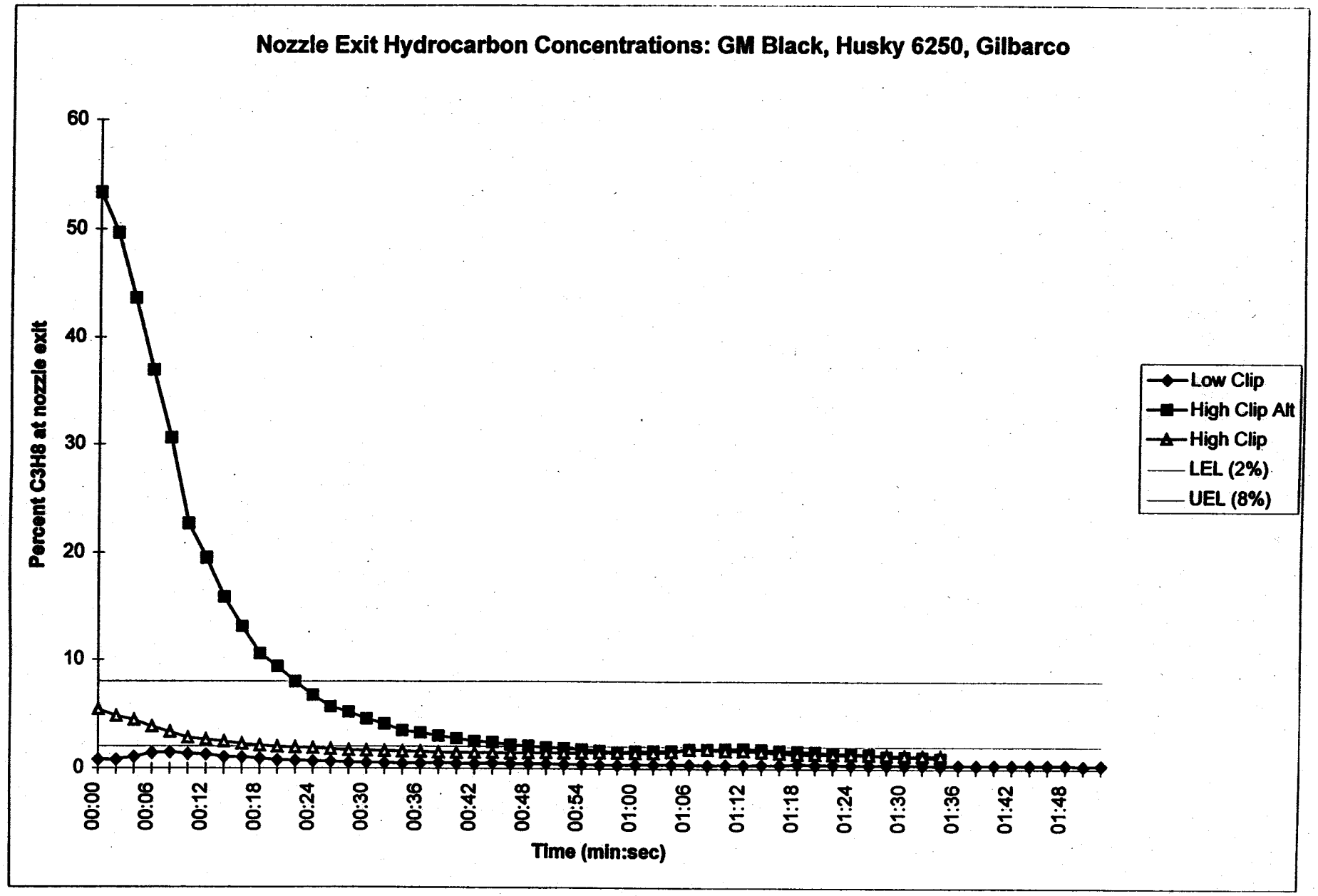

Nozzle Exit Hydrocarbon Concentrations: GM Black, Husky 6250, Gilbarco
Percent C3H8 at nozzle exit
60
50
40
30
20
10
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-72

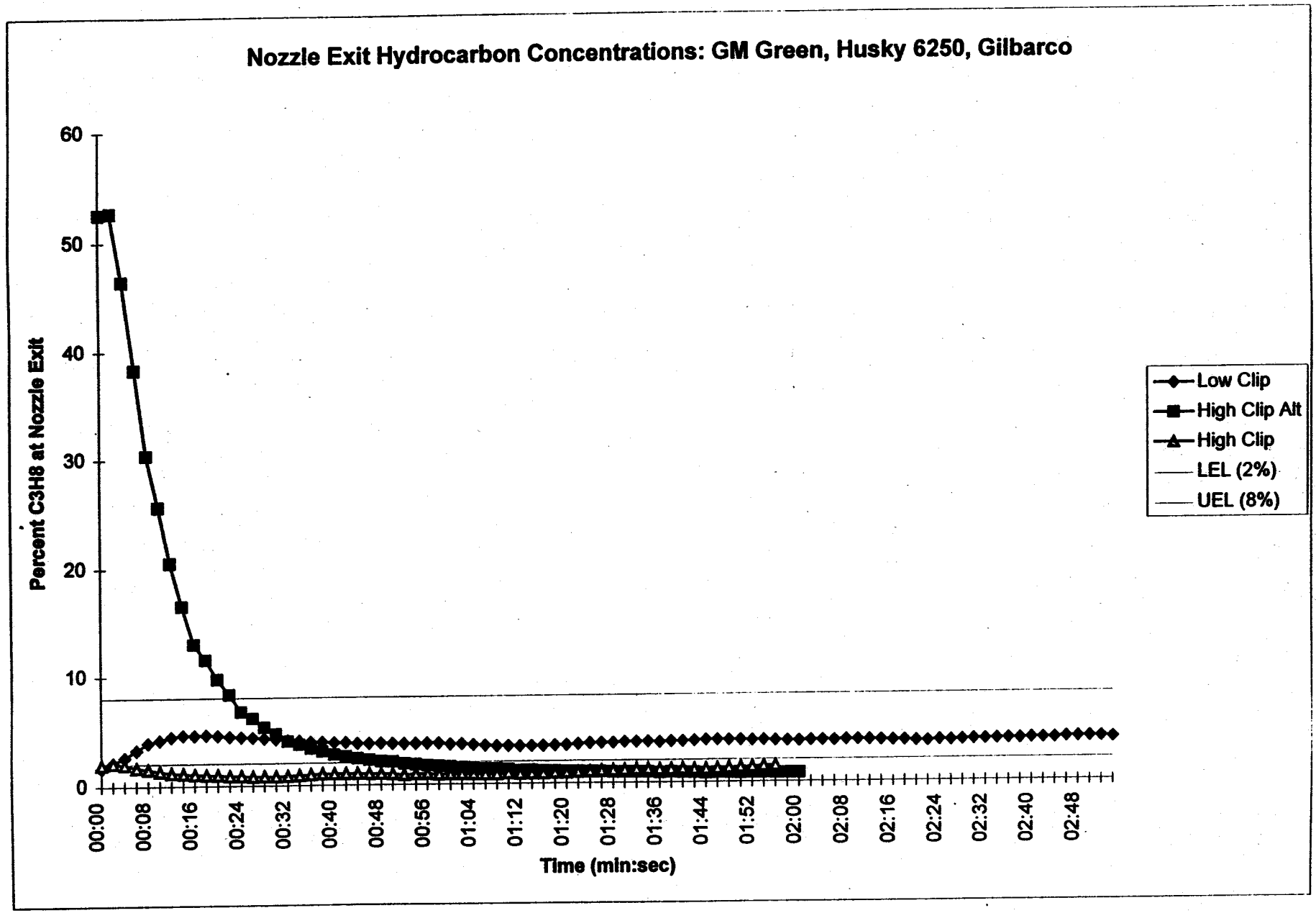

Nozzle Exit Hydrocarbon Concentrations: GM Green, Husky 6250, Gilbarco
Percent C3H8 at Nozzle Exit
60
50
40
30
20
10
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-73

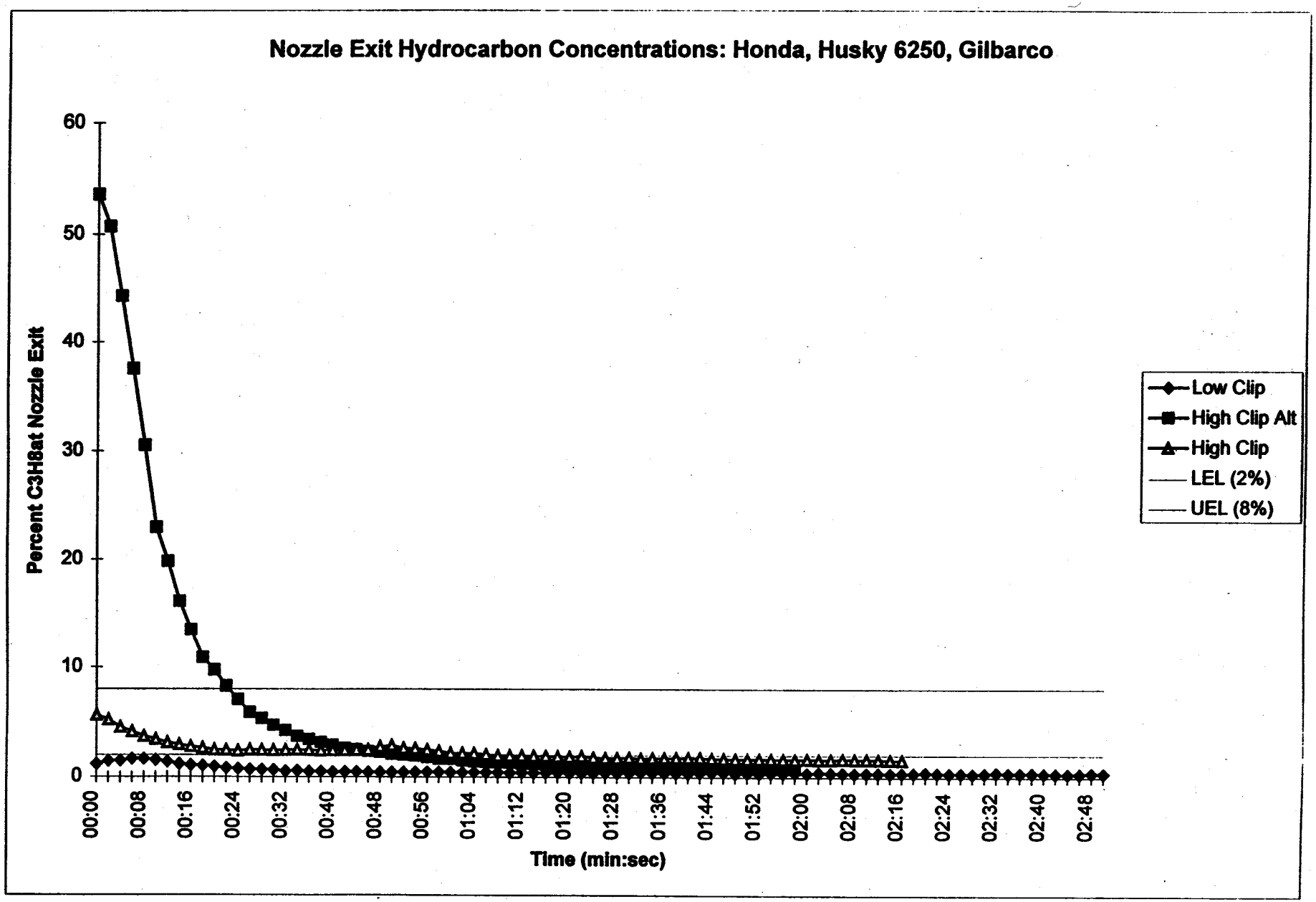

Nozzle Exit Hydrocarbon Concentrations: Honda, Husky 6250, Gilbarco
Percent C3H8at Nozzle Exit
60
50
40
30
20
10
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-74

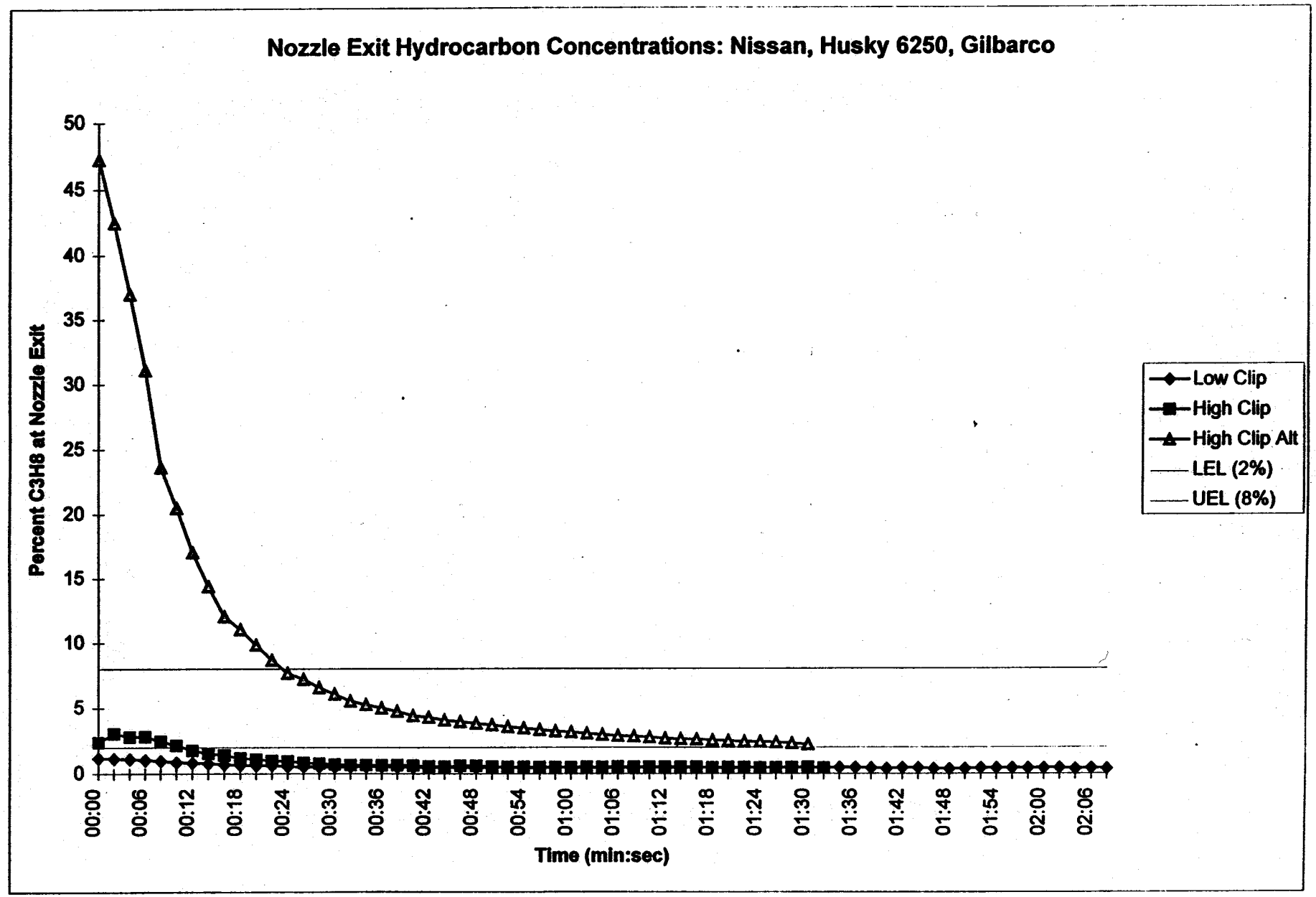

Nozzle Exit Hydrocarbon Concentrations: Nissan, Husky 6250, Gilbarco
Percent C3H8 at Nozzle Exit
50
45
40
35
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
Time (min:sec)
Low Clip
High Clip
High Clip Alt
LEL (2%)
UEL (8%)

FIGURE 6-75

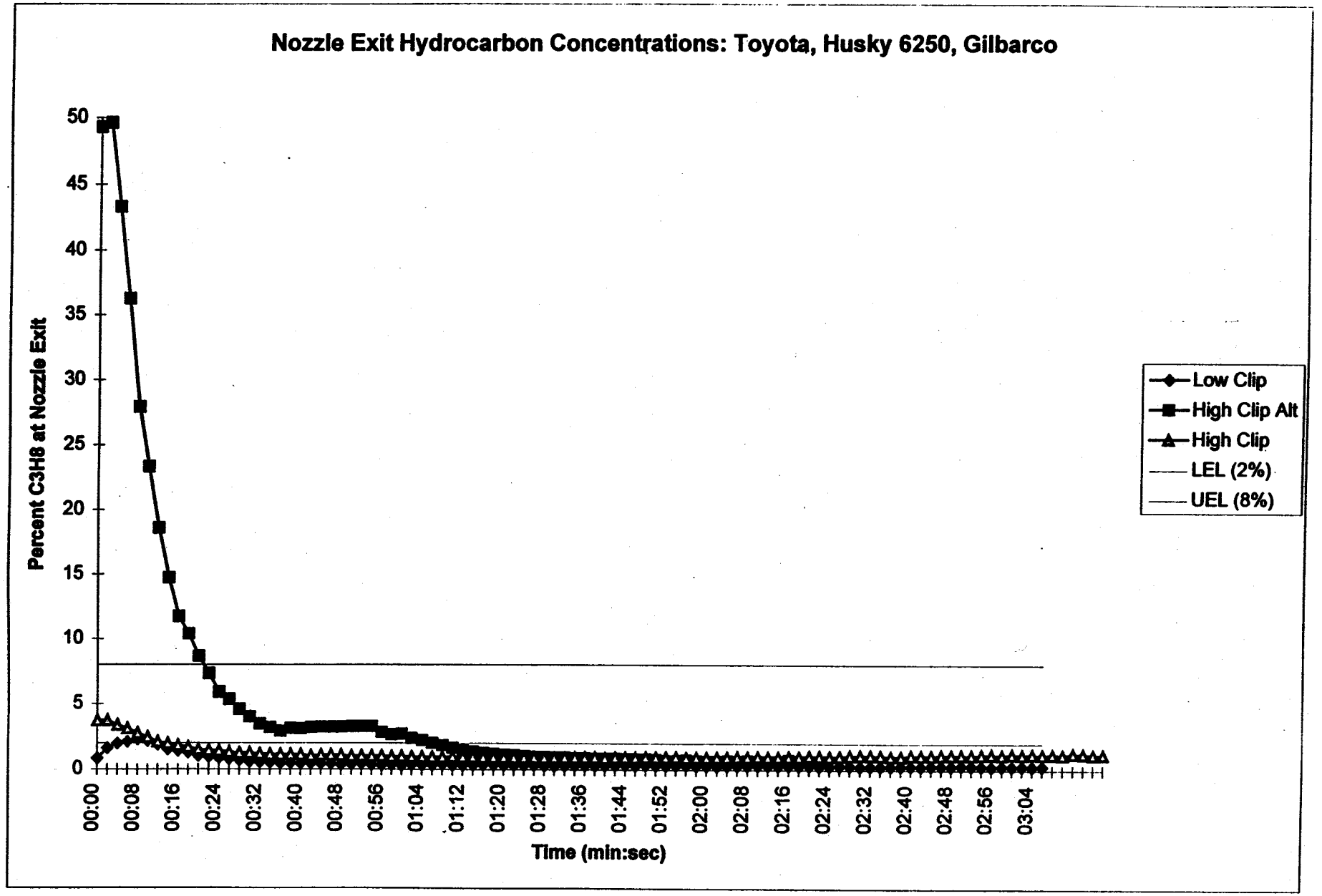

Nozzle Exit Hydrocarbon Concentrations: Toyota, Husky 6250, Gilbarco
Percent C3H8 at Nozzle Exit
50
45
40
35
30
25
20
15
10
5
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
02:56
03:04
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

TABLE 6-12

Catlow Vapor Recovery System w/ Catlow ICVN Nozzle, 7-17-97

ORVR SYSTEM	R/N	Dispensing Mode	Dispensing Rate*	NOZZLE EXIT HYDROCARBON CONCENTRATION - %C3H8 START Noz	START Dis	MAXIMUM Noz	MAXIMUM Dis	MINIMUM Noz	MINIMUM Dis	FINAL Noz	FINAL Dis	AVERAGE Noz	AVERAGE Dis	V/L@	%ER
Cry Grn	N	HC	7.53	5.4	5.4	5.9	5.5	2.2	3.0	2.2	3.0	3.0	4.1	0.93	100%
Cry Grn	N	HCA	7.09	29.8	29.8	36.0	32.0	1.8	7.8	1.9	7.8	7.7	16.6	0.97	82%
Cry Grn	N	LC	6.48	4.7	4.7	5.0	4.8	0.6	1.6	0.8	1.6	1.6	2.9	0.98	22%
Cry Wht	N	HC	7.52	5.3	5.3	5.3	5.3	4.8	5.0	4.9	5.0	5.0	5.1	0.96	100%
Cry Wht	N	HCA	7.53	21.7	21.8	26.6	23.5	1.0	4.6	1.3	4.6	4.6	10.5	0.97	21%
Cry Wht	N	LC	6.53	6.8	6.8	7.0	6.8	3.5	4.4	4.2	4.4	4.4	5.2	0.95	100%
GM Wht	N	HC	7.46	2.9	2.9	3.2	3.0	0.2	1.0	0.3	1.0	1.0	1.9	0.95	12%
GM Wht	N	HCA	7.33	29.7	29.7	38.9	33.2	1.2	8.7	1.2	8.7	8.6	18.3	1.00	44%
GM Wht	N	LC	6.47	8.7	8.7	8.7	8.7	0.5	2.0	0.6	2.0	2.0	4.3	0.98	18%
Ford	R	HC	7.47	7.6	7.6	7.7	7.7	4.7	5.2	4.8	5.2	5.2	6.0	0.94	100%
Ford	R	HCA	7.56	5.5	5.5	5.7	5.6	5.3	5.4	5.7	5.6	5.6	5.5	NA	100%
Ford	R	LC	6.33	5.8	5.8	5.8	5.8	5.2	5.4	5.3	5.4	5.4	5.5	0.98	100%
GM Blk	R	HC	7.40	6.8	6.8	6.9	6.8	5.0	5.4	5.1	5.4	5.4	6.0	0.93	100%
GM Blk	R	HCA	7.50	27.4	27.4	34.5	29.8	5.9	12.2	5.9	12.2	12.1	19.8	0.96	70%
GM Blk	R	LC	6.55	3.3	3.3	5.7	4.9	3.0	3.2	5.6	4.9	4.9	4.1	0.96	100%
GM Grn	R	HC	7.52	4.7	4.6	7.9	6.9	4.2	4.5	7.7	6.9	7.0	5.9	0.95	100%
GM Grn	R	HCA	7.51	26.2	26.2	33.3	29.0	7.8	11.3	8.1	11.3	11.2	17.1	0.95	46%
GM Grn	R	LC	6.47	39.0	39.0	42.3	40.1	8.5	15.0	8.5	15.0	14.9	24.2	0.96	0%
Honda	R	HC	7.47	2.3	2.3	11.8	9.5	2.2	2.3	10.2	9.5	9.5	7.5	0.94	8%
Honda	R	HCA	7.53	10.2	10.2	18.4	14.7	8.5	10.2	8.8	10.6	10.6	12.3	0.99	0%
Honda	R	LC	6.48	6.2	6.2	11.7	10.6	5.8	6.1	10.7	10.6	10.6	9.3	0.96	5%
Nissan	R	HC	7.41	2.6	2.6	6.7	5.8	2.6	2.6	6.8	6.8	5.8	4.8	0.95	100%
Nissan	R	HCA	7.10	27.0	27.0	32.0	28.8	8.5	13.7	8.6	13.7	13.6	20.0	0.96	0%
Nissan	R	LC	6.48	5.6	5.6	9.0	8.3	5.3	5.6	9.0	8.3	8.3	7.3	0.96	14%
Toyota	R	HC	7.53	4.8	4.8	4.8	4.8	1.3	2.0	2.0	2.0	2.0	2.9	0.95	17%
Toyota	R	HCA	6.70	24.0	24.0	28.4	25.7	3.5	7.0	3.5	7.0	7.0	12.7	0.98	85%
Toyota	R	LC	6.45	10.4	10.4	10.7	10.5	2.3	4.0	5.2	4.1	4.1	6.0	0.96	63%

R/N - Vapor Recirculation (R) or Non-Recirculating (N).
%ER - Percent dispensing time nozzle concentration in flammable range (2% - 8%).
* - Rate in gpm.
@ - V/L based on actual vapor volume.

FIGURE 6-76

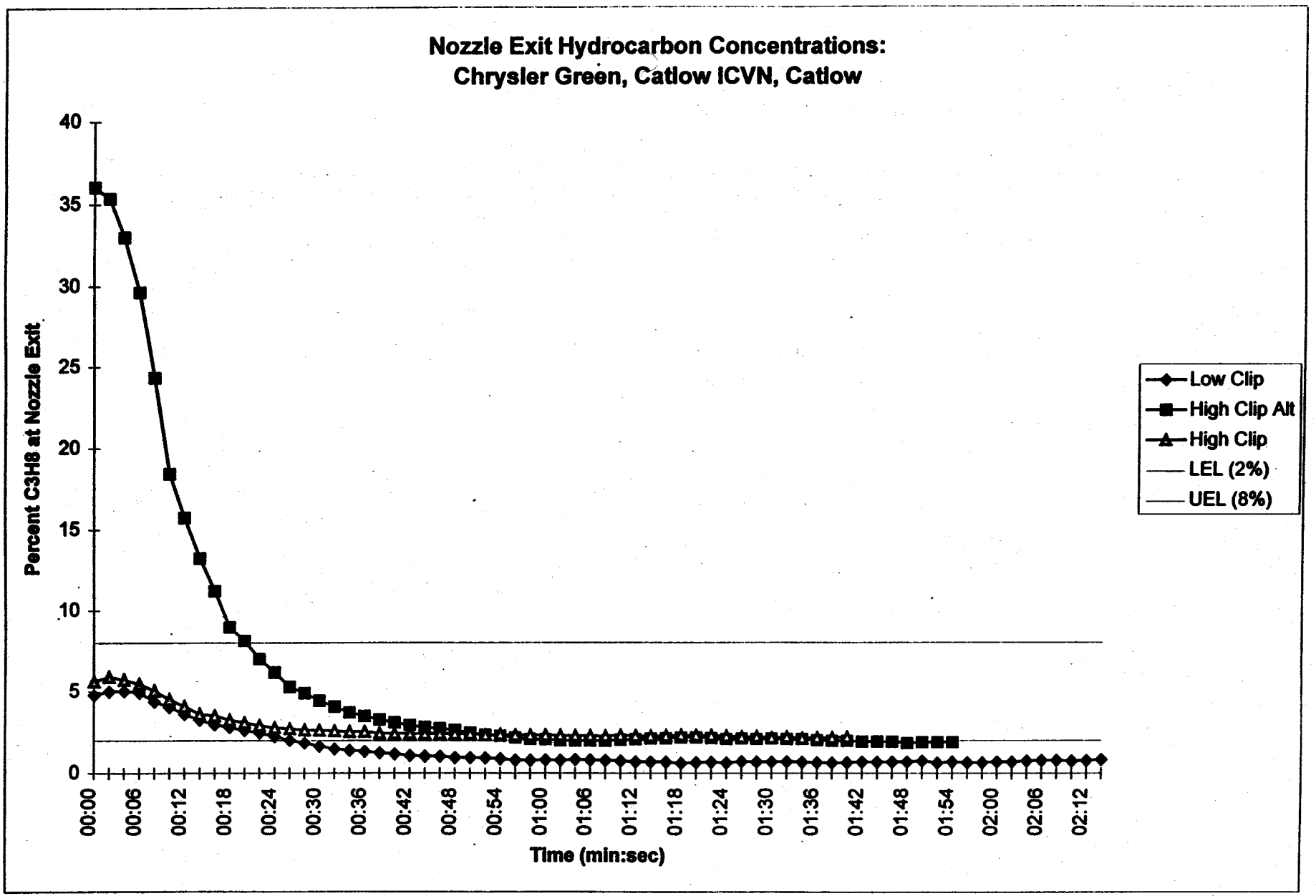

Nozzle Exit Hydrocarbon Concentrations:
Chrysler Green, Catlow ICVN, Catlow
Percent C3H8 at Nozzle Exit
40
35
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-77

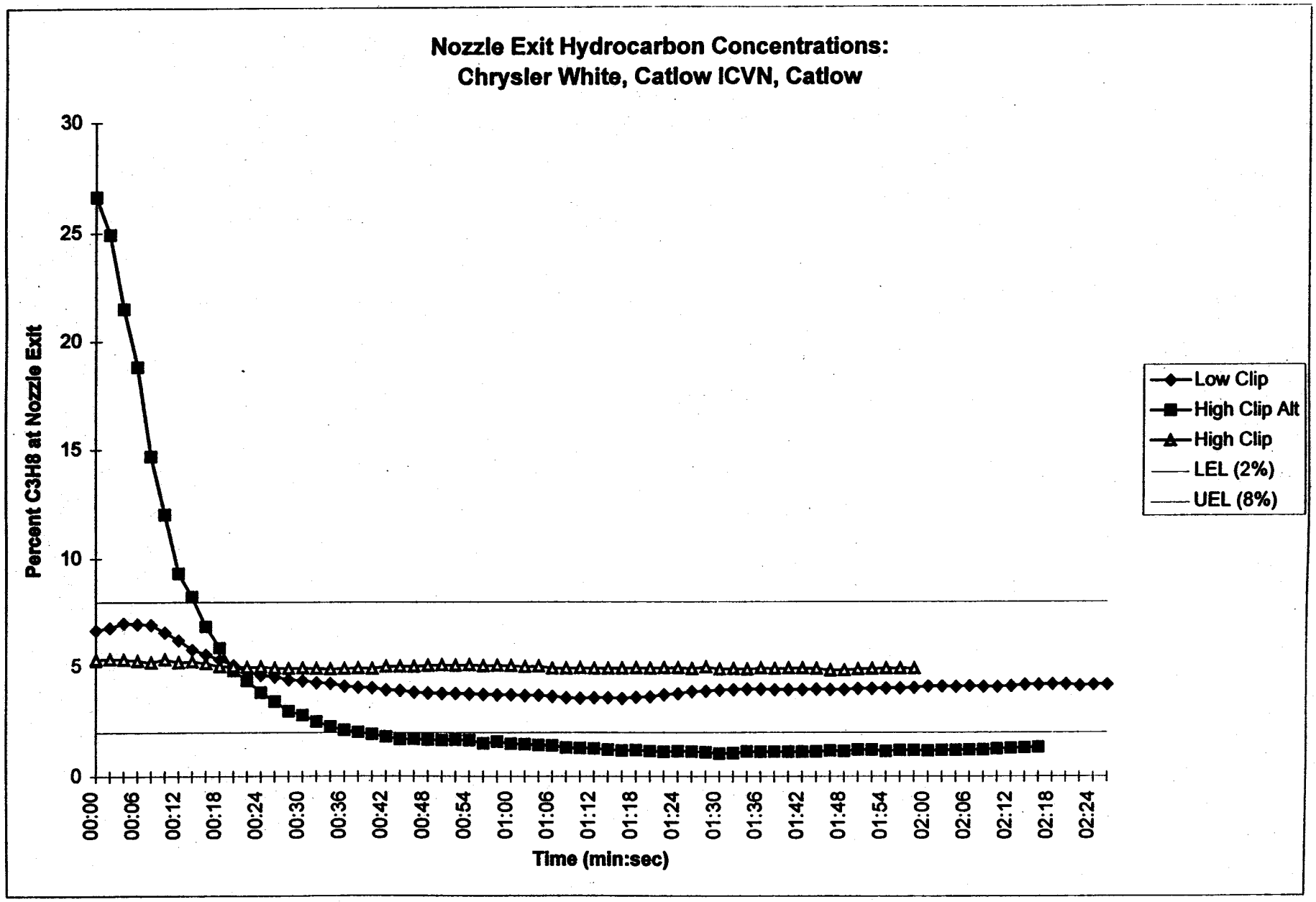

Nozzle Exit Hydrocarbon Concentrations:
Chrysler White, Catlow ICVN, Catlow
Percent C3H8 at Nozzle Exit
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
02:24
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-78

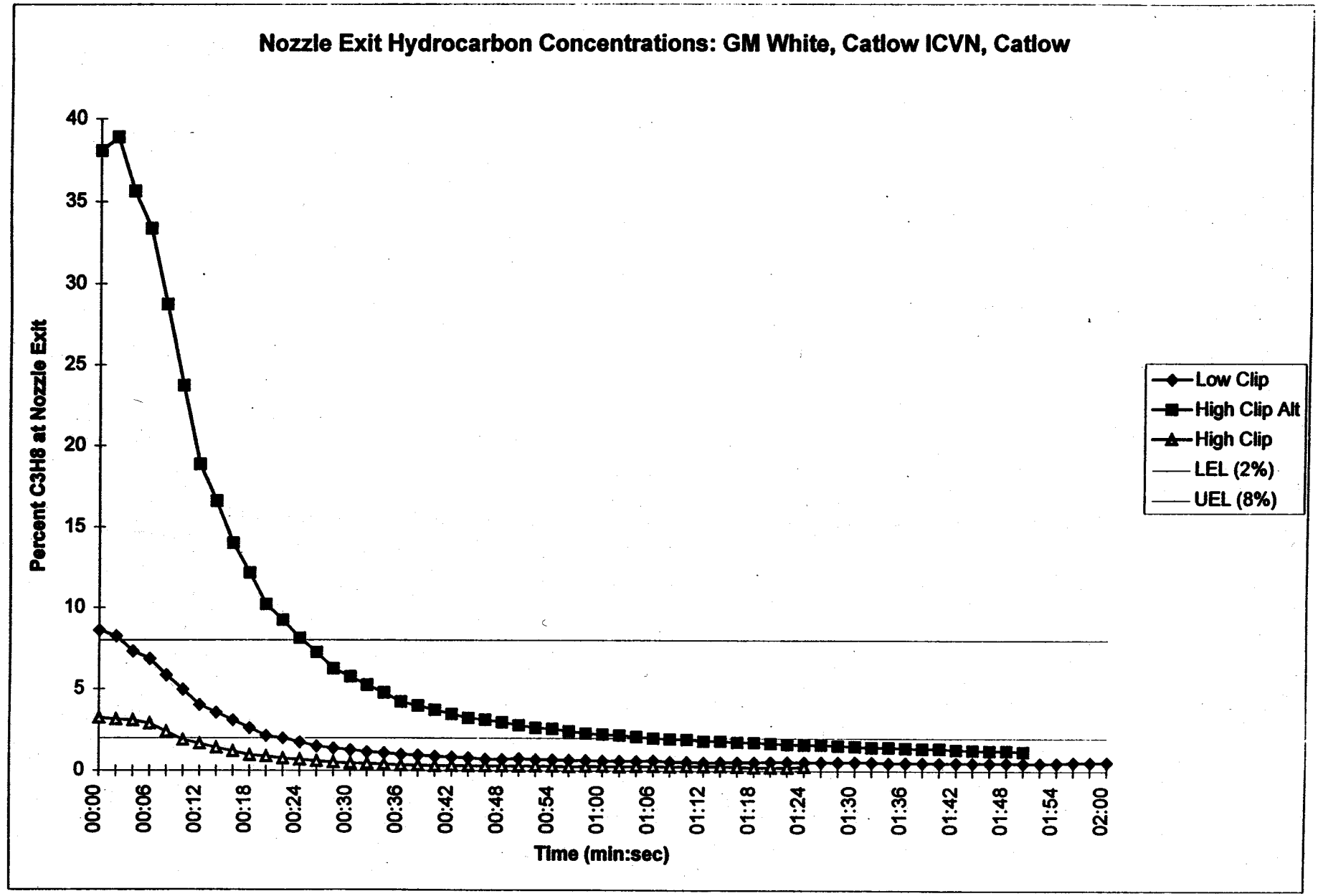

Nozzle Exit Hydrocarbon Concentrations: GM White, Catlow ICVN, Catlow
Percent C3H8 at Nozzle Exit
40
35
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-79

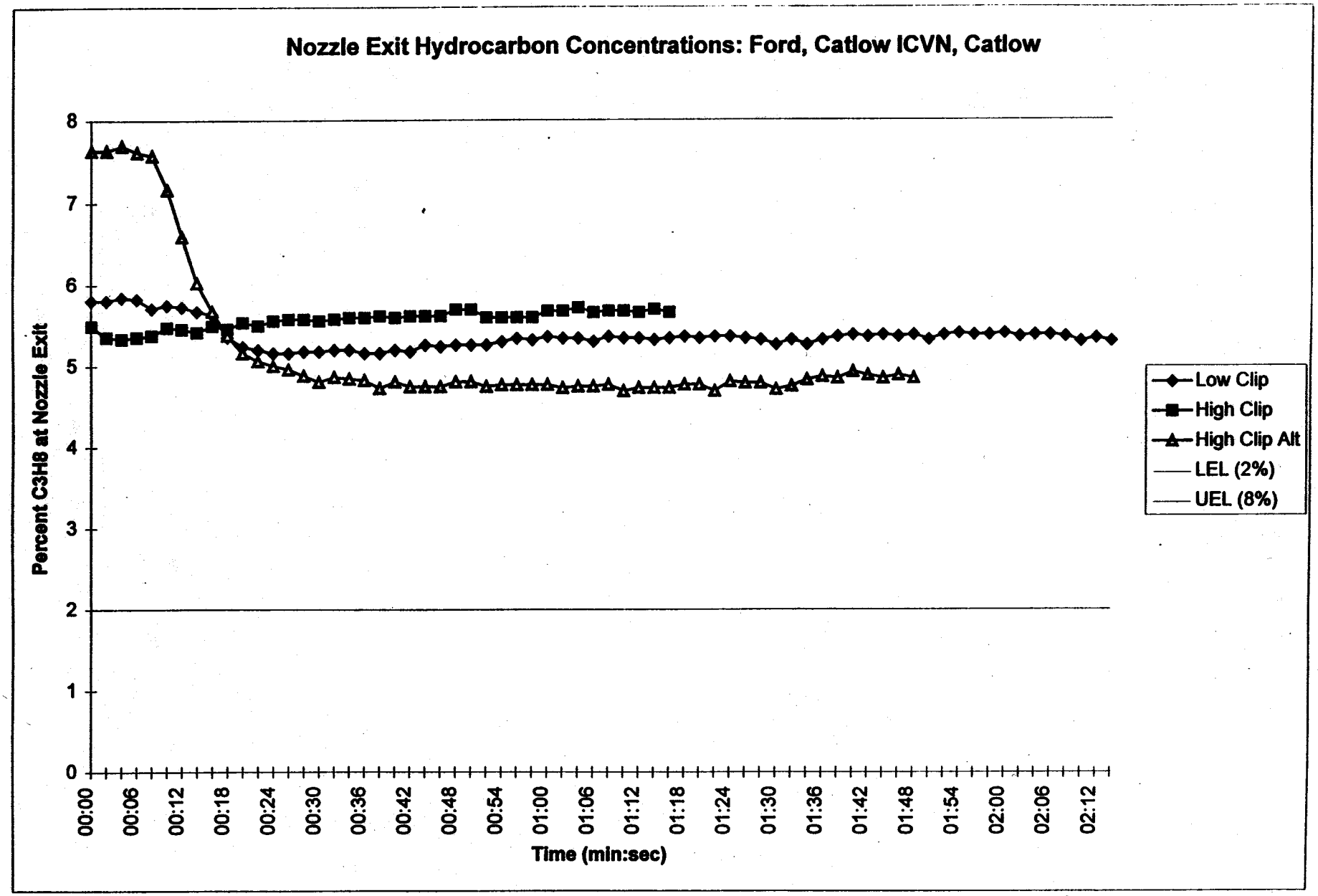

Nozzle Exit Hydrocarbon Concentrations: Ford, Catlow ICVN, Catlow
Percent C3H8 at Nozzle Exit
0
1
2
3
4
5
6
7
8
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
Time (min:sec)
Low Clip
High Clip
High Clip Alt
LEL (2%)
UEL (8%)

FIGURE 6-80

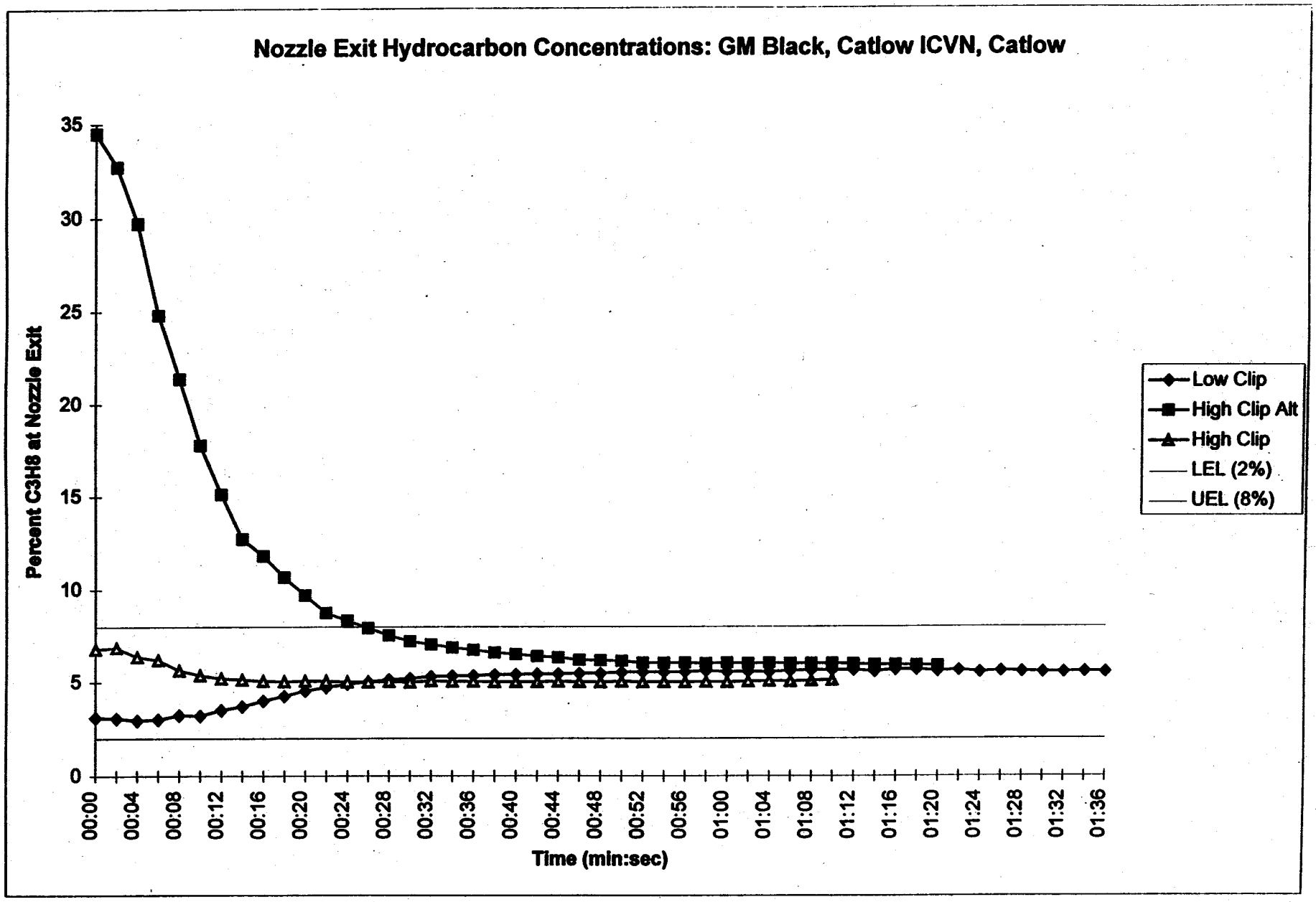

Nozzle Exit Hydrocarbon Concentrations: GM Black, Catlow ICVN, Catlow
Percent C3H8 at Nozzle Exit
35
30
25
20
15
10
5
0
00:00
00:04
00:08
00:12
00:16
00:20
00:24
00:28
00:32
00:36
00:40
00:44
00:48
00:52
00:56
01:00
01:04
01:08
01:12
01:16
01:20
01:24
01:28
01:32
01:36
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-81

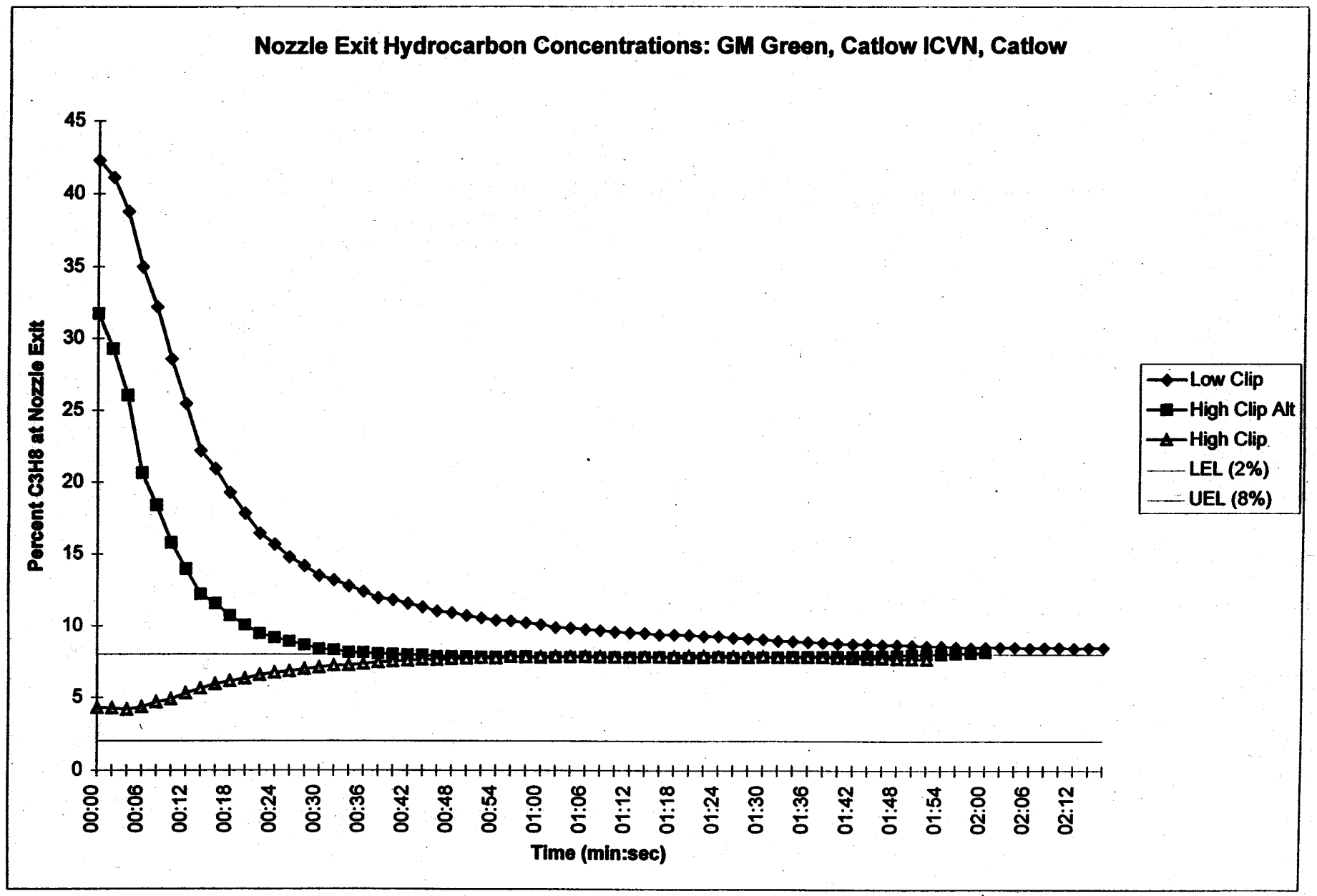

Nozzle Exit Hydrocarbon Concentrations: GM Green, Catlow ICVN, Catlow
Percent C3H8 at Nozzle Exit
45
40
35
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-82

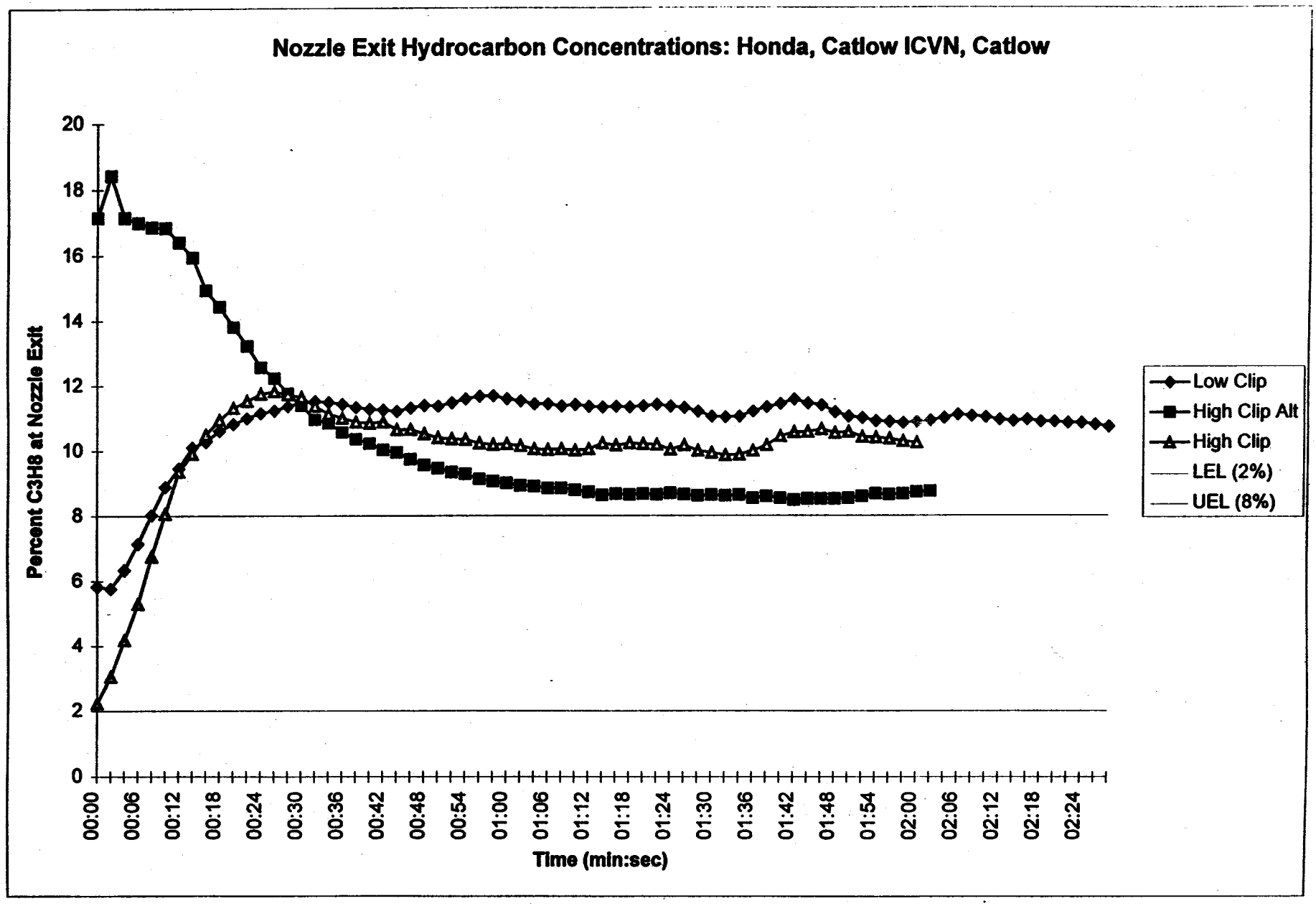

Nozzle Exit Hydrocarbon Concentrations: Honda, Catlow ICVN, Catlow
Percent C3H8 at Nozzle Exit
20
18
16
14
12
10
8
6
4
2
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
02:24
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-83

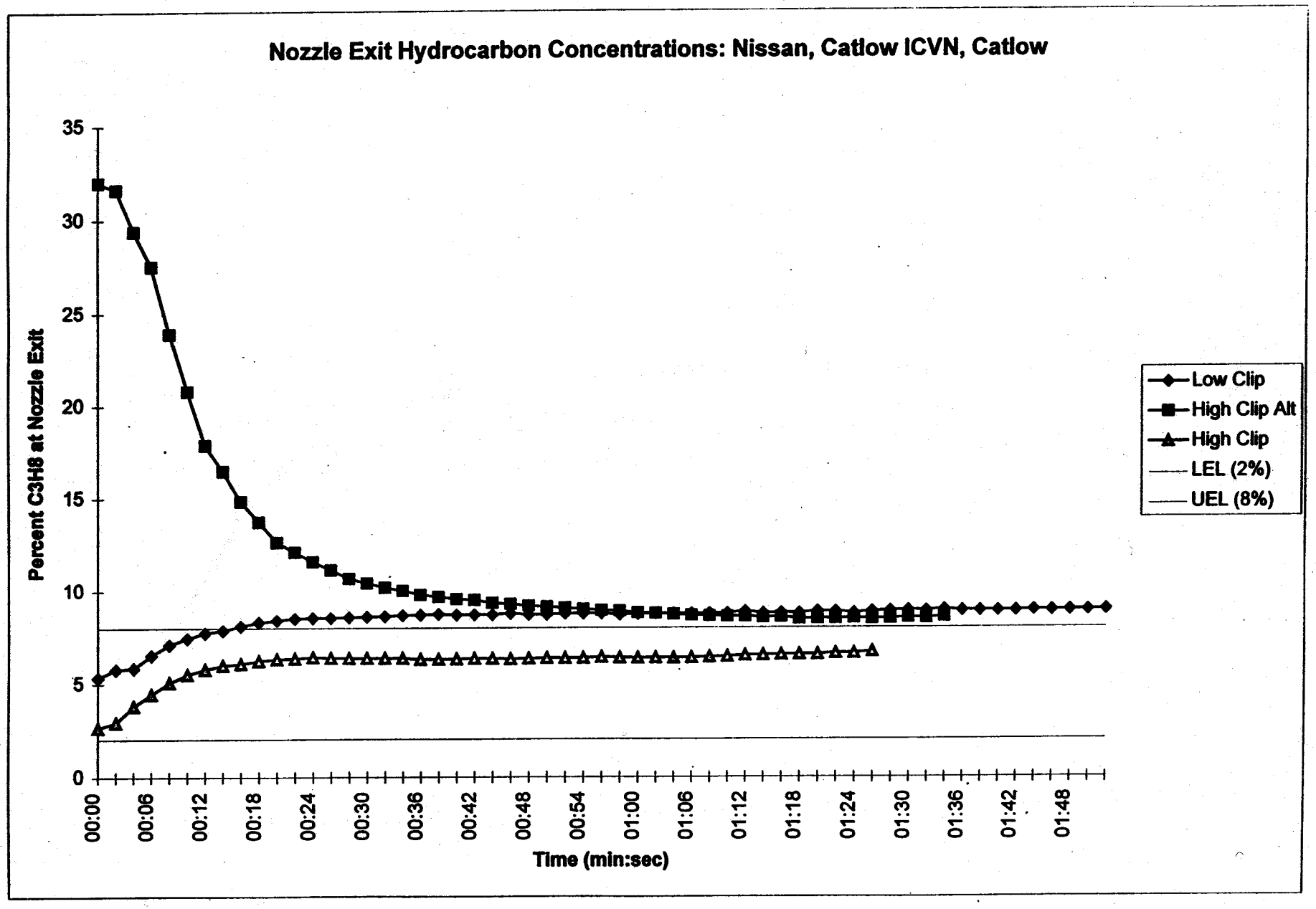

Nozzle Exit Hydrocarbon Concentrations: Nissan, Catlow ICVN, Catlow
Percent C3H8 at Nozzle Exit
35
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-84

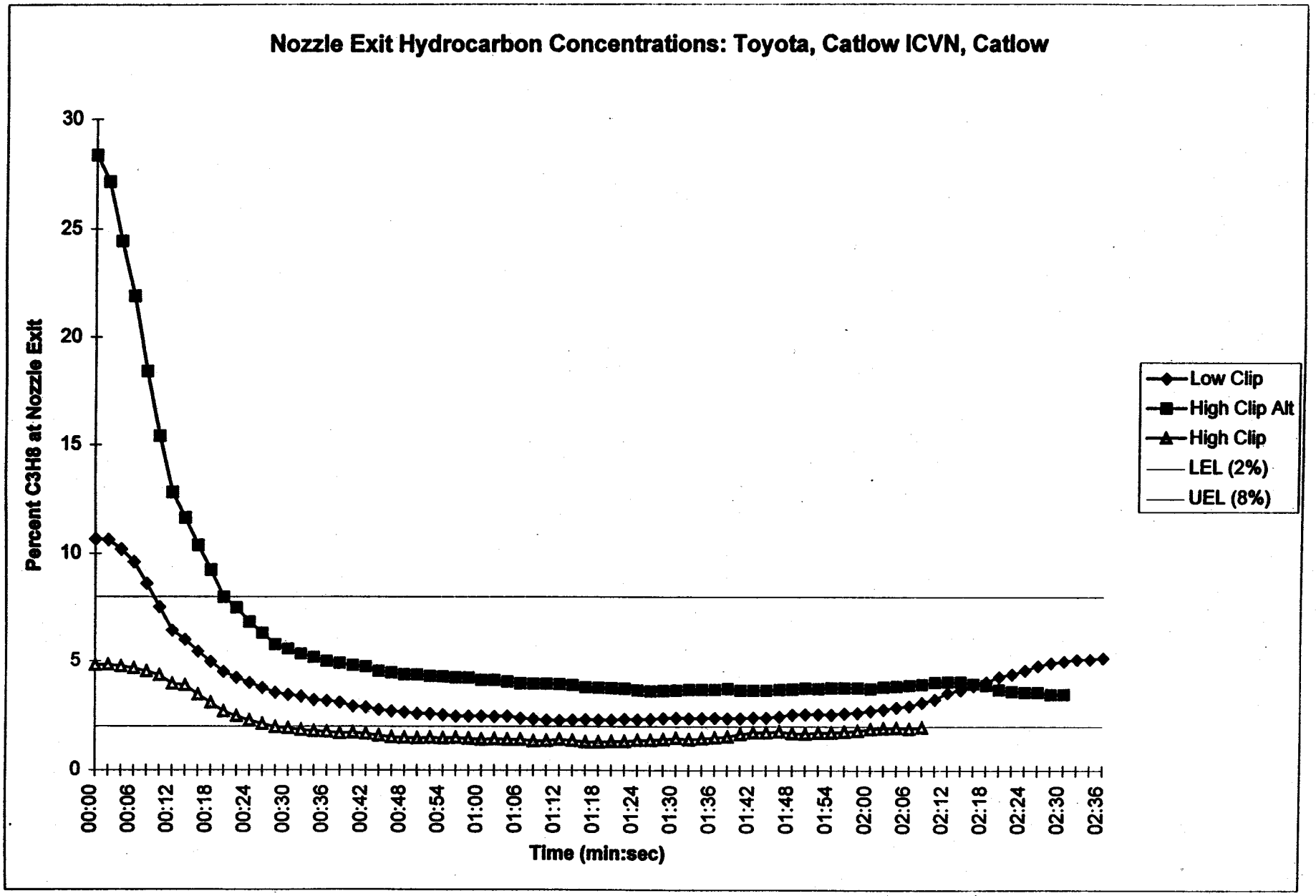

Nozzle Exit Hydrocarbon Concentrations: Toyota, Catlow ICVN, Catlow
Percent C3H8 at Nozzle Exit
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
02:24
02:30
02:36
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

TABLE 6-13

Healy Vapor Recovery System w/ Healy 600 Nozzle, 7-18-97

ORVR SYSTEM	R/N	Dispensing Mode	Dispensing Rate*	NOZZLE EXIT HYDROCARBON CONCENTRATION - %C3H8 START Noz	START Dis	MAXIMUM Noz	MAXIMUM Dis	MINIMUM Noz	MINIMUM Dis	FINAL Noz	FINAL Dis	AVERAGE Noz	AVERAGE Dis	V/L@	%ER
Cry Grn	N	HC	7.59	0.8	0.8	4.6	2.3	0.7	0.8	1.8	2.0	2.0	1.9	1.20	18%
Cry Grn	N	HCA	7.52	3.9	3.9	23.3	12.0	0.8	3.7	0.9	4.2	4.1	6.9	1.21	25%
Cry Grn	N	LC	4.41	1.4	1.4	7.7	4.2	0.9	1.4	1.0	1.7	1.7	2.4	1.29	13%
Cry Wht	N	HC	7.44	0.5	0.5	7.0	6.1	0.5	0.5	6.7	6.1	6.1	4.5	1.24	100%
Cry Wht	N	HCA	6.81	7.3	7.3	26.8	15.4	6.0	6.6	6.8	9.1	9.1	11.0	1.25	74%
Cry Wht	N	LC	4.42	0.9	0.9	6.3	5.7	0.8	0.9	6.1	5.7	5.7	4.7	1.29	100%
GM Wht	N	HC	7.52	0.7	0.7	5.4	2.5	0.7	0.7	1.0	1.6	1.6	1.8	1.30	18%
GM Wht	N	HCA	7.39	11.8	11.8	28.7	16.8	1.1	5.7	1.2	5.7	5.6	10.2	1.30	25%
GM Wht	N	LC	4.25	1.6	1.6	7.9	5.6	1.2	1.6	1.3	2.2	2.2	3.3	1.28	34%
Ford	R	HC	7.44	0.4	0.4	5.6	4.4	0.3	0.4	5.6	4.4	4.4	3.0	1.25	100%
Ford	R	HCA	6.72	6.2	6.2	23.5	13.5	4.7	5.8	4.8	7.1	7.1	9.1	1.28	84%
Ford	R	LC	5.56	0.5	0.5	6.9	6.0	0.4	0.4	6.9	6.0	6.0	4.7	1.34	100%
GM Blk	R	HC	7.27	0.8	0.8	5.3	4.3	0.7	0.7	5.3	4.3	4.3	3.1	1.25	100%
GM Blk	R	HCA	7.41	7.6	7.6	27.2	15.1	6.2	6.9	7.9	10.9	10.8	11.8	1.23	26%
GM Blk	R	LC	5.31	0.5	0.5	7.3	5.3	0.5	0.5	5.6	5.3	5.3	3.6	1.37	100%
GM Grn	R	HC	7.29	0.6	0.6	7.6	6.3	0.5	0.6	7.4	6.3	6.3	4.3	1.26	100%
GM Grn	R	HCA	7.43	4.8	4.8	24.4	13.5	4.3	4.6	9.1	9.9	9.9	10.4	1.26	0%
GM Grn	R	LC	4.76	0.8	0.8	8.8	7.5	0.8	0.8	8.8	7.5	7.5	5.9	1.34	48%
Honda	R	HC	7.50	0.8	0.8	4.3	1.1	0.8	0.8	6.9	5.4	1.3	0.8	1.23	100%
Honda	R	HCA	7.40	2.0	2.0	23.4	14.0	1.9	2.0	13.8	13.9	13.9	12.2	1.17	0%
Honda	R	LC	4.40	0.6	0.6	10.4	9.0	0.5	0.5	10.4	9.0	9.0	6.9	1.27	5%
Nissan	R	HC	7.52	0.8	0.8	9.6	6.8	0.7	0.7	7.7	6.8	6.8	5.0	1.27	79%
Nissan	R	HCA	7.44	7.2	7.2	22.2	14.0	6.7	7.0	11.0	12.1	12.0	12.0	1.21	0%
Nissan	R	LC	5.88	0.9	0.9	14.2	11.7	0.9	0.9	14.1	11.7	11.7	7.9	1.21	5%
Toyota	R	HC	7.07	0.5	0.5	7.3	5.9	0.5	0.5	7.2	5.9	5.9	4.0	1.25	100%
Toyota	R	HCA	7.44	6.0	6.0	25.6	13.8	5.2	5.7	6.1	7.8	7.8	9.6	1.30	78%
Toyota	R	LC	4.37	1.0	1.0	6.5	4.1	0.9	1.0	4.3	4.0	4.0	3.7	1.38	100%

R/N - Vapor Recirculation (R) or Non-Recirculating (N).
%ER - Percent dispensing time nozzle concentration in flammable range (2% - 8%).
* - Rate in gpm.
@ - V/L based on actual vapor volume.

FIGURE 6-85

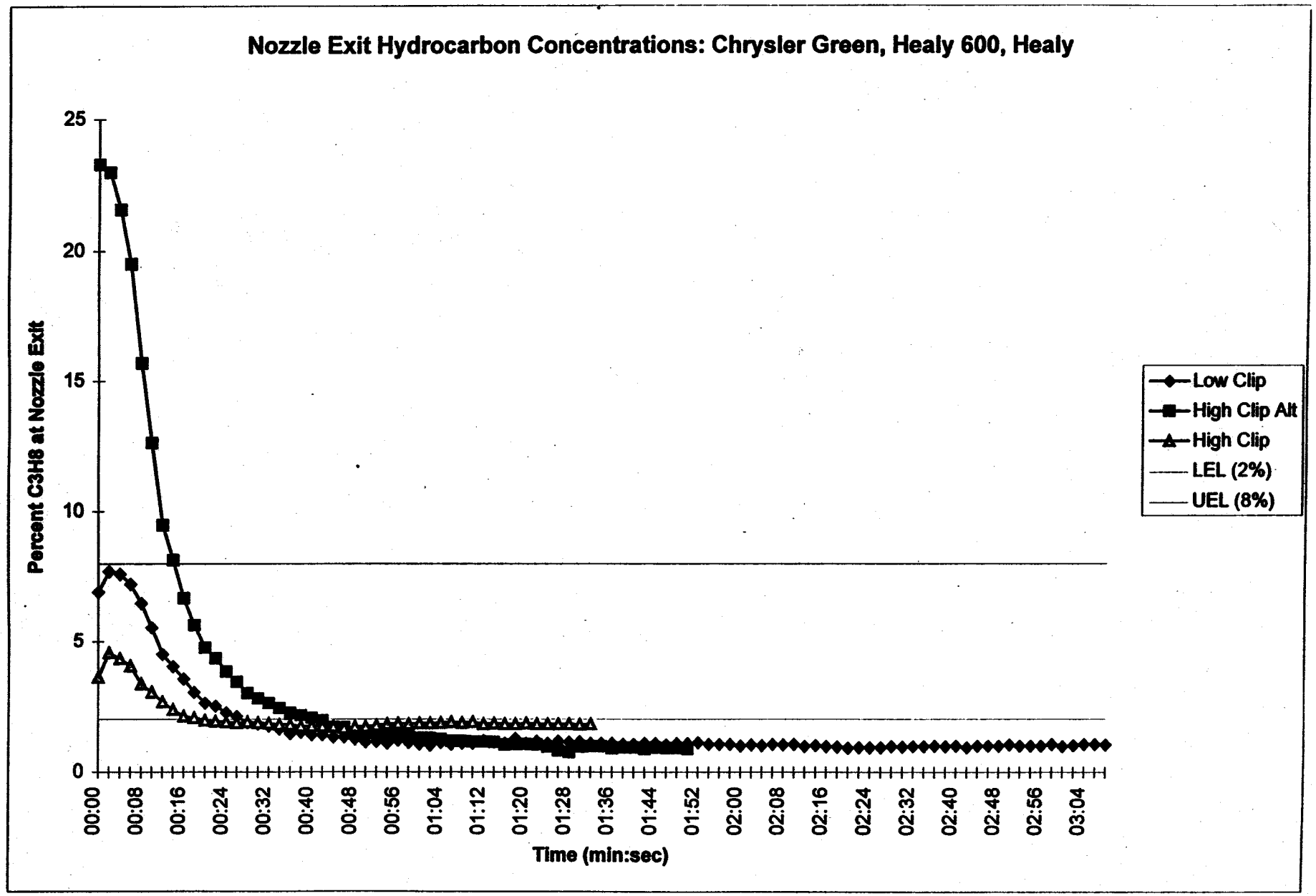

Nozzle Exit Hydrocarbon Concentrations: Chrysler Green, Healy 600, Healy
Percent C3H8 at Nozzle Exit
25
20
15
10
5
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
02:56
03:04
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-86

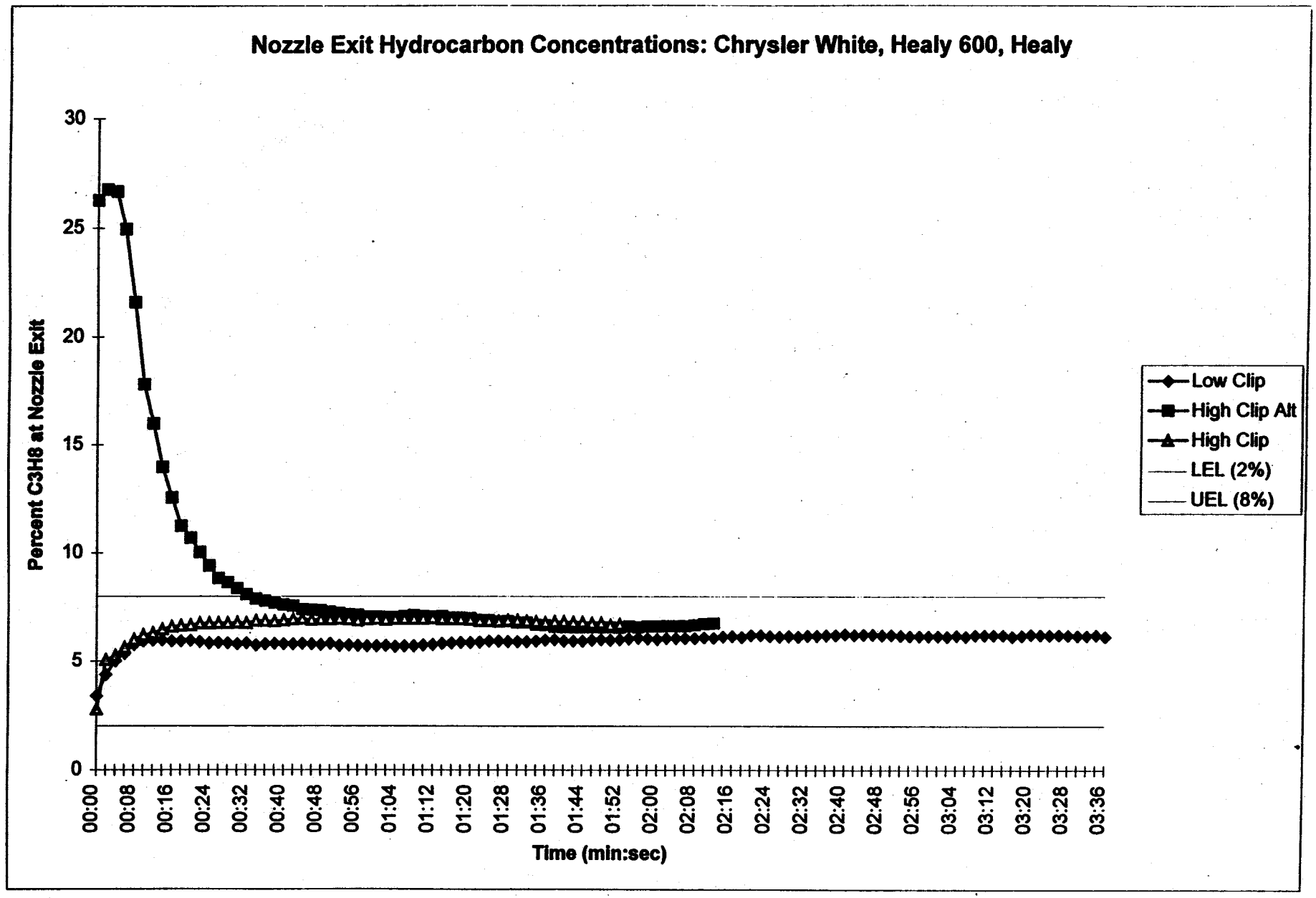

Nozzle Exit Hydrocarbon Concentrations: Chrysler White, Healy 600, Healy
Percent C3H8 at Nozzle Exit
30
25
20
15
10
5
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
02:56
03:04
03:12
03:20
03:28
03:36
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-87

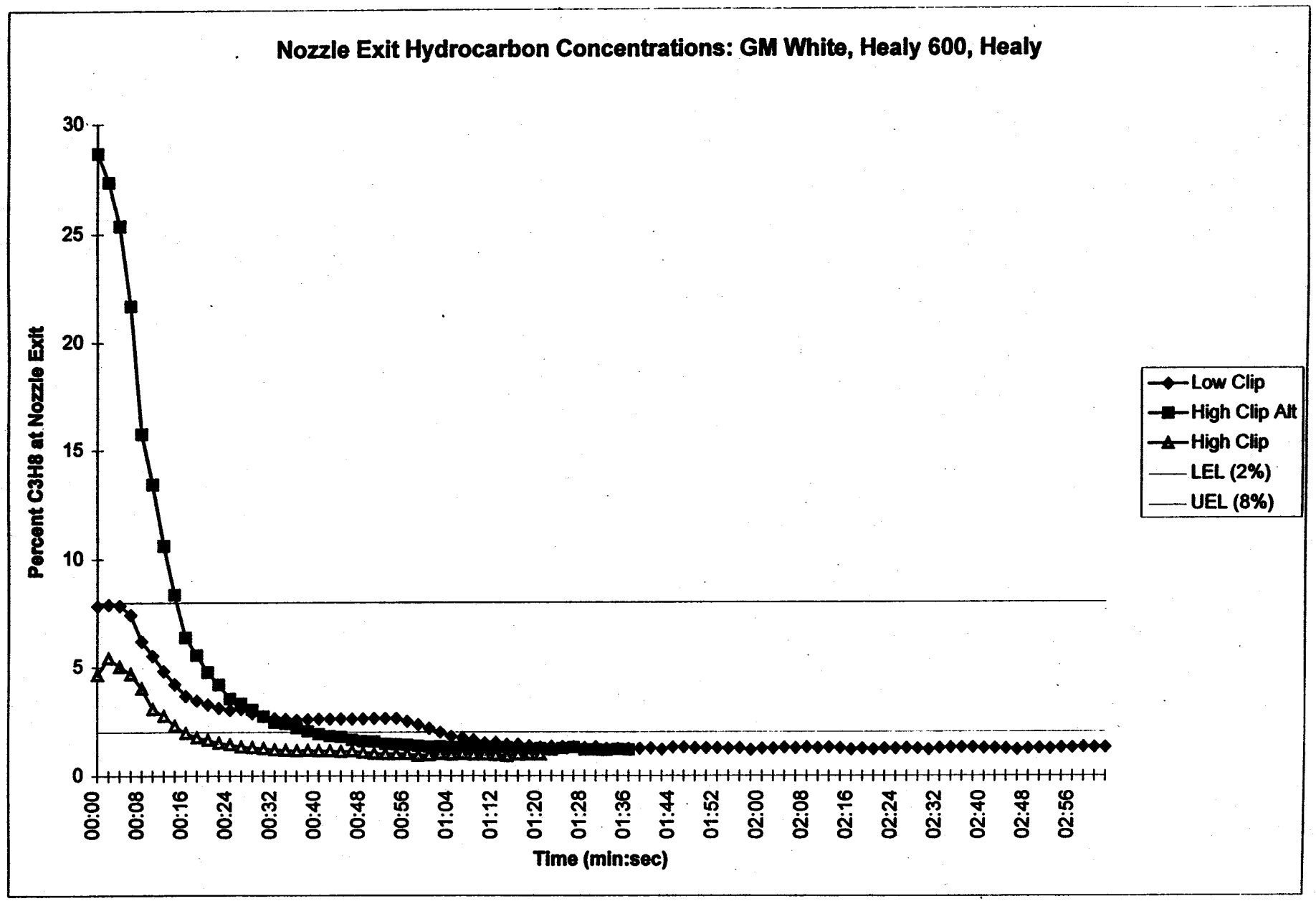

Nozzle Exit Hydrocarbon Concentrations: GM White, Healy 600, Healy
Percent C3H8 at Nozzle Exit
30
25
20
15
10
5
0
00:00
00:08
00:16
00:24
00:32
00:40
00:48
00:56
01:04
01:12
01:20
01:28
01:36
01:44
01:52
02:00
02:08
02:16
02:24
02:32
02:40
02:48
02:56
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-88

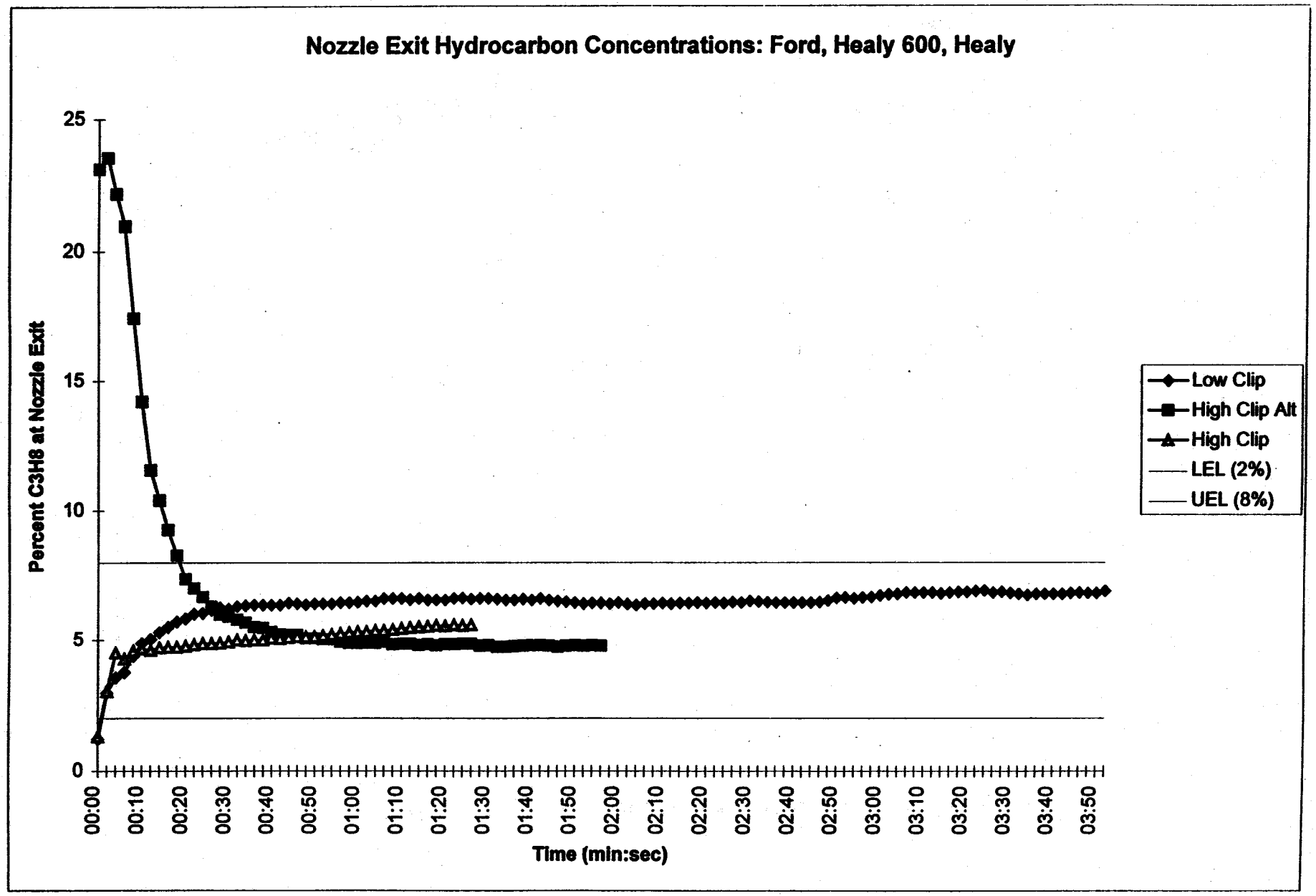

Nozzle Exit Hydrocarbon Concentrations: Ford, Healy 600, Healy
Percent C3H8 at Nozzle Exit
25
20
15
10
5
0
00:00
00:10
00:20
00:30
00:40
00:50
01:00
01:10
01:20
01:30
01:40
01:50
02:00
02:10
02:20
02:30
02:40
02:50
03:00
03:10
03:20
03:30
03:40
03:50
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-89

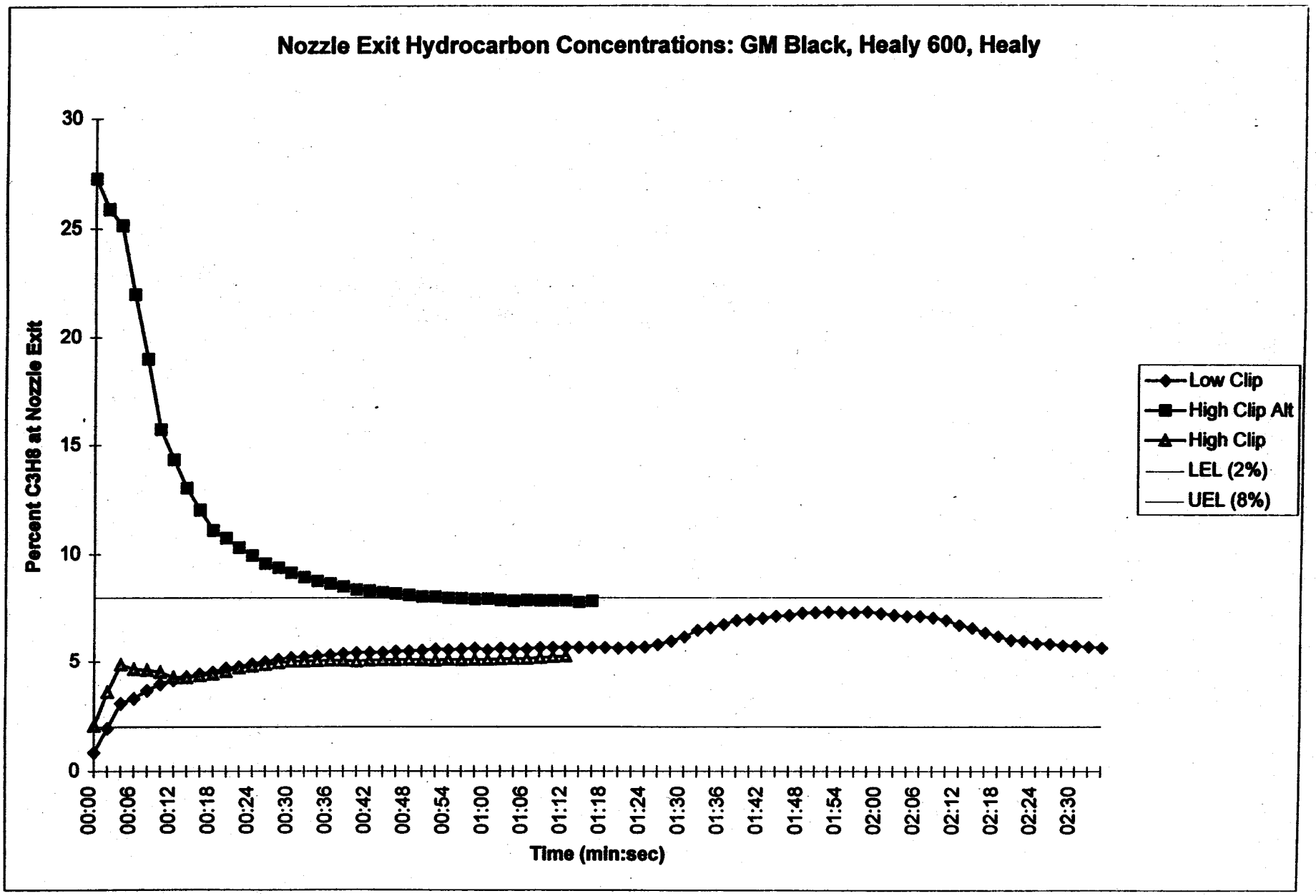

Nozzle Exit Hydrocarbon Concentrations: GM Black, Healy 600, Healy
Percent C3H8 at Nozzle Exit
30
25
20
15
10
5
0
00:00
00:06
00:12
00:18
00:24
00:30
00:36
00:42
00:48
00:54
01:00
01:06
01:12
01:18
01:24
01:30
01:36
01:42
01:48
01:54
02:00
02:06
02:12
02:18
02:24
02:30
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-90

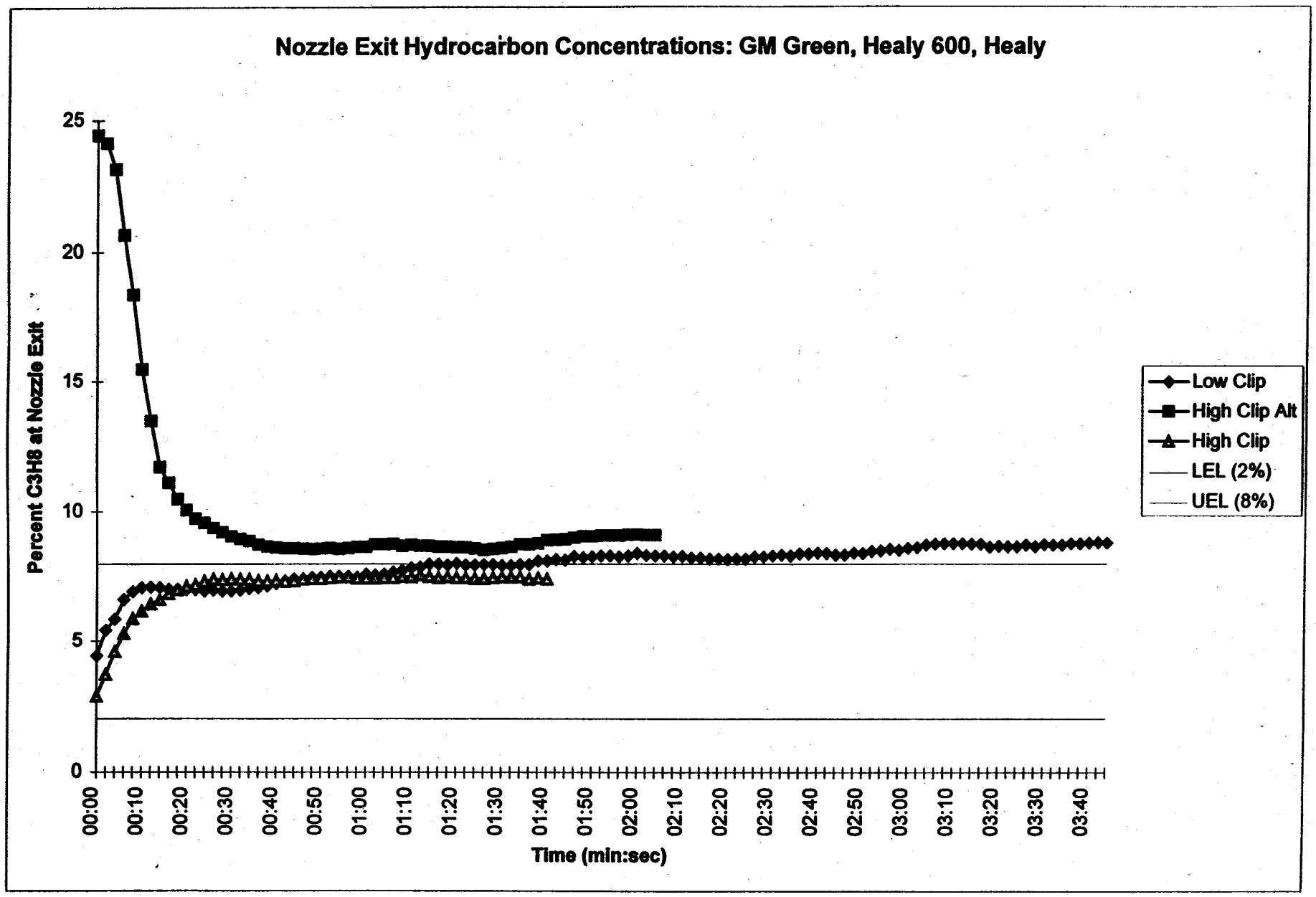

Nozzle Exit Hydrocarbon Concentrations: GM Green, Healy 600, Healy
Percent C3H8 at Nozzle Exit
25
20
15
10
5
0
00:00
00:10
00:20
00:30
00:40
00:50
01:00
01:10
01:20
01:30
01:40
01:50
02:00
02:10
02:20
02:30
02:40
02:50
03:00
03:10
03:20
03:30
03:40
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-92

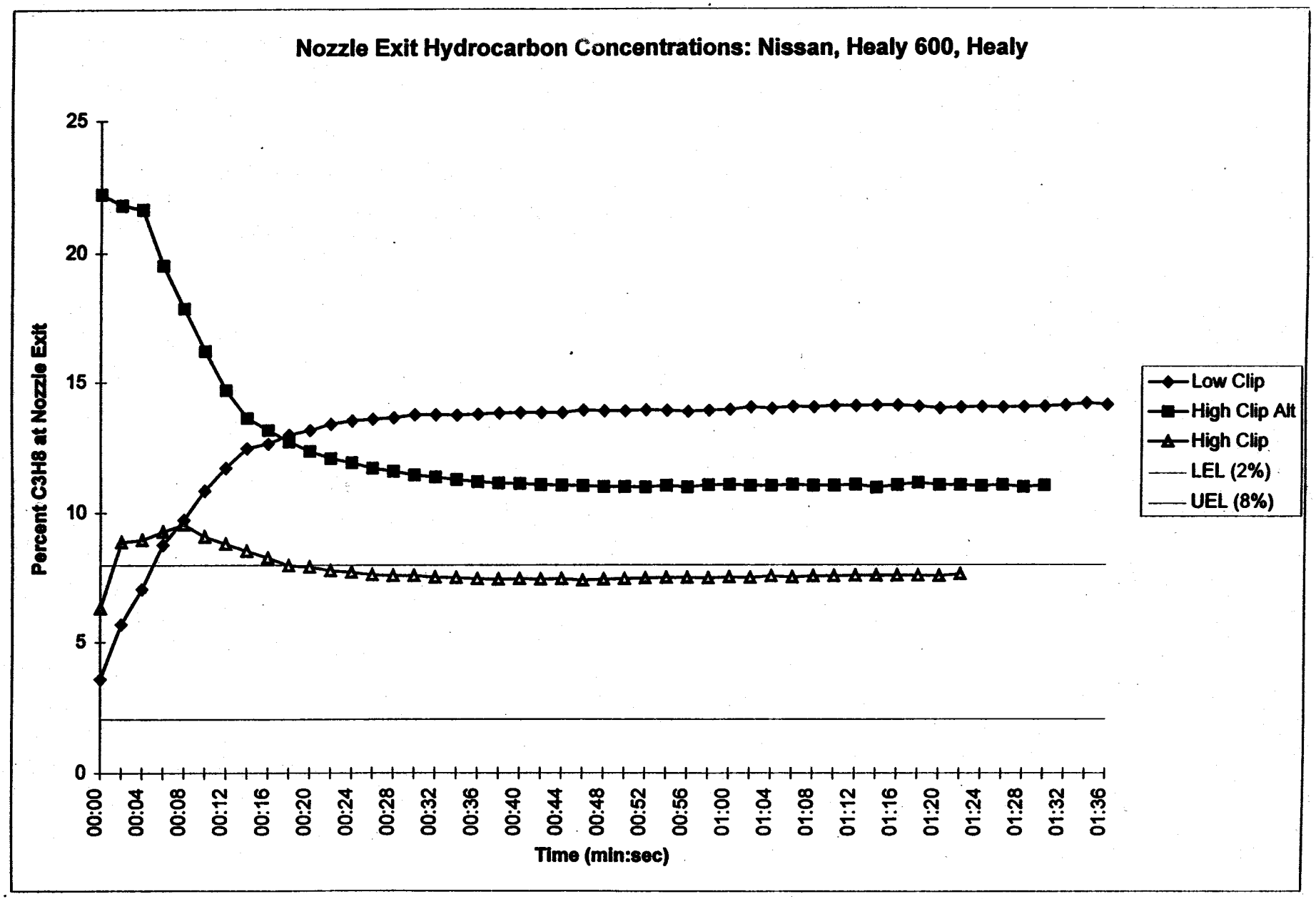
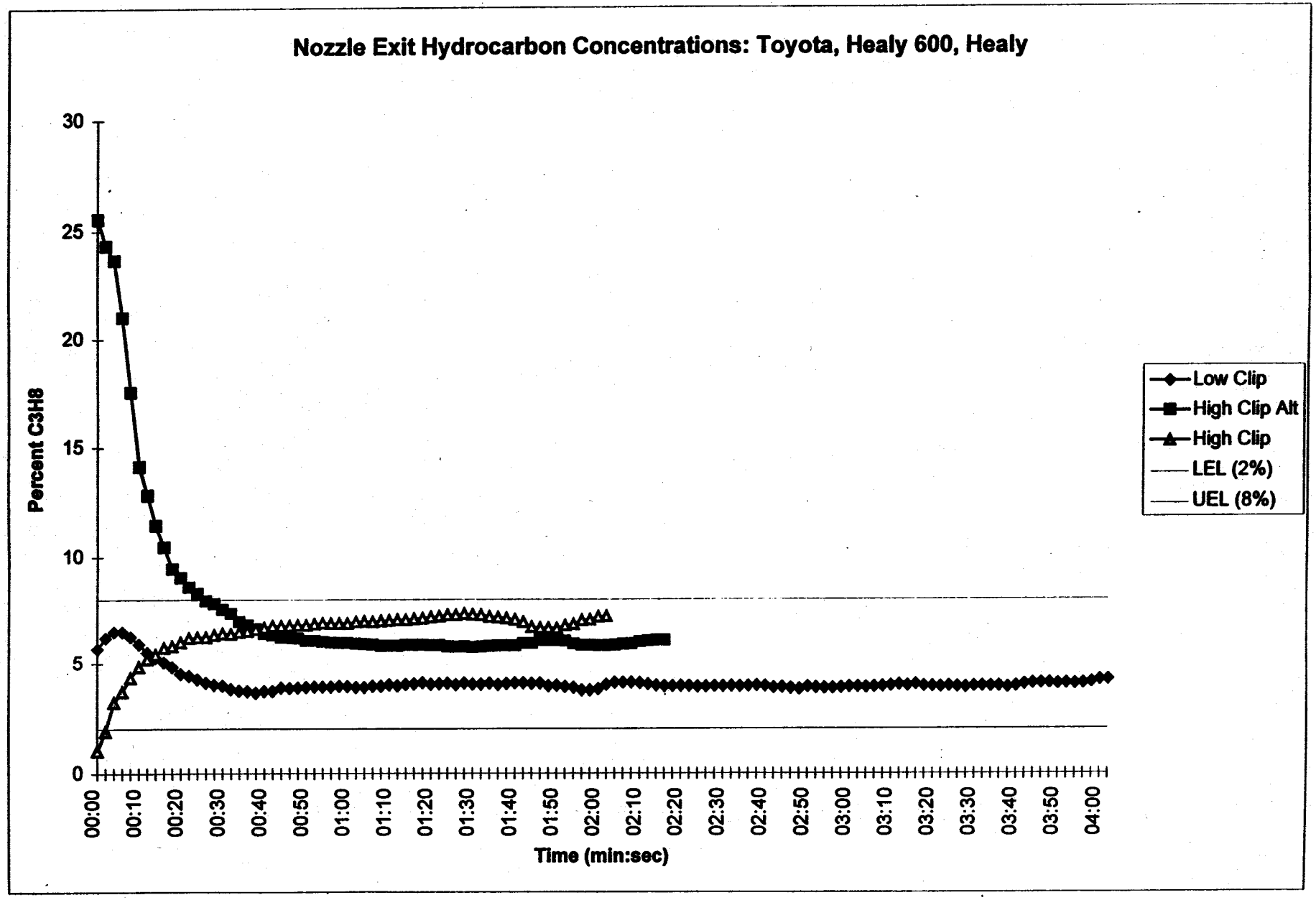

Nozzle Exit Hydrocarbon Concentrations: Nissan, Healy 600, Healy
Percent C3H8 at Nozzle Exit
25
20
15
10
5
0
00:00
00:04
00:08
00:12
00:16
00:20
00:24
00:28
00:32
00:36
00:40
00:44
00:48
00:52
00:56
01:00
01:04
01:08
01:12
01:16
01:20
01:24
01:28
01:32
01:36
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)

FIGURE 6-93


Nozzle Exit Hydrocarbon Concentrations: Toyota, Healy 600, Healy
Percent C3H8
30
25
20
15
10
5
0
00:00
00:10
00:20
00:30
00:40
00:50
01:00
01:10
01:20
01:30
01:40
01:50
02:00
02:10
02:20
02:30
02:40
02:50
03:00
03:10
03:20
03:30
03:40
03:50
04:00
Time (min:sec)
Low Clip
High Clip Alt
High Clip
LEL (2%)
UEL (8%)