MODEL CURRICULUM OUTLINE

FOR

Alternatively Fueled Vehicle (AFV) Automotive Technician Training In Light and Medium Duty CNG and LPG

Prepared by:

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DISCLAIMER

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LIGHT/MEDIUM DUTY CNG AND LPG

INTRODUCTION

This model curriculum outline was developed using a turbo-DACUM (Developing a Curriculum) process which utilizes practicing experts to undertake a comprehensive job and task analysis. The job and task analysis serves to establish current baseline data accurately and to improve both the process and the product of the job through constant and continuous improvement of training.

The DACUM process is based on the following assumptions:

1. Expert workers are the best source for task analysis.
2. Any occupation can be described effectively in terms of tasks.
3. All tasks imply knowledge, skills, and attitudes/values.

A DACUM panel, comprised of six experienced and knowledgeable technicians who are presently working in the field, was given an orientation to the DACUM process. The panel then identified, verified, and sequenced all the necessary job duty areas and tasks. The broad duty categories were rated according to relative importance and assigned percentage ratings in priority order. The panel then rated every task for each of the duties on a scale of 1 to 3. A rating of 3 indicates an "essential" task, a rating of 2 indicates an "important" task, and a rating of 1 indicates a "desirable" task.

These ratings from each of the content experts were averaged to establish a consensus which formed the basis for prioritizing and/or balancing all the essential elements of a training program for the occupation. This consensus can also be used to establish specifications for the assessment of the training program.

The experts also identified and rated physical parameters (positions, mobility, arm/hand use, senses and working conditions), knowledge (calculations and measurements) and communication skills (written, oral and reading). Additionally, characteristics, attributes, attitudes and traits of workers in the occupation were rated and given a consensus ranking by the panel.

The task analysis portion was organized by retrieving each task from a predesigned template. Each step necessary to accomplish a given task was then identified and sequenced by the panel. After all rational physical and decisional steps were identified, all related knowledge (applied mathematics, calculations, applied physics, applied technology, and applied communications) were listed. Additionally, all tools, equipment and resources necessary to accomplish the task were identified. The panel then identified the purpose of the task, the consequences of inaction, and any special care or precautions which should be taken. Safety procedures and equipment were also stipulated.

DACUM CHART
AFV Automotive Technician

A		CONVERT VEHICLES
	1	Perform pre–vehicle conversion assessment
	2	Prepare vehicle for conversion
	3	Fabricate brackets and hangers
	4	Install storage vessels
	5	Install remote fill and relief vent equipment
	6a	Install fittings per manufacturer's specifications (Propane)
	6b	Install fittings per manufacturer's specifications (CNG)
	7	Bend tubing (CNG)
	8a	Install fuel lines/filters/fuel locks/valves (Propane)
	8b	Install fuel lines/filters/fuel locks/valves (CNG)
	9a	Install pressure regulation systems (Propane)
	9b	Install pressure regulation systems (CNG)
	10	Install fuel injection/carburetion devices
	11	Install electrical/electronic system
	12	Perform post–conversion procedures

B		MAINTAIN VEHICLE'S GASEOUS FUEL SYSTEM
	13	Check/change fluid levels
	14	Recertify cylinders
	15	Inspect fuel system
	16	Inspect fuel storage vessels and brackets
	17	Check/tighten/replace hoses
	18	Replace air/fuel filters
	19	Perform emissions testing

C		TROUBLESHOOT SUPPLEMENTAL SYSTEMS
	20	Perform preliminary vehicle assessment
	21	Troubleshoot OEM computer support
	22	Troubleshoot ignition timing enhancer
	23	Troubleshoot fuel control processor
	24	Troubleshoot automatic fuel select device
	25	Troubleshoot fuel use hour meters
	26	Troubleshoot combustible gas detector
	27	Troubleshoot fuel level indicators
	28	Troubleshoot ignition and starter interlock
	29	Troubleshoot bi–fuel selector switch
	30	Troubleshoot cooling system interface

D		TROUBLESHOOT FUEL SYSTEM COMPONENTS
	31	Troubleshoot tank/cylinder
	32	Troubleshoot pressure relief valve
	33	Troubleshoot filter and lockoff
	34	Troubleshoot regulator/converter
	35	Troubleshoot air valve mixer
	36	Troubleshoot venturi
	37	Troubleshoot spray bar
	38	Troubleshoot injector
	39	Troubleshoot spud–in
	40	Troubleshoot base plate venturi
	41	Troubleshoot lift plate

E		TROUBLESHOOT EMISSION CONTROL DEVICES
	42	Troubleshoot ignition systems
	43	Troubleshoot O2 sensor
	44	Troubleshoot MAP sensor
	45	Troubleshoot RPM sensor
	46	Troubleshoot TP sensor
	47	Troubleshoot ECT sensor
	48	Troubleshoot IAT sensor
	49	Troubleshoot VS sensor
	50	Troubleshoot knock sensor
	51	Troubleshoot EGR valve position sensor
	52	Troubleshoot CKP sensor
	53	Troubleshoot MAF sensor
	54	Troubleshoot IAC actuator
	55	Troubleshoot EVAP cannister purge actuator
	56	Troubleshoot EGRV actuator
	57	Troubleshot AIR bypass/diverter actuator
	58	Troubleshoot fuel injectors actuators
	59	Troubleshoot fuel control regulators
	60	Troubleshoot ICM device
	61	Troubleshoot TCC actuator

F		REPAIR SYSTEMS
	62	Repair/replace valves and gauges
	63	Repair/replace fuel injection/carburetion system
	64	Repair/replace electrical connections/components
	65	Repair/replace pressure regulation devices
	66	Repair/replace brackets
	67	Repair/replace venting systems
	68	Repair/replace ignition systems
	69	Repair/replace cooling system components
	70	Perform fuel supply leak test

G		REPAIR/REPLACE EMISSION CONTROL DEVICES
	71	Repair/replace thermal reactor/catalytic converter
	72	Repair/replace input sensors or related equipment
	73	Repair/replace actuators

H		PERFORM MISCELLANEOUS TASKS
	74	Maintain supply inventory
	75	Operate DVOM
	76	Operate breakout box
	77	Perform housekeeping tasks
	78	Operate emissions analyzer and interpret resulting data
	79	Perform storage and fuel handling
	80	Identify federal, state, and local regulations
	81	Communicate with end users
	82	Handle hazardous materials
	83	Perform documentation

I.		DEMONSTRATE TECHNICAL KNOWLEDGE/ PERFORM TRAINING
	84	Plan training sessions
	85	Deliver training sessions
	86	Evaluate trainee performance
	87	Identify fuel characteristics
	88	Trace history of industry
	89	Distinguish differences between gasoline and alt. fuels
	90	Determine need for conversion
	91	Identify environmental effects
	92	Identify economic benefits
	93	Compare conversion and maintainence cost savings
	94	Identify R & D companies
	95	Identify source of supply and distribution
	96	Use technical terminology
	97	Remain technically updated

KNOWLEDGES--AFV Automotive Technician
(In descending order of importance)

	CALCULATIONS	Average
1	Perform simple math operations of addition	2.83
2	Perform simple math operations of multiplication	2.83
3	Perform simple math operations of division	2.83
4	Perform simple math operations of subtraction	2.83
5	Use a calculator	2.50
6	Perform math operations with fractions	2.33
7	Perform math operations with decimals	2.33
8	Perform math operations using single and multiple digit numbers	2.33
9	Compare numbers	2.17
10	Perform math operations using signed (positive and negative) numbers	2.00
11	Compute averages	2.00
12	Measure angles	1.83
13	Solve proportion problems	1.83
14	Transfer number sequences from a source to a column	1.80

	BASIC MEASUREMENT	Average
1	Measure pressure in psig (pounds per square inch gauge)	3.00
2	Measure pressure in inches of mercury	3.00
3	Measure pressure in inches of water column	3.00
4	Measure lengths from 1/32" to 1" and 1 mm to 1 cm	2.83
5	Record measurements, using appropriate unit notations	2.83
6	Estimate and approximate measurements	2.67
7	Measure temperature to within 1 degree F.	2.50
8	Measure volume, i.e., cubic inches, liters	2.50
9	Measure area, i.e., square inches, square centimeters	2.50
10	Measure linear distances (length, width, height)	2.50
11	Read, interpret, and use size–scale relationships	2.33
12	Convert measurements from one unit to another (English to metric, etc.)	2.33
13	Read and apply coefficient measurements indicated in table or chart form	2.20
14	Measure weights using devices calibrated in pounds	2.00
15	Measure accurately to 0.01 inches	2.00
16	Measure weights using devices calibrated in ounces	1.83

Rating Scale
3=Essential
2=Important
1=Desirable

KNOWLEDGES--AFV Automotive Technician
(In descending order of importance)

	COMMUNICATIONS SKILLS	Average
1	Read and follow directions found in equipment manuals and code books, etc.	3.00
2	Follow oral job instructions	3.00
3	Communicate using the vocabulary/terminology of a related trade	3.00
4	Evaluate solutions	3.00
5	Read and follow a map, chart, plan, etc.	3.00
6	Read and interpret labels or directions found on labels, packages or instruction sheets	3.00
7	Read drawings and specification sheets	2.83
8	Ask questions	2.83
9	Record information	2.83
10	Listen	2.83
11	Write words and numbers legibly	2.83
12	Find information in references, i.e., Machinery's Handbook, Tap/Drill charts	2.83
13	Communicate with co-workers and/or business people-Verbally (face-to-face)	2.83
14	Communicate with co-workers and/or business people-Verbally (telephone,radio)	2.67
15	Read flowcharts	2.67
16	Find information in catalogs	2.67
17	Evaluate options/alternatives	2.67
18	Explain procedures	2.50
19	Research information	2.50
20	Apply assertiveness	2.33
21	Participate in brainstorming	2.17
22	Summarize information	2.17
23	Communicate with co-workers and/or business people-Written (letters, memos, etc.)	2.17
24	Compare SAE J-1930 terminology with OEM terminology	1.83

Rating Scale
3=Essential
2=Important
1=Desirable

KNOWLEDGES--AFV Automotive Technician
(In descending order of importance)

	POSITION	Average
1	Bend forward frequently	3.00
2	Stoop, kneel, or crouch while working	3.00
3	Work in a squatting position for more than five (5) minutes per hour	2.67
4	Stand part of the time while working	2.33
5	Stand all of the time while working	2.33
6	Lay on back while working	2.00

	MOBILITY	Average
1	Walk	3.00
2	Crawl or creep	2.00

	LIFTING	Average
1	Lift 50 lbs. maximum with frequent lifting or carrying of objects up to 25 lbs.	2.67
2	Lift objects from ground to waist level	2.33
3	Lift 100 lbs. maximum with frequent lifting or carrying of objects up to 50 lbs.	2.00
4	Lift objects from waist to overhead level	1.83

	ARM/HAND USE	Average
1	Grip objects using the hands and fingers	3.00
2	Reach with arms and hands in any direction	2.67
3	Hold or move objects using the fingers	2.67
4	Work with hands and arms over head level	2.67
5	Feel size, shape, temperature or texture of objects with the hands	2.50
6	Hold or move objects using the hands but not the fingers	2.50
7	Push objects with arms/hands	2.50
8	Pull objects with arms/hands	2.50
9	Use digging or chopping motions while working	1.17

	SENSES	Average
1	Detect abnormal noises	2.83
2	See and discriminate colors	2.67
3	See clearly at 20 inches or less (with/without optical assistance)	2.50
4	Judge depth (the position and distance of objects) with the eyes	2.33
5	Speak	2.00
6	Hear speech	2.00
7	See clearly at 20 feet or more (with/without optical assistance)	1.83

Rating Scale
3=Essential
2=Important
1=Desirable

KNOWLEDGES--AFV Automotive Technician
(In descending order of importance)

	WORKING CONDITIONS	Average
1	Handle pressurized gases	3.00
2	Work in dust, oils, fumes, or smells	2.67
3	Work in high temperatures (85 to 130 degrees F)	2.50
4	Work in noisy places (85 DB or higher with ear protection)	2.50
5	Handle toxic materials	2.33
6	Work while wearing protective equipment, i.e., respirators, hoods	2.17
7	Handle hot or cold objects	2.17
8	Work in low temperatures (0 to 45 degrees F)	2.17
9	Work inside	2.17
10	Work in confined spaces	2.17
11	Work outside	2.00
12	Work in stale air (with some oxygen depletion)	2.00
13	Work around or near high voltage power sources or equipment	2.00
14	Work at heights of 1 to 25 feet above ground or floor level	2.00
15	Work in changing temperatures (in and out of building repeatedly)	1.83

Rating Scale
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ATTITUDES--AFV Automotive Technician
(In descending order of importance)

	ATTITUDE	Average
1	Safety conscious	3.00
2	Common sense	2.83
3	Responsible/accountable	2.83
4	Accurate/precise	2.67
5	Integrity	2.67
6	Pride in job	2.67
7	Professional	2.67
8	Quality focused	2.67
9	Analytic	2.50
10	Conscientious	2.50
11	Dependable	2.50
12	Focused	2.50
13	Free of substance abuse	2.50
14	Good listener	2.50
15	Honest	2.50
16	Neat	2.50
17	Work efficiently (resources)	2.50
18	Work efficiently (time)	2.50
19	Cooperative	2.33
20	Creative	2.33
21	Eager to learn new things	2.33
22	Enthusiasm	2.33
23	Ethical	2.33
24	Meticulous	2.33
25	Open-minded to change	2.33
26	Organized	2.33
27	Trustworthy	2.33

	ATTITUDE	Average
28	Adaptable/flexible	2.17
29	Caring	2.17
30	Confident	2.17
31	Customer-oriented	2.17
32	Industrious	2.17
33	Initiative	2.17
34	Patient	2.17
35	Persistent	2.17
36	Physical stamina	2.17
37	Positive attitude	2.17
38	Punctual	2.17
39	Respectful	2.17
40	Self-discipline	2.17
41	Self-motivated	2.17
42	Team player	2.17
43	Courteous	2.00
44	Goal-oriented	2.00
45	Manage stress/pressure	2.00
46	Self-control	2.00
47	Self-esteem	2.00
48	Tolerant	2.00
49	Work in teams	1.83

Rating Scale
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2=Important
1=Desirable

JOB AND TASK ANALYSIS--AFV Automotive Technician

A			CONVERT VEHICLES	Fuel	Level	Tools and Equipment
	1		**Perform pre-vehicle conversion assessment**	P & C	2	
		a	Conduct visual inspection and take measurements			Engine analyzer
		b	Document vehicle information (VIN)			Chassis dynamometer
		c	Conduct compression test			Infra-red exhaust gas analyzer (BAR 90 four gas)
		d	Check ignition system components			Compression tester
		e	Inspect fluids, belts, hoses, filters			Scan tool
		f	Check ECM for trouble codes			DVOM
		g	Check exhaust system			Common hand tools
		h	Check for function and existence of appropriate emission system			Hydrometer
		i	Test drive/dynamometer			Calculator
		j	Document initial exhaust emissions			
		k	Document all test results			
		l	Request client sign off of test results			
	2		**Prepare vehicle for conversion**	P & C	1	
		a	Clean vehicle (under hood and vehicle)			Battery load tester
		b	Protect vehicle interior from soiling			Compression tester
		c	Disconnect battery and ECM			Scan tool
		d	Drain and remove conventional fuel systems, as necessary			DVOM
			for bi-fuel or monofuel applications			Common hand tools
		e	Upgrade ignition components as necessary			Jacks and jack stands
		f	Upgrade suspension as necessary			Fender/seat/steering wheel covers
		g	Upgrade fluids, as necessary			Lighting
		h	Specify vehicle components			Drill and drill bits
		i	Identify location of under-hood components			Air compressor and tools
		j	Select position for fuel storage vessels			Markers--grease pencils
		k	Select position for remote filling and pressure relief devices			Advancing timing light
		l	Reroute exhaust system, if necessary			Eye protection
	3		**Fabricate brackets and hangers**	P & C	1	
		a	Conceptualize bracket and hanger design			1/2" drill and drill bits
		b	Select protected area for installation			Cutting tools/torch
		c	Select appropriate materials			Reciprocating saw
		d	Check for appropriate clearances			Common hand tools
		e	Relocate OEM equipment, as necessary			Metal brake
		f	Bend/cut/drill bracket materials as necessary			Welding equipment
		g	Paint materials, as required			Tap and die
						Metal shears
						Cutting fluids

Calculations	Communications	Technology	Purpose/Care	Safety
Read gauges	Refer to technical manuals	Basic automotive theory	Maintain/validate warranty	Accuracy of readings
Use calculator	Verbal with client	Basic gaseous fuel theory	Reduce liability	Accurate interpretation
Convert English to metric	Written documentation	Internal combustion engines	Vehicle qualifications	PPE
Basic math functions	Read charts and graphs	Analog and digital circuitry	Identify pre-conversion repairs	Don't smoke
Calculate costs	Verbal with manufacturer	Interpret emission control devices	Protect all involved parties	General shop safety
Calculate mileage/range	Verbal with co-workers	Dynamometer technology	Ensure quality performance	Component protection
Calculate tank capacities	Fax	Torque and horsepower		Comply with NFPA
Calculate volume of tanks	Use telephone	Basic mechanical principles		Exhaust ventilation
Determine useable GVW	Interpret computerized test data			
Use calculator	Refer to technical manuals	Basic automotive theory	Maintain/validate warranty	Accuracy of readings
Convert English to metric	Verbal with supervisor	Basic gaseous fuel theory	Reduce liability	Accurate interpretation
Basic math functions	Written documentation	Pressure and volume	Vehicle qualifications	PPE
Read rule/measure	Read charts and graphs	Internal combustion engines	Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer	Analog and digital circuitry	Ensure quality performance	General shop safety
	Verbal with co-workers	Interpret emission control devices	Protect vehicle	Component protection
	Fax	Lubricant specifications	Ensure emissions reductions	Comply with NFPA
	Use telephone	Dynamometer technology	Accommodate conversion	Exhaust ventilation
	Interpret computerized test data	Torque and horsepower	equipment	
		Basic mechanical principles		
Measure inches	Refer to technical manuals	Basic automotive theory	Vehicle serviceability/useability	Accuracy of readings
Fractions	Verbal with supervisor	Basic gaseous fuel theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Surface area	Reduce liability	PPE
Angles	Read charts and graphs	Basic metallurgy	Vehicle qualifications	Don't smoke
Basic geometry	Verbal with manufacturer	Welding	Protect all involved parties	General shop safety
	Verbal with co-workers	Basic physics	Ensure quality performance	Component protection
	Use telephone/fax	Basic mechanical principles	Protect vehicle	Comply with NFPA
			Accommodate conversion	Exhaust ventilation
			equipment	
			Structural integrity	
			Cosmetics	
			Driver safety	

A			CONVERT VEHICLES	Fuel	Level	Tools and Equipment
	4		**Install storage vessels**	P&C	1	
		a	Create bracket template			1/2" drill and drill bits
		b	Drill necessary holes using template			Hole saw
		c	Mount storage vessel bracket on vehicle with appropriate backing			Reciprocating saw
			plates			Common hand tools
		d	Isolate passenger compartment from fuel vapor, as appropriate			Nibbler
		e	Mount storage vessel			Tap and die
		f	Install valve protection equipment as required			Metal shears
		g	Install remote equipment			Cutting fluids
						Paint
	5		**Install remote fill and relief vent equipment**	P&C	1	
		a	Prepare surface	P&C		Thread sealing compound
		b	Modify vehicle to receive equipment	P&C		Hose end swage tool
		c	Install brackets	P&C		Hose end mandrel
		d	Install valving and necessary shielding	P&C		Common hand tools
		e	Install thread sealing compound as needed	P&C		Hose cutoff saw
		f	Install materials per manufacturer's specification	P&C		Torque wrench
		g	Install automatic stop-fill valve	P		Hardware and fittings
		h	Install vent apparatus	P&C		Venting hardware
		i	Install fuel level sending unit	P		Tubing bender and cutter
		j	Protect cut areas from corrosion	P&C		Flaring tools
		k	Install ignition lock switch, if applicable	C		Swage liner
						Deburring tool
						Markers--grease pencils
						Body putty
	6a		**Install fittings per manufacturer's specifications (Propane)**	P	1	
		a	Install flare fittings			Thread sealing compound
		b	Install NPT fittings			Common hand tools
		c	Apply pipe sealants (proper application required)			Hose cutoff saw
	6b		**Install fittings per manufacturer's specifications (CNG)**	C	2	
		a	Install swage fittings			Hardware and fittings
		b	Install compression fittings			Thread sealer approved for natural gas
		c	Install flare fittings			Markers--grease pencils
		d	Install captive o-ring			Common hand tools
		e	Install high pressure fittings (other)			
		f	Install NPT fittings			
		g	Apply pipe sealants (proper application required)			
	7		**Bend tubing (CNG)**	C	2	
		a	Locate and measure locations			Ruler or tape measure
		b	Use proper bending mandrels			Tubing bender
		c	Prepare tubing			Reamer and file
		d	Cut, debur, and clean tubing			
		e	Bend tubing			

Calculations	Communications	Technology	Purpose/Care	Safety
Measure inches	Refer to technical manuals	Basic automotive theory	Vehicle serviceability/useability	Accuracy of readings
Fractions	Verbal with supervisor	Basic gaseous fuel theory	Provide sufficient vehicle range	Accurate interpretation
Basic math functions	Written documentation	Volume	Ensure quality performance	PPE
Angles	Verbal with co-workers	Basic metallurgy	Vehicle qualifications	Don't smoke
Basic geometry		Welding	Protect vehicle	General shop safety
Compute discharge volume		Basic physics	Structural integrity	Component protection
		Basic mechanical principles	Driver safety	Comply with NFPA
				Exhaust ventilation
Measure in inches	Refer to technical manuals	Basic automotive theory	Vehicle serviceability/useability	Accuracy of readings
Angles	Verbal with supervisor	Basic gaseous fuel theory	Ease of refueling	Accurate interpretation
Fractions	Written documentation	Volume calculations	Ensure quality performance	PPE
Calculate discharge rates	Verbal with co-workers	Measure in inches	Vehicle qualifications	Don't smoke
Set and read torque wrench		Angles	Protect vehicle	General shop safety
		Fractions	Driver safety	Component protection
			Determine fuel quantity	Comply with NFPA
				Exhaust ventilation
Measure in inches	Refer to technical manuals	Measure in inches	Vehicle serviceability/useability	Accuracy of readings
Angles	Verbal with supervisor	Angles	Ease of refueling	Accurate interpretation
Fractions	Written documentation	Fractions	Ensure quality performance	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect vehicle	General shop safety
			Driver safety	Component protection
Torque wrench	Refer to technical manuals	Basic mechanical theory	Vehicle serviceability/useability	Accuracy of readings
Clearance gauge	Verbal with supervisor	Metallurgy	Warranty compliance	Accurate interpretation
	Written documentation		Reduce liability	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	
			Cosmetics	
Measure in inches	Refer to technical manuals	Basic mechanical theory	Vehicle serviceability/useability	Accuracy of readings
Angles	Verbal with supervisor	Metallurgy	Warranty compliance	Accurate interpretation
Fractions	Written documentation		Reduce liability	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	
			Cosmetics	

A			CONVERT VEHICLES	Fuel	Level	Tools and Equipment
	8a		**Install fuel lines/filters/fuel locks/valves (Propane)**	P	1	
		a	Plan routing and protection of fuel line components			Tape measure
		b	Install necessary tube and hose fittings			RTV sealent
		c	Plumb remote fill			Thread sealent
		d	Plumb remote relief			Basic automotive tools
		e	Install hose bulkhead, if applicable			Metal cutting tools
		d	Install hydrostatic relief valve			Drill and drill bits
		f	Install hose chafing protection, as necessary			Eye protection
		g	Install hose mounting fixtures, according to mfg. specifications			Markers--grease pencils
		h	Install filter and fuel lock or filter/fuel lock, as required			
		i	Install and properly support fuel line; allow for vehicle flexing			
		j	Install heat shields, as required or at assured minimum distance			
		k	Route hoses through vapor seal assembly, as required			
	8b		**Install fuel lines/filters/fuel locks/valves (CNG)**	C	2	
		a	Plan routing and protection of fuel line components			Tape measure
		b	Install necessary tube and hose fittings			Bending mandrels
		c	Plumb remote fill			Tubing cutters
		d	Plumb pressure relief vent			Basic automotive tools
		e	Connect fuel service lines/bend-install tubing to conform to vehicle			Metal cutting tools
		f	Install quarter turn valve			Drill and drill bits
		g	Install tubing bulkhead, if applicable			Eye protection
		i	Install tubing/hose chafing/fretting protection, as necessary			
		j	Install tubing/hose mounting fixtures, according to mfg. specifications			
		k	Install fuel locks, if applicable			
		l	Install and properly support fuel line			
		m	Install heat shields, as required at assured minimum distance			
		n	Install anti-vibration/expansion loops			
		o	Bend/install tubing to conform to vehicle			
		p	Install fuel system transducer, as applicable			
		q	Install pressure gauge			
		r	Apply appropriate anti-tamper paint			
	9a		**Install pressure regulation systems-(Propane Converters-Vaporizers-**	P	1	
			Regulators)			Tape measure
		a	Plan an area for mounting converter, considering possible areas of			Markers--grease pencils
			impact			Thread sealent
		b	Attempt to mount it with the vapor outlet at the			Basic automotive tools
			lowest point of converter body, and below the highest level in the			Metal cutting tools
			cooling system. Also consider component serviceability.			Drill and drill bits
		c	Assemble the converter to the mounting bracket, with the			Eye protection
			fuel lock, if required			
		d	Install all applicable fittings			
		e	If necessary, install starting aids, control valves, etc. to the			
			converter, as per manufacturer's instructions, prior to			
			installation.			
		f	Bolt the assembly to the vehicle, using fender washers for support			
		g	Attach coolant hoses to the converter body, ensuring that one			
			line is suction and one line is pressure.			
		h	On negative pressure systems, use a thermostat on the			
			suction side			

Calculations	Communications	Technology	Purpose/Care	Safety
Measure in inches	Refer to technical manuals	Basic mechanical theory	Vehicle serviceability/useability	Accuracy of readings
Angles	Verbal with supervisor	Metallurgy	Warranty compliance	Accurate interpretation
Fractions	Written documentation	Basic geometry	Reduce liability	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	
			Cosmetics	
Measure in inches	Refer to technical manuals	Basic mechanical theory	Vehicle serviceability/useability	Accuracy of readings
Angles	Verbal with supervisor	Metallurgy	Warranty compliance	Accurate interpretation
Fractions	Written documentation	Basic geometry	Reduce liability	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	
			Cosmetics	
Measure in inches	Refer to technical manuals	Basic mechanical theory	Vehicle serviceability/useability	Accuracy of readings
Angles	Verbal with supervisor	Metallurgy	Warranty compliance	Accurate interpretation
Fractions	Written documentation	Basic geometry	Reduce liability	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	
			Cosmetics	

A			CONVERT VEHICLES	Fuel	Level	Tools and Equipment
	9b		**Install pressure regulation systems--(CNG primary and secondary**	C	1	
			regulators)			Tape measure
		a	Confirm converter is sized properly as per mfg. recommendations			Bending mandrels
		b	Install the primary regulator on the vehicle, with fittings installed			Tubing cutters
		c	Attach coolant lines to the converter, ensuring that one line is			Basic automotive tools
			pressure and one line is suction.			Metal cutting tools
		d	Attach the low pressure fuel line to the primary regulator fitting			Drill and drill bits
		e	Install the secondary regulator as per manufacturer's instructions			Eye protection
		f	Attach the low pressure fuel line to the secondary regulator fuel fitting			
	10		**Install fuel injection/carburetion devices**	P&C	2	
		a	Reconfirm injection/carburetion application			Tape measure
		b	Reconfirm fuel injection/carburetion device locations			Bending mandrels
		c	Ensure access to fuel injection/carburetion device adjustments			Tubing cutters
		d	Install fuel injection/carburetion device according to mfg. specs			Basic automotive tools
		e	Attach fuel lines to fuel injection/carburetion device, as necessary			Metal cutting tools
		f	Install safety lockoff/relief device			Drill and drill bits
		g	Ensure anti-chafing, as necessary			Eye protection
	11		**Install electrical/electronic system**	P&C	2	
		a	Confirm component application specifications			DVOM
		b	Identify all locations of connections/components as per mfg. directions			Test lamp
		c	Prepare wire ends for connections (make weather-proof)			Wiring diagrams
		d	Route supplemental wiring harness to connections (esthetics)			Soldering equipment
		e	Solder and weatherproof connections in compliance with OEM specs			Good illumination
		f	Ensure protection from abrasion or corrosion			Tape
		g	Ensure proper sized and fuse protected circuits			Silicone
						Wire loom
	12		**Perform post-conversion procedures**	P&C	3	
		a	Purge and pressurize fuel system and check for system integrity			Engine analyzer
		b	Adjust primary regulator pressure as applicable			4 gas exhaust analyzer
		c	Start vehicle; run until it reaches operating temperature			Hand held DVOM
		d	Switch to alternative fuel (if bi-fuel)			Specialized tuning equipment
		e	Make all base adjustments (idle speed, ignition timing, etc.)			OBD test equipment
			as per vehicle or component manufacturer specifications			Chassis dynamometer
		f	Perform fuel systems adjustments, if any, as specified by equipment			Check list
			manufacturer specifications			
		g	Mechanical systems: adjust idle and WOT adjustment, on electronic			
			system, ensure calibration			
		h	Perform comprehensive driveability test to ensure proper functioning of			
			components			
		i	Perform PCM self-diagnostic check and correct any problems prior			
			to delivery of vehicle			
		j	Perform emission check			
		k	Document all post-conversion checks and all discrepancies			
			(have user acknowledge prior to delivery)			

Calculations	Communications	Technology	Purpose/Care	Safety
Measure in inches	Refer to technical manuals	Basic mechanical theory	Vehicle serviceability/useability	Accuracy of readings
Angles	Verbal with supervisor	Metallurgy	Warranty compliance	Accurate interpretation
Fractions	Written documentation		Reduce liability	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	
			Cosmetics	
Measure in inches	Refer to technical manuals	Basic mechanical theory	Vehicle serviceability/useability	Accuracy of readings
Angles	Verbal with supervisor	Metallurgy	Warranty compliance	Accurate interpretation
Fractions	Written documentation		Reduce liability	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	*Component protection*
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	
			Cosmetics	
Electrical terminology	Refer to technical manuals	Electical terminology	Vehicle serviceability/useability	Accuracy of readings
	Verbal with supervisor	Advanced automotive theory	Warranty compliance	Accurate interpretation
	Written documentation	Analog and digital circuitry	Reduce liability	PPE
	Verbal with co-workers	Basic mechanical principles	Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Cosmetics	
Comparative analysis	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
	Verbal with client	Basic automotive theory	Warranty compliance	Accurate interpretation
	Written documentation	Basic gaseous fuel theory	Reduce liability	PPE
	Read charts and graphs	Pressure and volume	Vehicle qualifications	Don't smoke
	Verbal with manufacturer	Internal combustion engines	Protect all involved parties	General shop safety
	Verbal with co-workers	Analog and digital circuitry	Ensure quality performance	Component protection
	Use telephone	Interpret emission control devices	Protect vehicle	Comply with NFPA
	Interpret computerized test data	Dynamometer technology		Exhaust ventilation
		Torque and horsepower		
		Basic mechanical principles		

B.			MAINTAIN VEHICLE'S GASEOUS FUEL SYSTEM	Fuel	Level	Tools and Equipment
	13		**Check/change fluid levels**	P & C	1	
		a	Verify system cooling level and condition			Basic automotive tools
		b	Verify all engine fluid levels			Shop rags
		c	Verify compatibility of fluid types with vehicle			
		d	Follow basic manufacturer's maintenance schedule			
	14		**Recertify cylinders/tanks**	P & C	3	
		a	At recertification date, remove cylinder/tank			Basic automotive tools
		b	Recertify by authorized agent			Eye protection
		c	Reinstall/replace cylinder/tank			Stamping dies
		d	Documentation			
	15		**Inspect fuel system**	P & C	2	
		a	Check all connections and fuel line for leaks or wear			Basic automotive tools
		b	Verify operation of excess flow and check valves			Leak detection equipment
		c	Repair/replace tank/serviceable items on tank/cylinder			Check lists
		d	Inspect/replace filters			Air compressor and tools
		e	Inspect/repair tank/cylinder venting systems			
		f	Check and clear obstructions from pressure relief valve			
		g	Inspect/replace hose or tubing as necessary			
		h	Check operation of manual shutoff valve and service			
		i	Check operation of fuel lockoff valves, solenoids			
	16		**Inspect fuel storage vessels and brackets**	P & C	2	
		a	Inspect for inspection date			Basic automotive tools
		b	Ensure data plate is legible			Leak detector
		c	Verify working pressures as appropriate for application			Refueling dispensers
		d	Inspect brackets for cracks, fatigue, rust, corrosion			
		e	Inspect mounting bolts, backing plates, etc.			
		f	Tighten and replace as necessary			
		g	Inspect fuel vessels for gouges, nicks, dents, heat damage			
		h	Ensure that all vapor sealing equipment is intact and functional			
		i	Check automatic stop fill valves for operation			
	17		**Check/tighten/replace hoses**	P & C	1	
		a	Check hoses for wear and abrasion, age			Basic automotive tools
		b	Relieve pressure on all hoses prior to further inspection			Leak detector
		c	Ensure hose is properly secured to vehicle with approved clips			
		d	Ensure joining material intact			
		e	Inspect protective grommets			
		f	Ensure that exhaust clearances are maintained			
		g	Inspect that heat shields are maintained			
		h	Verify hose or piping appropriate for application			
		i	Verify connections are accessible and undamaged			

Calculations	Communications	Technology	Purpose/Care	Safety
Addition/subtraction	Refer to technical manuals	Basic mechanical theory	Vehicle serviceability/useability	Accuracy of readings
	Verbal with supervisor		Warranty compliance	Accurate interpretation
	Written documentation		Reduce liability	PPE
	Verbal with co-workers		Protect all involved parties	Don't smoke
			Protect vehicle	General shop safety
				Component protection
				Comply with NFPA
				Exhaust ventilation
Addition/subtraction	Refer to technical manuals	Pressures and volumes	Vehicle serviceability/useability	Accuracy of readings
	Verbal with supervisor	Advanced automotive theory	Warranty compliance	Accurate interpretation
	Written documentation		Reduce liability	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	
			Cosmetics	
Addition/subtraction	Refer to technical manuals	Pressures and volumes	Vehicle serviceability/useability	Accuracy of readings
	Verbal with supervisor	Basic automotive theory	Warranty compliance	Accurate interpretation
	Written documentation		Reduce liability	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	
			Vehicle serviceability/useability	Accuracy of readings
Addition/subtraction	Refer to technical manuals	Basic automotive theory	Warranty compliance	Accurate interpretation
	Verbal with supervisor		Reduce liability	PPE
	Written documentation		Vehicle qualifications	Don't smoke
	Verbal with co-workers		Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	
Addition/subtraction	Refer to technical manuals	Basic automotive theory	Vehicle serviceability/useability	Accuracy of readings
	Verbal with supervisor		Warranty compliance	Accurate interpretation
	Written documentation		Reduce liability	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	

B.			MAINTAIN VEHICLE'S GASEOUS FUEL SYSTEM	Fuel	Level	Tools and Equipment
	18		**Replace air/fuel filters**	P & C	1	
		a	Follow vehicle manufacturers specs	P & C		Basic automotive tools
		b	Ensure filters are appropriate size for CFM ratings	C		Leak detector
		c	Retain appropriate air induction	P & C		
		d	Ensure proper filter orientation	P & C		
		e	Ensure crankcase vent line is downstream of filter element	P & C		
	19		**Perform emissions testing**	P & C	3	
		a	Ensure that all required emissions control devices are present, intact,			Engine analyzer
			and functional			OBD tester
		b	Extract codes for OEM self diagnostics and documents			4-gas analyzer
		c	Service codes as needed			Specialized tuning equipment
		d	Bring vehicle to appropriate running temperature			Chassis dynamometer
		e	Record and document emissions results--four gases			Basic automotive tools
		f	Adjust fuel mixtures according to manufacturers' requirements			
		g	Confirm that emissions meet local, state, and federal requirements			

Calculations	Communications	Technology	Purpose/Care	Safety
Addition/subtraction	Refer to technical manuals	Basic automotive theory	Vehicle serviceability/useability	Accuracy of readings
	Verbal with supervisor		Warranty compliance	Accurate interpretation
	Written documentation		Reduce liability	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	
Comparative analysis	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
	Verbal with client	Pressures and volumes	Warranty compliance	Accurate interpretation
	Written documentation	Engine theory	Reduce liability	PPE
	Read charts and graphs	Equipment proficiency	Vehicle qualifications	Don't smoke
	Verbal with manufacturer		Protect all involved parties	General shop safety
	Verbal with co-workers		Ensure quality performance	Component protection
	Use telephone		Protect vehicle	Comply with NFPA
	Interpret computerized test data		Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	

C.			TROUBLESHOOT SUPPLEMENTAL SYSTEMS	Fuel	Level	Tools and Equipment
	20		**Perform preliminary vehicle assessment**	P & C	2	
		a	Interview operator			Basic automotive tools
		b	Collect vehicle history and document (new vehicle, in service,			
			mileage, mono- or bi-fuel, new/old conversion, conversion, and type)			
		c	Determine frequency of occurrence			
		d	Describe driveability condition at time of occurrence			
			(idle, acceleration, cruise, load, deceleration, and startup)			
		e	Describe atmospheric conditions at time of occurrence			
			(rain, cold, heat, humidity, road conditions, and altitude)			
		f	Conduct road test to validate problem			
	21		**Troubleshoot OEM computer support**	P & C	3	
		a	Perform vehicle assessment (#20)			Engine analyzer
		b	Perform OEM self diagnostics and read codes			OBD tester
		c	Inspect power source			4-gas analyzer
		d	Inspect grounds			Specialized tuning equipment
		e	Check input sensor to device; verify in range			Chassis dynamometer
		f	Check output signal from support component; verify in range			Basic automotive tools
		g	Simulate sensor failure to generate sensor and trouble code			
		h	Check circuit continuity between sensor and component and			
			component and PCM			
		i	Seek references and sources for assistance			
		j	Isolate and repair/replace component			
	22		**Troubleshoot ignition timing enhancer**	P & C	3	
		a	Perform vehicle assessment (#20)			Engine analyzer
		b	Perform OEM self diagnostics and read codes			OBD tester
		c	Inspect power source			4-gas analyzer
		d	Inspect grounds			Specialized tuning equipment
		e	Check input from reference signal path to enhancer; verify in range			Chassis dynamometer
		f	Check output signal from enhancer to PCM; verify in range			Basic automotive tools
		g	Simulate sensor failure from sensor and trouble code			Continuity tester
		h	Check circuit continuity between enhancer and PCM			
		i	Seek references and sources for assistance			
		j	Isolate and repair/replace component			
	23		**Troubleshoot fuel control processor**	P & C	3	
		a	Perform vehicle assessment (#20)			DVOM
		b	Perform OEM self diagnostics and read codes			Specialized tuning equipment
		c	Inspect power source			Continuity tester
		d	Inspect grounds			Basic automotive tools
		e	Check input sensors to device; verify in range			
		f	Check output signals from fuel controller to actuators; verify in range			
		g	Simulate sensor failure to generate sensor and trouble code			
		h	Simulate actuator failure to generate change in exhaust content			
		i	Check circuit continuity between sensor and component and			
			component and PCM			
		j	Seek references and sources for assistance			
		k	Isolate and repair/replace component			

Calculations	Communications	Technology	Purpose/Care	Safety
Comparative analysis	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
	Verbal with client	Pressures and volumes	Warranty compliance	Accurate interpretation
	Written documentation	Engine theory	Reduce liability	PPE
	Read charts and graphs	Equipment proficiency	Vehicle qualifications	Don't smoke
	Verbal with manufacturer		Protect all involved parties	General shop safety
	Verbal with co-workers		Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Ensure emissions law compliance	
Comparative analysis	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Basic math skills	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
	Written documentation		Reduce liability	PPE
	Read charts and graphs		Protect all involved parties	Don't smoke
	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers		Ensure emissions law compliance	Component protection
				Comply with NFPA
				Exhaust ventilation
Comparative analysis	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
	Written documentation		Reduce liability	PPE
	Read charts and graphs		Protect all involved parties	Don't smoke
	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers		Ensure emissions law compliance	Component protection
				Comply with NFPA
				Exhaust ventilation
Comparative analysis	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
	Written documentation		Reduce liability	PPE
	Read charts and graphs		Protect all involved parties	Don't smoke
	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers		Ensure emissions law compliance	Component protection
				Comply with NFPA
				Exhaust ventilation

C			TROUBLESHOOT SUPPLEMENTAL SYSTEMS	Fuel	Level	Tools and Equipment
	24		**Troubleshoot automatic fuel select device**	P & C	3	
		a	Perform vehicle assessment (#20)			DVOM
		b	Perform OEM self diagnostics and read codes			Specialized tuning equipment
		c	Inspect power source			Continuity tester
		d	Inspect grounds			Basic automotive tools
		e	Check input sensor to device; verify in range			Lab scope
		f	Check output signal from support component; verify in range			Soldering equipment
		g	Simulate sensor failure to generate sensor and trouble code			Electrical fittings
		h	Check circuit continuity between sensor and component and			Scan tool
			component and PCM			
		i	Seek references and sources for assistance			
		j	Isolate and repair/replace component			
	25		**Troubleshoot fuel use hour meters**	P & C	2	
		a	Perform vehicle assessment (#20)			DVOM
		b	Inspect power source			Continuity tester
		c	Inspect grounds			Basic automotive tools
		d	Check circuit continuity between sensor and component and			Lab scope
			component and PCM			Soldering equipment
		e	Seek references and sources for assistance			Electrical fittings
		f	Isolate and repair/replace component			
	26		**Troubleshoot combustible gas detector**	P & C	2	
		a	Perform vehicle assessment (#20)			DVOM
		n	Inspect power source			Continuity tester
		c	Inspect grounds			Basic automotive tools
		d	Check input sensor to device; verify in range			Portable combustible gas supply
		e	Check output signal from support component; verify in range			Lab scope
		f	Simulate sensor failure to generate sensor and trouble code			Soldering equipment
		g	Check circuit continuity between sensor and component and			Electrical fittings
			component and PCM			
		h	Seek references and sources for assistance			
		i	Isolate and repair/replace component			
		k	Perform hydrocarbon forced default test			
	27		**Troubleshoot fuel level indicators**	P & C	2	
		a	Perform vehicle assessment (#20)			DVOM
		b	Inspect power source			Continuity tester
		c	Inspect grounds			Basic automotive tools
		d	Check input sensor to device; verify in range			Signal generator
		e	Check output signal from support component; verify in range			Applicable pressure gauges
		f	Simulate sensor failure to generate sensor and trouble code			Lab scope
		g	Check circuit continuity between sensor and component and			Soldering equipment
			component and PCM			Electrical fittings
		h	Seek references and sources for assistance			
		i	Isolate and repair/replace component			
	28		**Troubleshoot ignition and starter interlock**	P & C	2	
		a	Perform vehicle assessment (#20)			DVOM
		b	Perform OEM self diagnostics and read codes			Scan tool
		c	Inspect power source			Continuity tester
		d	Inspect grounds			Basic automotive tools
		e	Check circuit continuity between sensor and component and			Breakout box
			component and PCM			Lab scope
		f	Seek references and sources for assistance			Soldering equipment
		g	Isolate and repair/replace component			Electrical fittings

Calculations	Communications	Technology	Purpose/Care	Safety
OHM's Law	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Basic math skills	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
	Written documentation		Reduce liability	PPE
	Read charts and graphs		Protect all involved parties	Don't smoke
	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
OHM's Law	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Basic math skills	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
	Written documentation		Reduce liability	PPE
	Read charts and graphs		Protect all involved parties	Don't smoke
	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
OHM's Law	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Basic math skills	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
	Written documentation	Knowledge of combustible gas limits	Reduce liability	PPE
	Read charts and graphs		Protect all involved parties	Don't smoke
	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Addition/subtraction	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Pressures and volumes	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Ohm's Law	Written documentation	Knowledge of combustible gas limits	Reduce liability	PPE
	Read charts and graphs		Protect all involved parties	Don't smoke
	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Pressures and volumes		Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Ohm's Law	Refer to technical manuals	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math skills	Verbal with client	Knowledge of combustible gas limits	Reduce liability	PPE
	Written documentation		Protect all involved parties	Don't smoke
	Read charts and graphs		Protect vehicle	General shop safety
	Verbal with manufacturer			Component protection
	Verbal with co-workers			Comply with NFPA
				Exhaust ventilation

C.			TROUBLESHOOT SUPPLEMENTAL SYSTEMS	Fuel	Level	Tools and Equipment
	29		**Troubleshoot bi-fuel selector switch**	P & C	2	
		a	Perform vehicle assessment (#20)			DVOM
		b	Determine switch functions			Continuity tester
			(1) fuel selection; (2) injector shutoff; (3) fuel level sending units			Basic automotive tools
			(4) other circuits operated through fuel select switch			Lab scope
		c	Isolate separate circuits			Soldering equipment
		d	Verify proper switch input for each separate function			Electrical fittings
		e	Verify proper switch output for each separate function			
		f	Inspect power source to each separate circuit			
		g	Inspect grounds to each separate circuit			
		h	Check circuit continuity between switch poles and functions			
		i	Correct cross circuits between cross functions, if necessary			
		j	Repair or replace relays or other output controls operated by			
			switch function			
		k	Seek references and sources for assistance			
		l	Isolate and repair/replace component			
	30		**Troubleshoot cooling system interface**	P & C	2	
		a	Check coolant level and condition			Pressure tester
		b	Conduct pressure test of cooling system			Basic automotive tools
		c	Verify coolant flow direction through converter/regulators			Thermometer (Pyrometer)
		d	Bleed system			DVOM
		e	Verify proper thermostat operation/converter thermostat operation			Portable heat source
		f	Verify proper ECT switch and ECT sensor operation			Coolant recovery equipment
		g	Verify cooling fan operation, if applicable			Drip pans
		h	Check for proper water "Y" orientation			Spill equipment
		i	Use OEM quality components for replacement, if required			

Calculations	Communications	Technology	Purpose/Care	Safety
Pressures and volumes	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Ohm's Law	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math skills	Written documentation	Basic electronics	Reduce liability	PPE
	Read charts and graphs		Protect all involved parties	Don't smoke
	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Pressures and volumes	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Ohm's Law	Verbal with client	Directional flow theory	Warranty compliance	Accurate interpretation
Basic math skills	Written documentation	Cooling system theory	Reduce liability	PPE
	Read charts and graphs		Protect all involved parties	Don't smoke
	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

D.			TROUBLESHOOT FUEL SYSTEM COMPONENTS	Fuel	Level	Tools and Equipment
	31		**Troubleshoot tank/cylinder**	P & C	2	
		a	Perform vehicle assessment (#20)			Basic automotive tools
		b	Verify fuel in the tank/cylinder			Leak detector
		c	Verify service valve operation			
		d	Verify manual valve operation			
	32		**Troubleshoot pressure relief valve**	P & C	2	
		a	Verify condition of PRD	P & C		Basic automotive tools
		b	Inspect for displacement of fusible material (CNG)	C		Leak detector
		c	Verify protective cover in place	P		
		d	Verify vent is routed properly and open	P & C		
		e	Replace as necessary	P & C		
	33		**Troubleshoot filter and lockoff**	P & C	2	
		a	Perform vehicle assessment (#20)			Basic automotive tools
		b	Verify fuel pressure to filter			DVOM
		c	Verify fuel flow through filter			Continuity tester
		d	Replace filter or filter element as necessary			Pressure gauge set
		e	Inspect power source/vacuum source			Leak detector
		f	Inspect grounds, if applicable			Soldering equipment
		g	Check circuit continuity/vacuum between lockoff			Electrical fittings
		h	Verify fuel pressure after lockoff			
		i	Verify if fuel flow stops when lockoff is closed			
		j	Isolate and repair/replace component			
		k	Seek references and sources for assistance			
	34		**Troubleshoot regulator/converter**	P & C	2	
		a	Perform vehicle assessment (#20)			Pressure gauge set
		b	Verify inlet pressure for each component according to mfg. specs			Basic automotive tools
		c	Verify outlet pressure for each component according to mfg. specs			DVOM
		d	Seek references and sources for assistance			Manufacturers set-up gauge set
		e	Isolate and repair; replace as necessary			Leak detector
	35		**Troubleshoot air valve mixer**	P & C	2	
		a	Verify conventional fuel shutoff			DVOM
		b	Verify mixer/air flow rating is sufficient for engine load			Basic automotive tools
		c	Verify air cleaner/filter element is sufficient for engine load			Engine analyzer
		d	Verify air flowing through filter			Exhaust analyzer
		e	Verify diaphragm lift/clearance and condition			Specialized tuning equipment
		f	Verify correct air valve application			
		g	Verify length, type, and size of fuel delivery hose			
		h	Verify no leaks in fuel delivery hose to spray bar			
		i	Verify no vacuum leaks			
		j	Reset idle fuel mixture as per mfg. specs, if required			
		k	Reset load fuel mixture as per mfg. specs, if required			
		l	Consult manufacturers' specifications			

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Knowledge of combustible gas limits	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Knowledge of combustible gas limits	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Knowledge of combustible gas limits	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation		Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

D.			TROUBLESHOOT FUEL SYSTEM COMPONENTS	Fuel	Level	Tools and Equipment
	36		**Troubleshoot Venturi**	P & C	2	
		a	Verify conventional fuel shutoff			DVOM
		b	Verify mixer/air flow rating is sufficient for engine load			Basic automotive tools
		c	Verify air cleaner/filter element is sufficient for engine load			Engine analyzer
		d	Verify air flowing through filter			Exhaust analyzer
		e	Verify no vacuum leaks			Specialized tuning equipment
		f	Verify length, type, and size of fuel delivery hose			
		g	Verify no leaks in fuel delivery hose to Venturi			
		h	Reset idle fuel mixture as per mfg. specs, if required			
		i	Reset load fuel mixture as per mfg. specs, if required			
		j	Consult manufacturers' specifications			
	37		**Troubleshoot spray bar**	P & C	2	DVOM
		a	Verify conventional fuel shutoff			Basic automotive tools
		b	Verify spray bar is proper application for engine			Engine analyzer
		c	Verify air cleaner/filter element is sufficient for engine load			Exhaust analyzer
		d	Verify air flowing through filter			Leak detector
		e	Verify no leaks in air intake system above or below spray bar			Specialized tuning equipment
		f	Verify satisfactory seal around spray bar			
		g	Verify spray bar is clean and clear of obstructions			
		h	Verify spray bar orientation			
		i	Verify length, type, and size of fuel delivery hose			
		j	Verify no leaks in fuel delivery hose to spray bar			
		k	Verify no vacuum leaks			
		l	Verify proper calibration and/or fuel mixture adjustments for fuel			
			control, if required			
		m	Verify proper calibration for fuel constituency, if required			
		n	Consult manufacturers' specifications			
	38		**Troubleshoot injector**	P & C	3	DVOM
		a	Verify conventional fuel shutoff			Basic automotive tools
		b	Verify injector is proper application for engine			Engine analyzer
		c	Verify air cleaner/filter element is sufficient for engine load			Exhaust analyzer
		d	Verify air flowing through filter			Leak detector
		e	Verify no leaks in air intake system above or below spray bar			Specialized sealant
		f	Verify continuity through solenoid coil			
		g	Verify power source to injector			
		h	Verify driver circuit			
		i	Verify satisfactory seal around injector			
		j	Verify injector cleanliness and clear obstructions			
		k	Verify no leaks in fuel delivery hose to injector			
		l	Verify no vacuum leaks			
		m	Verify proper calibration and/or fuel mixture adjustments as required			
		n	Verify proper calibration for fuel constituency, if required			
		o	Consult manufacturers' specifications			

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation		Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

D.			TROUBLESHOOT FUEL SYSTEM COMPONENTS	Fuel	Level	Tools and Equipment
	39		**Troubleshoot spud-in mixer**	P & C	2	
		a	Verify conventional fuel shutoff			DVOM
		b	Verify mixer/air flow rating is sufficient for engine load			Basic automotive tools
		c	Verify air cleaner/filter element is sufficient for engine load			Engine analyzer
		d	Verify air flowing through filter			Exhaust analyzer
		e	Verify no vacuum leaks			
		f	Verify proper depth and orientation of spud pipes			
		g	Verify matched pipe orientation specification (dual pipes)			
		h	Verify length, type, and size of fuel delivery hose			
		i	Verify no leaks in fuel delivery hose to spud pipes			
		j	Verify vaporizer/regulator gas supply to mixer			
		k	Reset idle fuel mixture as per mfg. specs, if required			
		l	Reset load fuel mixture as per mfg. specs, if required			
		m	Consult manufacturers' specifications			
	40		**Troubleshoot base plate venturi mixer**	P & C	2	
		a	Verify conventional fuel shutoff			DVOM
		b	Verify mixer/air flow rating is sufficient for engine load			Basic automotive tools
		c	Verify air cleaner/filter element is sufficient for engine load			Engine analyzer
		d	Verify air flowing through filter			Exhaust analyzer
		e	Verify no vacuum leaks			
		f	Verify barrel valve operation			
		g	Verify barrel valve link integrity			
		h	Verify length, type, and size of fuel delivery hose			
		i	Verify no leaks in fuel delivery hose to mixer			
		j	Verify vaporizer/regulator gas supply to mixer			
		k	Reset idle fuel mixture as per mfg. specs, if required			
		l	Reset load fuel mixture as per mfg. specs, if required			
		m	Consult manufacturers' specifications			
	41		**Troubleshoot lift plate mixer**	P & C	2	
		a	Verify conventional fuel shutoff			DVOM
		b	Verify mixer/air flow rating is sufficient for engine load			Basic automotive tools
		c	Verify air cleaner/filter element is sufficient for engine load			Engine analyzer
		d	Verify air flowing through filter			Exhaust analyzer
		e	Verify no vacuum leaks			Manufacturer's gauge block set
		f	Verify vacuum supply to Vacuum Lift Solenoid (VLS)			
		g	Verify VLS switching			
		h	Verify proper air gap spacing of lift plate to body as per mfg. spec			
		i	Verify length, type, and size of fuel delivery hose			
		j	Verify no leaks in fuel delivery hose to mixer			
		k	Verify vaporizer/regulator gas supply to mixer			
		l	Reset idle fuel mixture as per mfg. specs, if required			
		m	Reset load fuel mixture as per mfg. specs, if required			
		n	Consult manufacturers' specifications as required			

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation		Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client		Warranty compliance	Accurate interpretation
Basic math functions	Written documentation		Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client		Warranty compliance	Accurate interpretation
Basic math functions	Written documentation		Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

E.			TROUBLESHOOT EMISSION CONTROL DEVICES	Fuel	Level	Tools and Equipment
	42		**Troubleshoot ignition system**	P & C	3	
		a	Conduct pre-vehicle assessment (#20)			OBD tester
		b	Check battery voltage/primary voltage			DVOM
		c	Perform OEM self-diagnostics and read codes			Breakout box
		d	Confirm presence of secondary voltage (check for spark)			Specialized tester
		e	Inspect spark plug condition (electrode, gap, heat range)			Continuity tester
		f	Inspect secondary circuit wiring for continuity and resistance			Oscilliscope
		g	Check ignition module for proper operation			Lab scope
		h	Check cap and rotor condition			Soldering and electrical equipment.
		i	Check mechanical and vacuum advance mechanism, if needed			
		j	Check for proper sensor reference to PCM			
		k	Inspect power control relays			
	43		**Troubleshoot O2 sensor using mfg. manual**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check input from sensor to PCM; verify in range			Specialized tester
		e	Simulate sensor failure to generate sensor and trouble code			Lab scope
		f	Check circuit continuity between sensor and component and			Soldering and electrical equipment.
			component and PCM			Portable fuel supply
		g	Seek references and sources for assistance			
		h	Isolate and repair/replace component			
	44		**Troubleshoot MAP sensor**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Verify proper altitude reference, KOEO			Specialized tester
		e	Check input from sensor to PCM; verify in range			Vacuum pump
		f	Plot sensor output on graph using vacuum pump			Soldering and electrical equipment.
		g	Simulate sensor failure to generate sensor and trouble code			Lab scope
		h	Check circuit continuity between sensor and component and			
			component and PCM			
		i	Seek references and sources for assistance			
		j	Isolate and repair/replace component			
		k	Check for manifold vacuum test			
		l	Verify that sensor holds vacuum			
	45		**Troubleshoot RPM sensor**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check input from sensor to PCM; verify in range			Specialized tester
		e	Monitor square wave with oscilloscope/frequency meter			Lab scope
		f	Simulate sensor failure to generate sensor trouble code			Soldering and electrical equipment.
		g	Check circuit continuity between sensor and component and			
			component and PCM			
		h	Seek references and sources for assistance			
		i	Isolate and repair/replace component			

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Basic electrical theory	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers		Ensure emissions law compliance	Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

E.			TROUBLESHOOT EMISSION CONTROL DEVICES	Fuel	Level	Tools and Equipment
	46		**Troubleshoot TP sensor**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check input from sensor to PCM; verify in range			Specialized tester
		e	Verify range by observing open and closed throttle position			Lab scope
		f	Monitor voltage range for dead spots			Soldering and electrical equipment.
		g	Monitor for initial sensor reference, KOEO			
		h	Simulate sensor failure to generate sensor trouble code			
		i	Check circuit continuity between sensor and component and			
			component and PCM			
		j	Adjust base idle voltage, if possible			
		k	Seek references and sources for assistance			
		l	Isolate and repair/replace component			
	47		**Troubleshoot ECT sensor**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check input from sensor to PCM; verify in range			Specialized tester
		e	Verify range by placing ECT sensor in water of known temperature			
		f	Verify that signal/values matches known temperature			
		g	Simulate sensor failure to generate sensor trouble code			
		h	Check circuit continuity between sensor and component and			
			component and PCM			
		i	Seek references and sources for assistance			
		j	Isolate and repair/replace component			
		k	Check thermostat for correct heat range			
	48		**Troubleshoot IAT sensor**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check input from sensor to PCM; verify in range			Specialized tester
		e	Verify range by placing IAT sensor in air of known temperature			
		f	Verify that signal/values matches known temperature			
		g	Simulate sensor failure to generate sensor trouble code			
		h	Check circuit continuity between sensor and component and			
			component and PCM			
		i	Seek references and sources for assistance			
		j	Isolate and repair/replace component			
		k	Check thermostat for correct heat range			
	49		**Troubleshoot VS sensor**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check input from sensor to PCM; verify in range			Specialized tester
		e	Conduct speed and wave form test, using scan tool/frequency meter			
		f	Simulate sensor failure to generate sensor and trouble code			
		g	Check circuit continuity between sensor and component and			
			component and PCM			
		h	Seek references and sources for assistance			
		i	Isolate and repair/replace component			

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	
Read rule/measure	Read charts and graphs		Protect all involved parties	
Read gauges	Verbal with manufacturer		Protect vehicle	
	Verbal with co-workers			

E.			TROUBLESHOOT EMISSION CONTROL DEVICES	Fuel	Level	Tools and Equipment
	50		**Troubleshoot knock sensor**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check input from sensor to PCM; verify in range			Specialized tester
		e	Simulate sensor failure to generate sensor and trouble code			
		f	Check circuit continuity between sensor and component and			
			component and PCM			
		g	Seek references and sources for assistance			
		h	Isolate and repair/replace component			
	51		**Troubleshoot EGR valve position sensor**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check input from sensor to PCM; verify in range			Specialized tester
		e	Verify range by checking for proper signal when opening valve			
		f	Simulate sensor failure to generate sensor trouble code			
		g	Check circuit continuity between sensor and component and			
			component and PCM			
		h	Seek references and sources for assistance			
		i	Isolate and repair/replace component			
		j	Remove and clean EGR valve			
	52		**Troubleshoot CKP sensor**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check continuity of pick up (magnetic)			Specialized tester
		e	Check input from sensor to PCM; verify in range using frequency			
			meter/oscilloscope			
		f	Simulate sensor failure to generate sensor trouble code			
		g	Check circuit continuity between sensor and component and			
			component and PCM			
		h	Seek references and sources for assistance			
		i	Isolate and repair/replace component			
	53		**Troubleshoot MAF sensor**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check input from sensor to PCM			Specialized tester
		e	Verify in range using DVOM/frequency meter			
		f	Verify vane range, if applicable			
		g	Simulate sensor failure to generate sensor trouble code			
		h	Check circuit continuity between sensor and component and			
			component and PCM			
		i	Seek references and sources for assistance			
		j	Isolate and repair/replace component			

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

E.			TROUBLESHOOT EMISSION CONTROL DEVICES	Fuel	Level	Tools and Equipment
	54		**Troubleshoot IAC actuator**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check drive wire for continuity to PCM			Specialized tester
		e	Check output command from PCM; verify in range			
		f	Simulate actuator function and confirm proper response			
			by appropriate sensor signal			
		g	Seek references and sources for assistance			
		h	Repair/replace/adjust actuator as necessary per OEM specs			
	55		**Troubleshoot EVAP cannister purge actuator**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check drive wire for continuity to PCM			Specialized tester
		e	Check output command from PCM			
		f	Verify in range using DVOM			
		g	Simulate actuator function and confirm proper response			
			by appropriate sensor signal			
		h	Seek references and sources for assistance			
		i	Repair/replace/adjust actuator as necessary per OEM specs			
	56		**Troubleshoot EGR valve actuator**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check drive wire for continuity to PCM			Specialized tester
		e	Check output command from PCM; verify in range			
		f	Simulate actuator function and confirm proper response			
			by appropriate sensor signal			
		g	Seek references and sources for assistance			
		h	Repair/replace/adjust actuator as necessary per OEM specs			
	57		**Troubleshoot AIR bypass/diverter actuator**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check drive wire for continuity to PCM			Specialized tester
		e	Check output command from PCM; verify in range			
		f	Simulate actuator function and confirm proper response			
			by appropriate sensor signal			
		g	Seek references and sources for assistance			
		h	Repair/replace/adjust actuator as necessary per OEM specs			
	58		**Troubleshoot fuel injectors actuator**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check drive wire for continuity to PCM			Specialized tester
		e	Check output command from PCM			NOID lamp
		f	Verify command response with NOID lamp or similar device			
		g	Use test equipment to check spray pattern			
		h	Simulate actuator function and confirm proper response			
			by appropriate sensor signal			
		i	Seek references and sources for assistance			
		j	Repair/replace/adjust actuator as necessary per OEM specs			

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co–workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co–workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co–workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co–workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co–workers			Component protection
				Comply with NFPA
				Exhaust ventilation

E.			TROUBLESHOOT EMISSION CONTROL DEVICES	Fuel	Level	Tools and Equipment
	59		**Troubleshoot fuel control regulators**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Check manifold vacuum source			DVOM
		c	Check regulation to rail connection for leaks			Breakout box
		d	Check rail pressure			Specialized tester
		e	Check for proper by-pass to tanks/cylinders			
		f	Check fuel pump for proper operation			
		g	Seek references and sources for assistance			
		h	Repair/replace/adjust actuator as necessary per OEM specs			
	60		**Troubleshoot ICM device**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check drive wire for continuity to PCM			Specialized tester
		e	Check output command from PCM; verify in range			
		f	Simulate device function and confirm proper response			
			by appropriate sensor signal			
		g	Check for minimum spark voltage			
		h	Check for timing advancement			
		i	Check for dwell changes			
		j	Seek references and sources for assistance			
		k	Repair/replace/adjust device as necessary per OEM specs			
	61		**Troubleshoot TCC actuator**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check drive wire for continuity to PCM			Specialized tester
		e	Check output command from PCM; verify in range			
		f	Simulate actuator function and confirm proper response			
			by appropriate sensor signal			
		g	Seek references and sources for assistance			
		h	Repair/replace/adjust actuator as necessary per OEM specs			

Calculations	Communications	Technology	Purpose/Care	Safety
Convert English to metric	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Basic math functions	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Read rule/measure	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read gauges	Read charts and graphs		Protect all involved parties	Don't smoke
	Verbal with manufacturer		Protect vehicle	General shop safety
				Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

F.			REPAIR SYSTEMS	Fuel	Level	Tools and Equipment
	62		**Repair/replace valves and gauges**	P & C	3	Pressure gauge
		a	Identify problem as it relates to system			Leak detector
		b	Deplete vessel of fuel supply			Basic automotive tools
		c	Flare off or transfer fuel to another storage vessel			Tank flaring/evacuation equipment
		d	Repair or service gauge as appropriate for system			
		e	Verify component replacement for system compatibility			
	63		**Repair/replace fuel injection/carburetion system**	P & C	3	
		a	Identify problem area			Basic automotive tools
		b	Remove and service as needed			Engine analyzer
		c	Reinstall system as recommended by manufacturer			Exhaust analyzer
		d	Check for vacuum leaks			Chassis dynamometer
		e	Set up and tune to mfg. specifications as necessary			Fuel injector cleaning equipment
		f	Perform emission checks in compliance with all applicable regulations			Leak dectector
	64		**Repair/replace electrical connections/components**	P & C	3	
		a	Identify problem area, perform OEM self-diagnostics, and read codes			DVOM
		b	Correct all problems in order issued by PCM			Continuity tester
		c	Repeat as necessary until all problems resolved			Breakout box
		d	Perform continuity test on suspected problem area using			Soldering equipment
			appropriate test device			Electrical fittings
		e	Ensure correct electrical interfacing with OEM			Lab scope
			systems as per mfr. instructions			PCM safe test light
		f	Perform output state test on suspected problem area			
		g	Check systems for proper signal and ground			
		h	Verify if component or wiring harness is at fault			
		i	Repair or replace harness or component fault in compliance with			
			OEM warranty specifications			
	65		**Repair/replace pressure regulation devices**	P & C	3	
		a	Check for appropriate working pressure			Pressure gauge set
		b	Isolate or locate problem			Leak detector
		c	Deplete or flare off system pressure			Manufacturer's gauge set
		d	Disassemble and repair as per manufacturers' recommendations			Basic automotive tools
		e	Leak test as per manufacturers' recommendations			Thread sealent
		f	Reinstall or replace			
		g	Purge cooling system lines to assure proper engine coolant flow			
		h	Tune the system (See #19)			
	66		**Repair/replace brackets**	P & C	3	
		a	Identify problem area (see #16)			Basic automotive tools
		b	Repair/replace brackets with cracks, fatigue, rust, corrosion			Metal fabrication tools
			in compliance with all regulations			Drill and drill bits
		c	Replace fasteners, backing plates, etc. as needed to comply with			Welding and cutting equipment
			regulations			Tap and die set
		d	Replace bracket insulator material as needed to meet regulations (CNG)	C		
	67		**Repair/replace venting systems**	P & C	3	
		a	Identify problem			Leak detector
		b	Inspect PRD			Basic automotive tools
		c	Replace PRD according to mfg. specifications as needed			Thread sealent
		d	Inspect vapor containment system			
		e	Replace vapor containment system as needed according mfg. specs			
		f	Inspect vapor pipes for kinks, blockages, etc.	C		
		g	Repair/replace vapor pipes as needed	C		

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read ruler/measure	Read charts and graphs	Basic electrical theory	Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read ruler/measure	Read charts and graphs	Basic electrical theory	Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read ruler/measure	Read charts and graphs	Basic electrical theory	Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read ruler/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read ruler/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers		Component security	Component protection
			Accident/impact protection	Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read ruler/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

F.			REPAIR SYSTEMS	Fuel	Level	Tools and Equipment
	68		**Repair/replace ignition systems**	P & C	2	
		a	Repair/replace cap, rotor, pickup, distributor, spark plugs, spark plug			Engine analyzer
			wires, ignition coil and ignition control module as needed			DVOM
		b	Repair/replace crank, knock sensor, and or cam sensors, ICM			Specialized testing equipment
			modules, coil pack as needed			Basic automotive tools
		c	Adjust base timing to factory specifications			Lab scope
		d	Verify proper ignition system operation with primary and secondary			Soldering equipment
			oscilloscope tests			Electrical fittings
	69		**Repair/replace cooling system components**	P & C	2	
		a	Pressure test cooling system			Pressure tester
		b	Withdraw coolant from system in proper recycling system			Basic automotive tools
		c	Do not use coolant system leak repair chemicals			Drain pan
		d	Repair leaks, as necessary			Coolant storage and recycling
		e	Pressure test to confirm			Spill containment equipment
		f	Replace thermostat with OEM specified temperature range			
		g	Verify air flow through system			
		h	Confirm correct engine cooling fan operation			
		i	Bleed cooling system after repair, if required			
	70		**Perform fuel system leak test**	P & C	1	
		a	Verify system under operating pressure			Pressure gauge
		b	Identify area of suspected leak			Basic automotive tools
		c	Look, smell, listen, think			Leak detector
		d	Generously cover fittings with approved leak detector solution			Thread sealent
		e	Electronic leak detection			Tank flaring and evacuation equipment
		f	Bleed system pressure			
		g	Repair leak by disassembling connection			
		h	Inspect for faults			
		i	Reassemble connection			
		j	Repressurize to verify			

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Gaseous fuels theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Pressure terms and measurements	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Basic math skills	Reduce liability	PPE
Read rule/measure	Read charts and graphs	Basic electrical theory	Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers		Ensure emissions law compliance	Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Gaseous fuels theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Pressure terms and measurements	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation		Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Gaseous fuels theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Pressure terms and measurements	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Combustible gas flammability limits	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

G.			REPAIR/REPLACE EMISSION CONTROL DEVICE	Fuel	Level	Tools and Equipment
	71		**Repair/replace thermal reactor/catalytic converter**	P & C	2	Basic automotive tools
		a	For replacement, select appropriate catalytic converter for application			Exhaust analyzer
			(oxidation or three-way)			Vehicle support and lift device
		b	For repair, remove contaminated substrate and replace with proper			Eye protection
			volume of appropriate substrate			Welding/cutting equipment
		c	Reconnect air input or replace sensor if required			Tube/pipe bending equipment
		d	Tighten clamps			
		e	Check for leaks			
	72		**Repair/replace input sensors or related equipment**	P & C	2	
		a	Perform diagnostic test			Basic automotive tools
		b	If outside of OEM allowances, repair/replace the following:			DVOM
			--Replace O2 sensor using mfg. manual			Specialized testing equipment
			--Replace MAP sensor, as necessary			Breakout box
			--Replace RPM sensor			Vacuum pump
			--Repair/replace/adjust TP sensor, as necessary			Pressure gauges
			--Replace ECT sensor, as necessary			Soldering equipment
			--Replace IAT sensor, as necessary			Electrical fittings
			--Replace VS sensor, as necessary			OEM quality replacement components
			--Replace knock sensor, as necessary			Replacement connectors
			--Repair/replace/clean EVP sensor			
			--Replace CKP sensor, as necessary			
			--Repair/replace MAF sensor			
	73		**Repair/replace actuators**	P & C	2	
		a	Perform diagnostic test			Basic automotive tools
		b	If outside of OEM allowances, repair/replace the following:			DVOM
			--Repair/replace IAC			Specialized testing equipment
			--Repair/replace EVAP cannister purge			Breakout box
			--Repair/replace EGRV			Soldering equipment
			--Repair/replace AIR bypass/diverter			Electrical fittings
			--Repair/replace fuel injectors			OEM quality replacement components
			--Repair/replace fuel control regulators			
			--Repair/replace ICM			
			--Repair/replace TCC			

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs	Basic electrical theory	Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers		Ensure emissions law compliance	Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs	Basic electrical theory	Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers		Ensure emissions law compliance	Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs	Basic electrical theory	Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers		Ensure emissions law compliance	Component protection
				Comply with NFPA
				Exhaust ventilation

H.			PERFORM MISCELLANEOUS TASKS	Fuel	Level	Tools and Equipment
	74		**Maintain supply inventory**	P & C	2	
		a	Assess inventory needs			Computer database
		b	Verify minimum required inventory			Telephone
		c	Order inventory as required			Fax
		d	Maintain vendor catalogs			Catalogues
		e	Issue and follow up with purchase orders			Vendor cross-references
		f	Maintain inventory for upcoming conversions			
	75		**Operate Digital VOM**	P & C	2	
		a	Perform test for volts, ohms, amps by application			DVOM
		b	Perform test for frequency, temperature, tach, dwell duty cycle by			Shop manuals
			application			
		b	Determine proper probes for application			
		c	Use operating instructions			
	76		**Operate breakout box**	P & C	2	
		a	Select appropriate PCM intercept connector			Breakout box
		b	Select appropriate breakout box			Basic automotive tools
		c	Remove PCM connector and interact breakout box			DVOM
		d	Read and interpret pin voltage charts			Probes and intercept cables
		e	Perform output state and continuity checks, as applicable			
		f	Perform applicable test functions as specified in manufacturer			
			specified routines			
	77		**Perform housekeeping tasks**	P & C	2	
		a	Maintain safe working environment			Mop and bucket (water base)
		b	Maintain clean shop			Mop and bucket (solvent base)
		c	Organize and maintain tools			Broom
		d	Maintain bathrooms			Dust pan
		e	Help maintain ventilation			Oil and coolant containment barrier
		f	Mop floor after spills			OSHA rules and regs
		g	Notify supervisor of spill-related accidents			Basic automotive tools
		h	Ensure proper operation and visual location of emergency safety			
			equipment			
		i	Verify date of fire extinguisher inspection			
	78		**Operate emissions analyzer and interpret resulting data**	P & C	2	
		a	Allow machine to warm up and self-calibrate/span			Engine analyzer
		b	Perform periodic gas calibration, as necessary			Exhaust analyzer
		c	Make proper connections to engine exhaust			Basic automotive tools
		d	Check hose for leaks and maintain filters			Calibration gas bottles
		e	Monitor and record vehicle emissions			Technical manuals
		f	Evaluate vehicle emissions			
		g	Interpret vehicle emissions for diagnosing problems			
		h	Seek assistance, refer to equipment mfg. as needed			
		i	Operate vehicle as required to simulate driving conditions			
		j	Coordinate operations of gas analyzers and dynamometer			
		k	Perform all required pre- and post-conversion tests, if applicable			
		l	Analyze comparison of both conventional and alternative fuel results,			
			if applicable			

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Administrative procedures	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Basic accounting skills	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers		Fiscal accountibility	Component protection
			Maintain practical inventory levels	Comply with NFPA
			Timely repairs/service	Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with supervisor	Basic electrical theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation		Reduce liability	PPE
Read rule/measure	Verbal with co-workers		Protect all involved parties	Don't smoke
Read gauges			Protect vehicle	General shop safety
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with supervisor	Basic electrical theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation		Reduce liability	PPE
Read rule/measure	Verbal with co-workers		Protect all involved parties	Don't smoke
Read gauges			Protect vehicle	General shop safety
				Comply with NFPA
				Exhaust ventilation
Perform chemical drying/	Refer to technical manuals	OSHA rules and regulations	Vehicle serviceability/useability	Accuracy of readings
evaporation calculations	Verbal with supervisor	Basic sanitary procedures	Warranty compliance	Accurate interpretation
	Written documentation	Chemical handling procedures	Reduce liability	PPE
	Verbal with co-workers	Hazardous waste disposal	Protect all involved parties	Don't smoke
		Solvent handling procedures	Protect vehicle	General shop safety
			Protect specialty equipment	Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with supervisor	Basic electrical theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation		Reduce liability	PPE
Read rule/measure	Verbal with co-workers		Protect all involved parties	Don't smoke
Read gauges			Protect vehicle	General shop safety
			Protect specialty equipment	Comply with NFPA
				Exhaust ventilation

JOB AND TASK ANALYSIS--AFV Automotive Technician

H.			PERFORM MISCELLANEOUS TASKS	Fuel	Level	Tools and Equipment
	79		**Perform storage and fuel handling**	P & C	2	
		a	Refuel vehicle	P & C		Basic automotive tools
		b	Perform roadside fuel transfer	P		Fuel dispensing equipment
		c	Operate vehicle refueling station	P & C		PPE
		d	Identify working pressures	C		Fuel storage tanks and cylinders
		e	Read fuel level gauges	P & C		Supporting cocumentation
		f	Maintain safe environment	P & C		Technical manuals
		g	Vent systems properly	P & C		
		h	Purge tanks	P & C		
		i	Operate automated metering systems	P & C		
	80		**Observe federal and state regulations**	P & C	2	
		a	Identify emissions standards			Periodicals and technical bulletins
		b	Identify violations that render penalties			OSHA rules and regulations
		c	Identify compliance testing procedures			Technical manuals
		d	Identify upgrade system for compliance			Documentation materials
		e	Remove uncertified components			Logs and inspection records
		f	Comply with OSHA requirements			First aid equipment
		g	Observe vehicle warranty requirements			Emergency route guides
		h	Demonstrate emergency preparedness			Emergency lighting
			--Use proper fire extinguishers for situation			Hazardous area markings
			--Know building escape route			PPE
			--Know all emergency shutoff valves and switches			Shower/eye wash stations
			--Know employee emergency relocation points			
			--Locate eye wash station			
			--Use and locate PPE			
			--Know location of emergency phone numbers for emergency response			
			--Demonstrate CPR proficiency			
			--Demonstrate basic first aid			
			--Know location of emergency first aid equipment/supplies			
		i	Demonstrate knowledge of EEOC regulations			
			--Identify employee rights			
			--Identify employer responsibilities			
	81		**Communicate with end--users**	P & C	2	
		a	Orient end user to alternative fuels			Telephone
		b	Provide driver/fleet/owner orientation			FAX machine/fax--modem
		c	Provide explanation of maintenance requirements			Computers and related equipment
		d	Explain safety--related issues			MSDS documentation
		e	Explain reasons for suggested repair/maintenance			Technical manuals
		f	Provide customer with quotation for services			Labor guidebooks
		g	Secure customer acknowledgment			Warranty procedure checklists
		h	Provide customer with MSDS sheets			
	82		**Handle hazardous materials**	P & C	2	
		a	Contain spills			Mop and bucket (water base)
		b	Dispose of hazardous materials properly			Mop and bucket (solvent base)
		c	Alert supervisor of spills			Broom
		d	Maintain HAZMAT law, as required			Dust pan
		e	Maintain and display emergency numbers			Oil and coolant containment barrier
		f	Maintain proper signage in shop in accordance with regulations			OSHA rules and regulations
		g	Stay current on HAZMAT regulations			Basic automotive tools
		h	Maintain Materials Safety Data Summary (MSDS) sheets			MSDS documentation
		i	Comply with SARA Title III inventory report requirements			Technical manuals
						Recycling / recovery equipment

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with supervisor	Basic electrical theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation		Reduce liability	PPE
Read rule/measure	Verbal with co-workers		Protect all involved parties	Don't smoke
Read gauges			Protect vehicle	General shop safety
			Protect specialty equipment	Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with supervisor	Basic electrical theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Exhaust gas composition	Reduce liability	PPE
Read rule/measure	Verbal with co-workers	EPA Clean Air Act	Protect all involved parties	Don't smoke
Read gauges		DOE Energy Policy Act	Protect vehicle	General shop safety
Interpret emissions data		State/local vehicle emissions testing	Protect specialty equipment	Comply with NFPA
			Ensure emissions law compliance	Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with supervisor	Basic electrical theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Exhaust gas composition	Reduce liability	PPE
Read rule/measure	Verbal with co-workers	EPA Clean Air Act	Protect all involved parties	Don't smoke
Read gauges	Professional courtesy	DOE Energy Policy Act	Protect vehicle	General shop safety
Interpret emissions data	Telephone etiquette	State/local vehicle emissions testing	Protect specialty equipment	Comply with NFPA
			Ensure emissions law compliance	Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with supervisor	Basic electrical theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Exhaust gas composition	Reduce liability	PPE
Read rule/measure	Verbal with co-workers	EPA Clean Air Act	Protect all involved parties	Don't smoke
Read gauges		DOE Energy Policy Act	Protect vehicle	General shop safety
Interpret emissions data		State/local vehicle emissions testing	Protect specialty equipment	Comply with NFPA
			Ensure emissions law compliance	Exhaust ventilation

H.			PERFORM MISCELLANEOUS TASKS	Fuel	Level	Tools and Equipment
	83		**Perform documentation**	P & C	1	
		a	Complete pre-conversion check sheet			Telephone
		b	Inform client of discrepancies			FAX machine/fax-modem
		c	Report conversion to appropriate authorities			Computers and related equipment
		d	Submit warranty forms to vendors			MSDS documentation
		e	Document equipment warranty			Technical manuals
		f	Maintain record keeping system			Labor guidelines
		g	Perform post-conversion checklist and attach labels			Warranty procedure checklists

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Basic electrical theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with supervisor	Exhaust gas composition	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	EPA Clean Air Act	Reduce liability	PPE
Read rule/measure	Verbal with co-workers	DOE Energy Policy Act	Protect all involved parties	Don't smoke
Read gauges		State/local vehicle emissions testing	Protect vehicle	General shop safety
Interpret emissions data			Protect specialty equipment	Comply with NFPA
			Ensure emissions law compliance	Exhaust ventilation

JOB AND TASK ANALYSIS--AFV Automotive Technician

I.			DEMONSTRATE TECHNICIAN KNOWLEDGE/PERFORM TRAINING	Fuel	Level	Tools and Equipment
	84		**Plan training sessions**	P&C	3	
		a	Assess needs of trainees through pretesting			
		b	Select and/or prepare instructional materials regarding--			
			--Regulatory/safety policies			
			--Conversion components			
			--Vehicle compatibility analysis			
			--Equipment installation (parts fabrication)			
			--Equipment installation (hands-on installation of tanks/cylinders)			
			--Equipment installation (hands-on installation of regulators)			
			--Equipment installation (hands-on installation of fuel lines and shut off valves)			
			--Equipment installation (hands-on installation of electrical equipment/wiring)			
			--Equipment installation (hands-on installation of carburetion and fuel injection systems)			
			--Vehicle emissions inspection, testing, and safety			
			--Emissions diagnosis and tuning			
			--Driver orientation			
			--Legislative and regulatory policies			
			--Suppliers and manufacturers			
		c	Review and/or develop lesson plans on units			
	85		**Deliver training sessions**	P&C	3	
		a	Conduct group discussions and lectures			
		b	Direct trainee lab experiences			
		c	Coach trainees			
		d	Demonstrate manipulative skills			
		e	Present information with a variety of instructional media (overhead, video, etc.)			
		f	Present information with the chalkboard or flip chart			
	86		**Evaluate trainee performance**	P&C	3	
		a	Assess trainee knowledge using pretests and posttests			
		b	Assess trainee skill performance			
		c	Determine trainee competence			
	87		**Identify fuel characteristics**	P & C	1	
	88		**Trace history of industry**	P & C	1	Mop and bucket (water base)
	89		**Distinguish differences between gasoline and alternative fuels**	P & C	1	Mop and bucket (solvent base)
	90		**Determine need for conversion**	P & C	1	Broom
	91		**Identify environmental effects**	P & C	1	Dust pan
	92		**Identify economic benefits**	P & C	1	Oil and coolant containment barrier
	93		**Compare conversion and maintenance cost savings**	P & C	1	OSHA rules and regulations
	94		**Identify R and D companies**	P & C	1	Basic automotive tools
	95		**Identify source of supply and distribution**	P & C	1	MSDS documentation
	96		**Use technical terminology**	P & C	1	Technical manuals
	97		**Remain technically updated**	P & C	1	Recylcing/recovery equipment
						Basic automotive tools
						DVOM
						Specialized testing equipment
						Breakout box
						Soldering equipment
						Electrical fittings
						OEM quality replacement components

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Basic electrical theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with supervisor	Exhaust gas composition	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	EPA Clean Air Act	Reduce liability	PPE
Read rule/measure	Verbal with co-workers	DOE Energy Policy Act	Protect all involved parties	Don't smoke
Read gauges		State/local vehicle emissions testing	Protect vehicle	General shop safety
Interpret emission data			Protect specialty equipment	Comply with NFPA
			Ensure emissions law compliance	Exhaust ventilation

DUTY AREAS WEIGHTED FOR IMPORTANCE -- AFV Automotive Technician

			Points	Points
		%	1000	200
A	CONVERT VEHICLES	16.0	160	32
B	MAINTAIN VEHICLE'S GASEOUS FUEL SYSTEM	7.0	70	14
C	TROUBLESHOOT SUPPLEMENTAL SYSTEMS	12.0	120	24
D	TROUBLESHOOT FUEL SYSTEM COMPONENTS	12.0	120	24
E	TROUBLESHOOT EMISSION CONTROL DEVICES	12.0	120	24
F	REPAIR SYSTEMS	10.0	100	20
G	REPAIR/REPLACE EMISSION CONTROL DEVICES	5.0	50	10
H	PERFORM MISCELLANEOUS TASKS	10.0	100	20
I	DEMONSTRATE TECHNICAL KNOWLEDGE/PERFORM TRAINING	16.0	160	32
	SUM	100.0	1000	200

TASK AREAS WEIGHTED FOR IMPORTANCE -- AFV Automotive Technician

(Importance as rated by panel: 3=essential, 2=important, 1=desirable
Difficulty as rated by panel: 3=hard, 2=moderate, 1=easy
Level as rated by panel: 3=Master technician/trainer, 2=Journeyman Level, 1=Entry level
Points: total job = 1000 points; individual points allocated based on difficulty and importance
Items: total job = 200 test items; individual items based on importance)

A		CONVERT VEHICLES	Importance	Difficulty	Level	Points	Items
	1	Perform pre-vehicle conversion assessment	3.0	1.8	2.0	11	2
	2	Prepare vehicle for conversion	2.8	2.0	1.5	11	2
	3	Fabricate brackets and hangers	1.8	2.5	2.0	10	1
	4	Install storage vessels	3.0	1.5	1.0	10	2
	5	Install remote fill and relief vent equipment	2.3	1.8	1.2	9	2
	6a	Install fittings per manufactuer's specifications (Propane)	3.0	1.5	1.3	10	2
	6b	Install fittings per manufactuer's specifications (CNG)	3.0	1.5	1.3	10	2
	7	Bend tubing (CNG)	3.0	2.2	1.5	11	2
	8a	Install fuel lines/filters/fuel locks/valves (Propane)	3.0	1.7	1.3	10	2
	8b	Install fuel lines/filters/fuel locks/valves (CNG)	3.0	1.7	1.5	10	2
	9a	Install pressure regulation systems (Propane)	3.0	1.8	1.3	11	2
	9b	Install pressure regulation systems (CNG)	3.0	2.0	1.5	11	2
	10	Install fuel injection/carburetion devices	3.0	2.2	1.8	11	2
	11	Install electrical/electronic system	3.0	2.7	2.2	13	2
	12	Perform post-conversion procedures	3.0	2.2	2.3	11	2
B.		MAINTAIN VEHICLE'S GASEOUS FUEL SYSTEM	Importance	Difficulty	Level	Points	Items
	13	Check/change fluid levels	1.8	1.0	1.0	7	1
	14	Recertify cylinders	2.5	2.3	2.7	12	2
	15	Inspect fuel system	3.0	1.5	1.8	11	2
	16	Inspect fuel storage vessels and brackets	2.8	1.7	1.8	11	2
	17	Check/tighten/replace hoses	2.2	1.2	1.0	8	2
	18	Replace air/fuel filters	2.2	1.0	1.0	8	2
	19	Perform emissions testing	2.8	2.7	2.3	13	2
C		TROUBLESHOOT SUPPLEMENTAL SYSTEMS	Importance	Difficulty	Level	Points	Items
	20	Perform preliminary vehicle assessment	2.7	2.0	1.8	11	2
	21	Troubleshoot OEM computer support	2.8	2.8	2.5	13	2
	22	Troubleshoot ignition timing enhancer	2.7	2.5	2.2	12	2
	23	Troubleshoot fuel control processor	2.8	2.8	2.5	13	2
	24	Troubleshoot automatic fuel select device	2.7	2.3	2.3	11	2
	25	Troubleshoot fuel use hour meters	2.0	2.0	2.0	9	2
	26	Troubleshoot combustible gas detector	1.8	2.2	2.0	9	2
	27	Troubleshoot fuel level indicators	2.7	2.0	2.0	11	2
	28	Troubleshoot ignition and starter interlock	2.5	2.3	2.0	11	2
	29	Troubleshoot bi-fuel selector switch	2.5	2.2	1.8	11	2
	30	Troubleshoot cooling system interface	2.5	1.8	1.8	10	2
D		TROUBLESHOOT FUEL SYSTEM COMPONENTS	Importance	Difficulty	Level	Points	Items
	31	Troubleshoot tank/cylinder	2.7	1.7	1.5	11	3
	32	Troubleshoot pressure relief valve	2.7	1.3	1.7	11	3
	33	Troubleshoot filter and lockoff	2.5	1.7	1.7	11	2
	34	Troubleshoot regulator/converter	2.8	2.2	2.0	13	3
	35	Troubleshoot air valve mixer	2.7	2.5	1.8	14	3
	36	Troubleshoot venturi	2.2	1.7	1.8	10	2
	37	Troubleshoot spray bar	2.3	1.5	2.0	10	2
	38	Troubleshoot injector	2.7	2.5	2.2	14	3
	39	Troubleshoot spud-in	1.5	1.4	1.8	8	1
	40	Troubleshoot base plate venturi	1.8	2.0	1.8	10	2
	41	Troubleshoot lift plate	1.7	1.8	1.8	9	2

E		TROUBLESHOOT EMISSION CONTROL DEVICES	Importance	Difficulty	Level	Points	Iten
	42	Troubleshoot ignition systems	3.0	3.0	2.3	8	
	43	Troubleshoot O2 sensor	3.0	2.2	2.3	6	
	44	Troubleshoot MAP sensor	2.8	2.2	2.3	6	
	45	Troubleshoot RPM sensor	2.8	2.2	2.3	6	
	46	Troubleshoot TP sensor	3.0	2.2	2.3	6	
	47	Troubleshoot ECT sensor	2.8	2.2	2.3	6	
	48	Troubleshoot IAT sensor	2.8	2.2	2.3	6	
	49	Troubleshoot VS sensor	2.8	2.2	2.3	6	
	50	Troubleshoot knock sensor	3.0	2.2	2.3	6	
	51	Troubleshoot EGR valve position sensor	2.8	2.2	2.3	6	
	52	Troubleshoot CKP sensor	2.8	2.2	2.3	6	
	53	Troubleshoot MAF sensor	2.8	2.2	2.3	6	
	54	Troubleshoot IAC actuator	2.8	2.2	2.3	6	
	55	Troubleshoot EVAP cannister purge actuator	2.8	2.2	2.3	6	
	56	Troubleshoot EGRV actuator	2.8	2.2	2.3	6	
	57	Troubleshoot AIR bypass/diverter actuator	2.8	2.2	2.3	6	
	58	Troubleshoot fuel injectors actuators	3.0	2.2	2.3	6	
	59	Troubleshoot fuel control regulators	3.0	2.2	2.3	6	
	60	Troubleshoot ICM device	2.8	2.2	2.3	6	
	61	Troubleshoot TCC actuator	2.8	2.2	2.3	6	
F		REPAIR SYSTEMS	Importance	Difficulty	Level	Points	Iten
	62	Repair/replace valves and gauges	2.7	1.5	1.5	11	
	63	Repair/replace fuel injection/carburetion system	2.7	2.8	2.2	14	
	64	Repair/replace electrical connections/components	2.8	2.3	2.2	13	
	65	Repair/replace pressure regulation devices	2.8	2.0	2.0	12	
	66	Repair/replace brackets	2.3	1.2	1.2	9	
	67	Repair/replace venting systems	2.5	1.3	1.3	10	
	68	Repair/replace ignition systems	2.7	2.3	2.0	13	
	69	Repair/replace cooling system components	2.2	1.3	1.5	9	
	70	Perform fuel supply leak test	2.7	1.5	1.5	11	
G		REPAIR/REPLACE EMISSION CONTROL DEVICES	Importance	Difficulty	Level	Points	Iten
	71	Repair/replace thermal reactor/catalytic converter	2.7	2.2	2.0	15	
	72	Repair/replace input sensors or related equipment	3.0	2.7	2.3	18	
	73	Repair/replace actuators	3.0	2.5	2.2	17	
H		PERFORM MISCELLANEOUS TASKS	Importance	Difficulty	Level	Points	Iten
	74	Maintain supply inventory	2.3	2.2	1.7	9	
	75	Operate digital VOM	3.0	1.8	1.7	10	
	76	Operate breakout box	2.7	2.5	2.3	11	
	77	Perform housekeeping tasks	2.3	1.2	1.0	7	
	78	Operate emissions analyzer and interpret resulting data	2.8	2.5	2.5	11	
	79	Perform storage and fuel handling	3.0	1.5	1.0	9	
	80	Identify federal, state, and local regulations	3.0	2.5	2.3	11	
	81	Communicate with end users	2.7	2.7	2.2	11	
	82	Handle hazardous material	2.8	2.0	1.3	10	
	83	Perform documentation	2.7	2.0	1.3	10	
I		DEMONSTRATE TECHNICAL KNOWLEDGE/PERFORM TRAINING	Importance	Difficulty	Level	Points	Iten
	84	Plan training sessions	3.0	2.0	3.0	12	
	85	Deliver training sessions	3.0	2.0	3.0	12	
	86	Evaluate trainee performance	3.0	2.0	3.0	12	
	87	Identify fuel characteristics	2.8	2.5	1.7	13	
	88	Trace history of industry	2.2	1.7	1.5	10	
	89	Distinguish differences between gasoline and alternative fuels	2.5	1.8	1.3	11	
	90	Determine need for conversion	2.5	1.8	1.7	11	
	91	Identify environmental effects	2.7	2.0	1.7	12	
	92	Identify economic benefits	2.5	2.0	2.0	11	
	93	Compare conversion and maintainence cost savings	2.3	2.5	2.2	12	
	94	Identify R&D companies	1.8	1.5	2.5	8	
	95	Identify source of supply and distribution	2.3	2.0	1.8	11	
	96	Use technical terminology	3.0	1.5	1.3	11	
	97	Remain technically updated	3.0	2.5	2.0	14	

GLOSSARY

CNG-LPG Model Curriculum Outlines for Entry Level, Journeyman and Master Technician/Trainer.

AIR Bypass/Diverter Actuator -- Thermal Air By-Pass/Thermal Air Diverter Actuator
CFM -- Cubic Feet per Minute
CNG -- Compressed Natural Gas
CKP Sensor -- Crankshaft Position Sensor
CPR -- Cardio-Pulmonary Resuscitation
DB -- Decibels
Digital VOM -- Digital Volt-Ohm Meter
DOE -- Department of Energy (U.S. Government)
DVOM -- Digital Volt-Ohm Meter
ECM -- Engine Control Module
ECT Sensor -- Engine Coolant Temperature Sensor
EEOC -- Equal Employment Opportunity Commission (U.S. Government)
EGR Valve -- Exhaust Gas Recirculation Valve
EGRV Actuator -Exhaust Gas Recirculation Valve Actuator
EPA -- Environmental Protection Agency (U.S. Government)
EVAP Canister Purge Actuator -- Evaporative Emission Canister Purge Actuator
EGR Valve Position Sensor -- Exhaust Gas Recirculation Valve Position Sensor
GVW -- Gross Vehicle Weight
H_2O -- Water
HAZMAT -- Hazardous Materials
IAC Actuator --Idle Air Control Actuator
IAT Sensor -- Intake Air Temperature/Air Change Temperature Sensor
ICM Actuator --Ignition Control Module Actuator
KOEO -- Key On, Engine Off
MAF Sensor -- Mass Air Flow Sensor
MAP Sensor -- Manifold Absolute Pressure Sensor
MSDS -- Material Storage Data Sheets
NFPA -- National Fire Protection Association
NOID Lamp -- Solenoid Lamp
NPT -- National Pipe Thread
OC -- Oxidation Catalytic Convertor
O_2S -- Oxygen Sensor
OBD Tester -- On-Board Diagnostics Tester
OEM -- Original Equipment Manufacturer
OSHA -- Occupational Safety and Health Administration (U.S. Government)
P & C -- Propane and CNG
P -- Propane
PCM -- Powertrain Control Module
PPE -- Personnel Protection Equipment
PRD -- Pressure Relief Device
PSIG -- Pounds per Square Inch Gauge
R & D -- Research and Development
RPM Sensor -- Revolutions Per Minute (Engine Speed) Sensor
RTV Sealant -- Room Temperature Vulcanizing Sealant
SARA -- Title III -- Superfund Amendments and Reauthorization Act

Glossary, page 2

TCC Actuator -- Torque Converter Clutch Actuator
TP Sensor -- Throttle Position Sensor
VIN --Vehicle Identification Number
VS Sensor -- Vehicle Speed Sensor
WOTS -- Wide Open Throttle Switch

PRELIMINARY NATIONAL INFORMATION DISSEMINATION PLAN

SECTION 411 ENERGY POLICY ACT OF 1992

Certification of Alternatively Fueled Vehicles (AFV)

Technician Training Programs

Prepared for U.S. DOE

By

American Society of Advanced Fuels Technology, Inc.

Under Cooperative Agreement #DE-FC36-94GO10010

October 1994

PRELIMINARY NATIONAL INFORMATION DISSEMINATION PLAN

Introduction

This preliminary national dissemination plan is designed to provide a systematic approach for informing training providers and other interested parties about EPACT 1992, Section 411 requirements: certification standards for AFV training programs, application process, and model curriculum outlines for LPG and CNG at three levels -- entry, journeyman, master technician/train-the-trainer.

Reaching the Target Audiences

Several methods can be used to reach target audiences including:

- Preparation of information packets for dissemination to training providers and other interested parties
- Radio and TV public services announcements (PSAs)
- Participation in national automotive speaker's bureau which is now in formation
- News releases and feature articles to:
  - -- Technical/industry media including newsletters, magazines, journals
  - -- Academic media including newsletters, magazines, journals
  - -- E-mail, database networks and wire services
  - -- Education and training institutions and associations
  - -- Technical and professional societies and associations
  - -- Industry and trade associations
  - -- OEMs, equipment manufacturers, fabricators, and vehicle converters
- Participation as speakers and panelists at conferences, seminars, workshops, and briefings related to AFVs, automotive education, alternative fuels, fleet management and conversion, etc.
- Use of "merchandise premiums" such as caps, key chains, mugs, pens, pins, decals, etc. in conjunction with U.S. DOE's scholarship and certification activities.
- Regional one-day briefing workshops conducted by the certifying agency throughout the country over a 6 to 12 month period.

Identifying the Target Audiences

The following entities and publications are broadly representative, but are not inclusive of all the avenues by which training providers and others may receive information about Section 411 requirements. Complete listings with addresses and contact persons, to be included in the final, comprehensive national dissemination plan.

Preliminary Dissemination Plan
October 1994

EDUCATION AND TRAINING INSTITUTIONS AND ASSOCIATIONS

American Association of Community Colleges (AACC)
American Vocational Association (AVA)
California Automotive Teachers Assn. (CATA)
Colorado St. Univ., Dept. of Industrial Sciences
Distributive Education Clubs of America (DECA)
Equipment and Tool Institute (ETI)
Federation of Qualified Automotive Technicians (FQAT)
Institute for Media Education (IME)
International Technology Education Association (ITEA)
International Television Association (ITA)
National Association of College Admissions Counselors (NACAC)
National Association of Secondary School Principals (NASSP)
National Association of State Directors of Vocational Education (NASDVE)
National Automotive Technicians Education Foundation (NATEF)
National Institute of Automotive Service Excellence (ASE)
National School Transportation Association (NSTA)
NGV Institute
North American Council of Automotive Teachers (NACAT)
Northwestern College
OEM Partnership Programs with Education, such as Chrysler (CAPS), Ford (ASSET), General Motors (ASEP), Honda (PACT), Nissan (PROCAP), and Toyota (T-TEN)
Oklahoma State University, Okamulgee
State Departments of Education -- K-12
Univ. of California, Riverside CE/CERT
Vehicle Research Institute, Western Washington Univ.
Vocational Industrial Clubs of America (VICA)

TECHNICAL/PROFESSIONAL SOCIETIES AND ASSOCIATIONS

Assn. of Local Air Pollution Control Officials (ALAPCO)
Automotive Training Managers Council (ATMC)
California State Automobile Association (CSAA)
Car Care Council (CCC)
Clean Air Vehicle Association (CAVA)
Coalition for Safer, Cleaner Vehicles (CSCV)
Coordinating Committee for Automotive Repair (CCAR)
Society of Automotive Engineers (SAE)
Society for Technical Communication (STC)
Transportation Data Coordinating Committee (TDCC)
State and Territorial Air Pollution Program Administrators (STAPPA)
Union of Concerned Scientists (UCS)

INDUSTRY AND TRADE ASSOCIATIONS

Air and Waste Management Association (AWMA)
American Automobile Association (AAA)
American Automobile Manufacturers Association (AAMA)
American Gas Association (AGA)
American Methanol Institute (AMI)
American Trucking Association (ATA)
Association of Diesel Specialists (ADS)
Association of International Automobile Manufacturers (AIAM)
Automotive Booster Clubs, International (ABCI)
Automotive Engine Rebuilders Association (AERA)
Automotive Parts and Accessories Association (APAA)
Automotive Parts Rebuilders Association (APRA)
Automotive Service Association (ASA)
Automotive Service Industry Association (ASIA)
California NGV Coalition (CNC)
Compressed Gas Association (CGA)
Council on Alternative Fuels (CAF)
Engine Manufacturers Association
Equipment Manufacturers Association (EMA)
Governors' Ethanol Coalition (GEC)
Inter-Industry Conference on Automobile Collision Repair (IACAC)
Intermodal Transportation Association (ITA)
Manufacturers of Emission Controls Association (MECA)
Motor and Equipment Manufacturers Association (MEMA)
National Association of Fleet Administrators (NAFA)
National Association of Truck Stop Operators (NATSO)
National Automobile Dealers Association (NADA)
National Gas Vehicle Producers Association (NGVPA)
National Propane Gas Association (NPGA)
National Soydiesel Development Board (NSDB)
NGV Coalition
Propane Vehicle Council (PVC)
Service Station Dealers of America (SSDA)
Specialty Equipment Manufacturers Association (SEMA)

PUBLICATIONS

Air and Waste
AG Week
Alternative Fuels in Trucking
Alternative Fuels Insider
American Methanol Institute News
Automotive Fleet
Automotive News
Autoweek
BPN (Butane-Propane News)

California Fleet News
California NGV Coalition News
CAR-EPA News
CALSTART News Notes
Car and Driver
CARB News
Clean Air Transportation Report
Clean Fuels Report
Energy Conservation News
Engine Manufacturers Association News
Federal Agency Newsletters e.g., DOE, EPA, DOL, Education Dept., DOL, DOD, DOT
Fleets and Fuels
Fuels for the Future News
Gas Daily
Green Car Journal
Journal of Commerce
Motor
Motor Age
Motor Trend
Natural Gas Fuels
Natural Gas Week
Nebraska Energy Quarterly
NGV Institute News
NGV News
Octane Week
Oxy-Fuel News
State Agency Newsletters i.e., state departments of energy, education, environmental protection, transportation, et al.
Texas General Land Office News
The Energy Report
Traffic World
Utility Fleet Management
21st Century Fuels

E-MAIL, DATABASE NETWORKS, ELECTRONIC BULLETIN BOARDS AND WIRE SERVICES

Alternative Energy Network Online Today
Business Wire
Clean Air Network Online Today
Comline Transportation Wire
Commercial On-Line Networks, such as CompuServe, Dialog, Prodigy
Internet
PR Newswire
Toyota T-Ten Bulletin Board
U.S. Newswire

Preliminary Dissemination Plan
October 1994

Initial Implementation Strategies and Proposed Timelines

The following action items, when coordinated and undertaken over a well planned time schedule, represent a comprehensive strategy for national dissemination of key information concerning Section 411, EPACT 1992.

1. Preparation of information packets for distribution to training providers upon request. There could be two types of packets:

   A. Initial Packet - Should contain the following information:
      - General description of certification requirements for AFV training programs(s) offered for light and medium duty vehicles at three technician levels: entry, journeyman and master technician/trainer.
      - Summary of model curriculum outlines.
      - Brief description of the U.S. DOE CHAMP Team Scholarship Program.
      - Instructions for requesting a full certification/scholarship information packet.
      - Master schedule for 12 regional workshops designed to inform training providers about certification procedures and requirements.

   Produce in final form - Month 1.

   B. Full Information Packet - Should contain the following:
      - All information necessary for training providers to initiate the certification process: Users' Guidebook, Self-Study Report Form, Weighted Example and Model Curriculum Outlines.
      - Master schedule of regional certification orientation workshops for training providers.
      - Complete information about the national U.S. DOE CHAMP Team Scholarship Program.

   Produce in final form - Month 2.

2. During Month 2, send initial information packets to the following for inclusion in their regular mailings/ communications to their members/constituents:

   - CHAMP Team members
   - Vocational educational and training institutions and associations.

- Industry and trade associations representing OEMs, equipment manufacturers/suppliers, fuel providers, fleet owners/operators, etc.
- Technical/professional societies and associations
- E-mail, database networks, electronic bulletin boards, and wire services

3. During months 3 through 11, continually develop news articles, press releases, special interest feature stories and related information pieces for dissemination to the technical, industry, and academic media for placement in their publications; e.g., newsletters, magazines, house organs, etc.

4. During months 2 through 11, send full information packets to training providers requesting same.

5. During months 3 through 9, conduct 12 one-day regional workshops for training providers and other interested parties seeking information regarding the certification process, procedures, and requirements for AFV technician training programs. These informational workshops will afford attendees the opportunity to raise specific questions and to obtain answers from the workshop leader(s). In addition, the workshops will address the U.S. DOE CHAMP Team Scholarship Program purpose, operation, and application and awards process.

Certification of Alternatively Fueled Vehicle (AFV) Automotive Technican Training Programs

SELF-STUDY REPORT FORM

Prepared by:
American Society of Advanced
Fuels Technology, Inc.
P.O. Box 9600
Alpine, Texas 79831

for
U.S. Department of Energy
Under
Cooperative Agreement #DE-FC36-94GO10010

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Self-Study Report Form

An eligible training provider must initiate a self-study process which provides an opportunity for the certification applicant to evaluate itself against national standards. There are seven program standards: five mandatory and two non-mandatory. Mandatory standards contain the word "must" and are to be construed as essential requirements. Non-mandatory standards contain the word "should" and are to be construed as highly desirable attributes which add strength and quality to the training program. Within these seven standards, there are 27 categories, which contain questions pertinent to certification and over which 1,000 points have been distributed proportionately. Each standard and category has been weighted by a team of experts for its relative importance in certifying AFV technician training programs.

Seventy-five percent of the points in the five mandatory standards must be achieved on the self-study for the training provider to be eligible for a site visit by the certifying agency review team.

A low score in the two non-mandatory standards will not be used in determining eligibility for a site visit. However, achievement of high scores on the two non-mandatory standards will be recommending in those instances where compliance with the five mandatory standards is marginal or borderline.

Instructions

Evaluate your training program by answering the questions in the Self-Study Report form. Please strive for objectivity in responding to each question using the critieria defined on the 4-to-1 scale as follows:

4	Exceptional, Above Average
3	Acceptable, Average
2	Somewhat Acceptable, Needs Improvement
1	Unacceptable

SELF STUDY REPORT FORM

Self–Study Rating 4, 3, 2 or 1

Standard One——Purpose

National gaseous fuels training programs must have clearly stated program performance goals and must be related to the needs of the technicians, employers, and vehicle owners/operators.

A. Program Purpose

–Evidence of clearly stated program performance goals

1 Does the statement of purpose indicate that the training provider's mission is to provide instruction which qualifies people for employment or advancement in the alternatively fueled vehicles (AFV) industry?

2 Does the statement of purpose indicate that the program's performance goals reflect the needs of the technicians to be trained and the needs of employers and vehicle owners/operators to have access to trained AFV technicians?

Standard Two--Instruction

Instruction must be systematic and reflect program goals. A task list and specific performance objectives with criterion–referenced measures must be used. Support materials consistent with program goals and performance objectives must be available to staff and trainees

A. Program Plan

–Evidence that curriculum is logically sequenced
–Evidence that goals articulate with curriculum
–Evidence that goals are measurable

1 Is the instructional program organized to provide trainees with the knowledge and skills development necessary for employment at the level of the training program; that is, entry, journeyman or master technician/trainer?

2 Have specific competencies been organized into a logical sequence for the program?

3 Have prerequisite knowledges (math, communication, technology, etc.) been identified and integrated, as required, to assure trainee success in the content area?

4 Does the program plan reflect the most current technologies (including facilities, instructional staff, curriculum, budget, administration, etc.)?

5 Is there evidence that the program content is updated annually?

6 Does the instructional program reflect the needs of the vehicle and equipment manufacturers and owners/operators?

7 Is there evidence of on–going coordination with and support from the vehicle and equipment manufacturers?

B. Individualized Training Plans

–Evidence that trainees are provided a copy of an individualized training plan

1 Is each trainee provided a planned sequence of courses and/or tasks necessary to complete the program successfully?

2 Are trainees provided with individual progress sheets indicating tasks that have been mastered?

C. Trainee Recordkeeping System

–Evidence of permanent trainee record keeping system

1 Are performance records of trainees permanently maintained?

2 Are transcripts and/or certificates of trainee performance available to trainees and employers (with written permission of trainee)?

D. Instructional Load

–Evidence of appropriate instructional load
–Evidence of appropriate trainee–instructor ratio consistent with quality educational norms and prevailing safety practices

1 Is there a plan to assure that a qualified instructor is available at all times? ☐

2 Is the trainee–instructor ratio sufficient for individual interaction and safety? ☐

3 Does the instructor workload allow for opportunities to plan, develop, and evaluate the program? ☐

4 Do workload assignments accommodate instructors' involvement in administrative activities, including curriculum development, committee work, advising, counseling, tutoring, etc.? ☐

5 Is there evidence that the workload permits on–going coordination with industry? ☐

E. Curriculum

–Evidence that curriculum is consistent with nationally developed task lists and provides adequate time to accomplish program objectives
–Evidence of an adequate balance between lecture and hands–on lab experiences

1 Is there evidence that the program content contains the duties, tasks, and steps defined in the nationally developed model curriculum outline for the level of training offered; that is, entry, journeyman, master technican/trainer?

2 Is the curriculum organized to provide knowledge and skills development necessary for employment at the level of the training provided?

3 Have the specific trainee outcomes (or competencies) been identified?

4 Is the curriculum organized to ensure individual trainee participation?

5 Are courses or units of instruction based upon defined and measurable trainee competencies required for employment?

6 Do instructors follow updated lesson plans to assure that all material is covered?

7 Is instructional time adjusted to allow for mastery of the content?

8 Does the curriculum provide for sufficient classroom time and hands–on lab activities (including but not limited to co–op and apprenticeship) to permit trainees to achieve the learning outcomes?

9 Are applied math and science, as well as communications and interpersonal skills, provided for in the program?

10 Are there written policies which stipulate the restrictions that apply to live work such as approvals, institutional/organizational liability and handling of funds?

11 Is the live work related to training for the acquisition of occupational skills which the program purports to develop, and is it assigned to individuals, or to groups of trainees, for the purpose of such skills development?

12 Does the program provide technicians at all levels with clear, concise instruction on the proper and safe operation, installation, repair, and maintenance procedures and techniques for alternatively fueled vehicles?

F. Trainee Performance Standards

–Evidence that performance standards are consistent with learning objectives including knowledge, skills, and the ability to perform tasks

1 Is there a system for evaluating trainee achievement based upon established learning outcomes?

2 Are specific criteria defined to measure trainee attainment of performance objectives?

3 Are trainees evaluated for their knowledge, skills, and ability to perform tasks?

4 Are performance standards based upon nationally defined and measurable trainee competencies required for employment?

G. Health and Safety Standards

–Evidence that health and safety training is integrated into the instructional program

1 Is health and safety training integrated into all aspects of the instructional program?

2 Are health and safety practices, procedures, and facilities in compliance with all applicable federal, state and local regulations?

3 Are health and safety training and testing provided prior to lab experiences?

H. Provisions for Individual Differences

–Evidence of accommodating learning differences

1 Are learning experiences individualized so that all trainees are provided an opportunity to achieve program objectives?

2 Is a formal pretesting process used to assess trainee abilities in reading, mathematics, and mechanical skills to evaluate readiness and to assure a reasonable probability of success?

3 Is instruction provided to trainees needing remediation in the areas of reading, mathematics, and mechanical skills?

4 Does the program provide for 'reasonable accommodation' as required by the Americans With Disabilities Act (ADA)?

I. Testing

–Evidence that written and performance tests are administered
–Evidence that tests are criterion–based

1 Are both written and performance–based tests used to validate trainee competencies?

2 Are continuous efforts made to determine if the evaluation methods used to measure trainee achievement are valid and reliable?

3 Is there a procedure for evaluating trainee performance on live work projects and/or co–op and apprenticeship projects?

4 Are trainees able to pass a national written and performance test based on the national model curriculum outline for the appropriate level; that is, entry, journeyman, or master technician/trainer?

J. Program Evaluation

–Evidence of a systematic course and instructor evaluation process that includes trainee input

–Evidence of an on–going program monitoring and evaluation process

1 Is there a continuous and systematic process to evaluate the curriculum, the lab tools and equipment, and the competencies of each trainee who completes the program?

2 Are trainee evaluations used to assess instructor effectiveness and program quality?

3 Is the advisory committee/board actively involved in program planning and evaluation?

4 Do instructors use trainee followup data to make judgments regarding program content, length and relevancy?

5 Does the history of trainee enrollments, retention, job placement, and followup data indicate that adequate planning and evaluation are integral components of the program?

6 Is job followup information collected on completers annually for a three–year period?

7 Is followup information collected on dropouts regarding reasons for leaving?

8 Is followup information on each completer or dropout used as a means of measuring the success of the institution/organization in meeting the training program objectives?

9 Is the followup information collected sufficient to identify salary ranges, sex, race, etc., of former trainees?

10 Is there evidence to indicate that the placement and followup information is used to improve the quality of the training program?

11 Does the followup process include information on employer satisfaction with trainees as compared to the performance of employees who have not had similar training?

12 Is the trainee pass rate on the national test used in evaluating program effectiveness?

K. Training Materials

–Evidence of appropriate instructional materials (training aids, audiovisual materials, lab components)

–Evidence of current technical materials

1 Are quality instructional materials available and provided to the trainees in quantities sufficient to meet program objectives?

2 Are the instructional materials of sufficient variety to accommodate different trainee learning styles?

3 Are current service information and technical bulletins available and accessible to trainees in the lab area?

4 Are textbook copyright dates within five years?

5 Are current and industry–related periodicals available for trainee and instructor use?

6 Is there evidence that available instructional materials are nondiscriminatory in content?

7 Are consumable supplies and related training materials adequate and in quantities sufficient to meet program objectives?

8 Are AFV technical components and equipment used in support of the program legally certified and reviewed annually by the instructional staff?

9 Is documentation regarding certification of technical components and equipment available and on file?

10 Are donators of technical components and equipment required to provide certification documentation?

Standard Three—Instructional Staff

The instructional staff must have technical competency and must be afforded regular opportunities for professional/technical development

A. Technical Competence

—Evidence that instructional staff is technically competent using the following criteria (1) adequate work experience; (2) holding appropriate certification(s); and (3) possessing appropriate communication and teaching skills

1 Do instructors have documented relevant work experience, have they successfully completed relevant technical coursework, and have they completed an appropriate train—the—trainer program successfully?

2 Do instructors hold appropriate and valid certification(s) or equivalents for their content area (including but not limited to state certifications, industry certifications in electrical, engine performance, engines, advanced engine performance, and gaseous fuels, such as CNG)?

3 Do instructors possess appropriate communications and teaching skills as attested to by such mechanisms as instructor peer review and trainee evaluations of instruction?

B. Staff Development

–Evidence of instructor(s) maintaining technical and teaching proficiency and participating in professional development activities

1 Are instructors provided with opportunities for inservice training and professional skills development at least annually?

2 Are instructors provided with recent, up–to–date technical and training materials to enable them to maintain currency in their content field?

Standard Four--Trainee Services

Appropriate trainee services should be provided by the institution/organization, including but not limited to admissions counseling, program advisement, recordkeeping, placement and followup.

A. Recruitment, Admissions Counseling, and Program Advisement

--Evidence of systematic and consistent recruitment activities and admissions counseling and program advisement services

1 Are admissions policies and standards clearly expressed, openly displayed and readily available to applicants, trainees, and the general public?

2 Are admissions policies and standards free of bias, discrimination and role stereotyping that would adversely affect protected classes?

3 Are recruitment and admissions materials up-to-date and do they clearly describe the program completion requirements, all associated costs, licensing and/or certification requirements (state and federal), and potential job opportunities?

4 Are job-related tests or test batteries available to assist with the selection and placement of trainees in programs for which there is a reasonable chance for success?

5 Are comprehensive admissions counseling and program advisement services provided to trainees?

B. Placement, Followup and Occupational Enhancement Services

–Evidence of organized, systematic placement, followup and career enhancement services

1 Does the institution/organization offer job counseling, placement and followup services to trainees? ☐

2 Is there an up–to–date inventory of employers and employment opportunities to facilitate placement of current trainees? ☐

3 Does the institution/organization provide co–op or apprenticeship opportunities for trainees? ☐

4 Are trainees encouraged to take industry recognized certification tests for which they are eligible? ☐

5 Does the institution/organization have an operational plan which describes its available placement services? ☐

Standard Five—Facilities

The physical facilities must permit achievement of the program goals and performance objectives and must comply with all applicable federal, state and local regulations.

A. Health and Safety

—Evidence of appropriate facilities and equipment including:

Adequate ventilation

1 Is there an adequate ventilation system?

First aid

1 Are emergency eye—wash stations available in all training areas housing caustic or toxic substances?

2 Are first aid kits available, properly stocked, easily accessible, and clearly marked?

3 Is there a plan whereby instructors and trainees know what to do and whom to contact in case of medical emergency or injury?

Hazardous materials storage and use

1 Are storage facilities adequate to accommodate solvents, flammable gases, combustible liquids, paints and solvents, etc.?

2 Does the program comply with Right—to—Know regulations, including Materials Safety Data Sheets (MSDS)?

3 Are hazardous materials appropriately labeled?

4 Is the storage area secured?

5 Are adequate spill response materials immediately available?

6 Are hazardous and toxic substances properly stored and separated appropriately?

Facility Signage

1 Are hazardous materials storage and work areas and substances clearly identified?

2 Are all exits clearly marked and free from obstructions?

Fire Protection

1 Do all buildings contain fire protection devices?

2 Is all fire extinguishing equipment currently inspected and certified?

3 Is there appropriate fire suppression and safety equipment (including but not limited to fire blankets, automated fire suppression equipment, emergency shut–off valves and switches)?

4 Do instructional areas contain operating smoke detectors, gas sensors, etc.?

Lighting

1 Is there explosion–proof lighting installed?

2 Is emergency lighting installed as required?

3 Is lighting adequate for safety and task performance?

Safety inspections

1 Are all required safety inspections performed and documented (including but not limited to electrical, fire extinguishing equipment, gas safety sensors, smoke detectors)?

Traffic area identification

1 Are traffic areas clearly marked and color coded?

Availability of electrical disconnect systems

1 Are emergency shut–off switches for machines and equipment easily identified and reasonably accessible from the operator's position?

2 Do emergency disconnect systems operate properly?

B. Maintenance

–Evidence of regular maintenance program to ensure usability of facilities

1 Is there an effective plan for operating, maintaining and upgrading the facility and its related equipment?

2 Does the institution/organization place emphasis on proper maintenance, housekeeping, and inspection of all emergency and safety equipment?

3 Does the institution/organization provide adequate materials, equipment, supplies and personnel to operate and maintain its facilities?

4 Are all floors kept in good repair, free from protruding nails, splinters, holes, loose boards, obstructions, and are they treated to prevent slipping?

5 Are electrical receptacles and plugs in the facility, as well as those on machinery and equipment, in safe operating condition?

6 Are the shops and classrooms kept clean and orderly?

7 Is the parking lot clean, orderly, safe and secure?

8 Are all storage areas (vehicle, equipment and hazardous/toxic materials) clean and orderly?

C. Instructional and Support Areas

–Evidence of adequate training stations, lab space, classroom and related facilities

1 Is the legally required minimum space (square feet) per trainee allocated for laboratory experiences?

2 Is the legally required minimum space (square feet) per trainee allocated for classroom learning experiences?

3 Is there sufficient space in labs and shops to minimize hazards associated with nearby machinery and/or equipment?

4 Are classrooms and labs separated? If not separated, are activities scheduled to prevent simultaneous usage?

5 Are instructors provided with adequate office space?

6 Are adequate and accessible restroom facilities provided for trainee and staff use?

D. Facility Security

–Evidence that the facility is secure from vandalism and theft

1 Does the institution/organization have a security program?

2 Is there a method of accountability for hazardous materials, equipment, tools, supplies, keys, and vehicles?

3 Is there a method to assure security of trainee and staff personal materials?

Standard Six—Equipment

Equipment and tools used in the training program must be of the type and quality found in the industry and must also be the type needed to provide training to meet the program goals and performance objectives

A. Equipment Safety

—Evidence of safety equipment
—Evidence of OSHA regulation compliance

1 Are machinery, tools, and/or other equipment maintained in a clean and safe operating condition? ☐

2 Are instructional tools, instruments, machinery and equipment properly cleaned, and as appropriate, oiled, with cutting edges sharpened, stored and ready for use? ☐

3 Are personal protection devices such as rubber gloves, eye and ear protectors, aprons, respirators, etc., available and used? ☐

4 Where applicable, are all machinery and equipment secured to assure proper operation and safety? ☐

5 Are all machinery and equipment provided with proper safety devices which are in working order and used whenever the machinery and equipment are operated? ☐

6 Are equipment and machinery work areas clearly marked? ☐

B. Equipment Type, Quality and Quantity

–Evidence of appropriate inspection, diagnostic, and evaluation equipment and accessories

1 Are sufficient equipment and/or learning stations provided to allow each trainee adequate scheduled time for practice?

2 Are all required equipment and materials, as specified in the model curriculum outlines, available and in sufficient quantities for the number of trainees enrolled in the program?

3 Are training supplies (such as consumable materials, oil, coolants, etc.) available in sufficient quantities?

4 Is there a plan for ordering, purchasing and maintaining the necessary inventory of equipment, parts, supplies and tools?

Standard Seven—Administration

Program administration should ensure that administrative activities support and promote the goals of the program

A. Administrative Structure

—Evidence of well functioning administrative structure
—Evidence of well defined roles, responsibilities and authority of all personnel
—Evidence of commitment to diversity and affirmative action

1 Does the institution/organization have a legal governing board/body responsible for its policies and procedures?

2 Have the goals and priorities of the institution/organization been identified and clearly expressed?

3 Does the legal governing board/body delegate authority for implementation of policy to persons responsible for the operation of the institution/organization?

4 Is the administration comprised of a chief executive officer/administrator (CEO/CAO) and other administrative personnel to perform duties required for the operation of the institution/organization?

5 Are lines of authority and responsibility clearly defined?

6 Are all personnel informed of the existing administrative structure, systems, policies and procedures?

7 Are all personnel policies and practices, including but not limited to, hiring, promotion and dismissal in compliance with applicable civil rights and affirmative action regulations?

8 Is there a strategic plan and planning process for the institution/organization?

9 Is the strategic plan reviewed and updated quarterly?

B. Written Policies and Procedures

–Evidence of written policies and procedures regarding the operation of the training program

1 Are there clearly written job descriptions for all employees including professional and support personnel?

2 Are institutional/organizational policies and procedures published and distributed including but not limited to:

–employee recruitment
–job descriptions
–personnel hiring
–promotion
–dismissal
–benefits
–compensation
–safety
–liability
–lab/shop operation
–purchasing and inventory management
–financial and accounting procedures and controls?

3 Is there evidence of compliance with these policies and procedures?

C. Program Advisory Committee/Board

–Evidence of a functioning program advisory committee/board

1 Is there an active advisory committee/board for the program?

2 Does the advisory committee/board include diverse representation?

3 Does the advisory committee/board meet regularly?

4 Does the advisory committee/board include program completers, representatives from business and industry, trainees, instructors, administrators and staff?

5 Are minutes of advisory committee/board meetings on file?

6 Is the advisory committee/board involved in the strategic planning process?

7 Are advisory committee/board recommendations considered and implemented when appropriate?

D. Budget

–Evidence of fiscal responsbility and control

1 Is there an adequate operating program budget?

2 Are budget status reports periodically made available to the instructional staff?

3 Does the instructional staff have input into the program's budgetary process?

4 Is the budgeting process integrated into the strategic planning process?

E. Cooperative and Apprenticeship Agreements

–Evidence of written policies and procedures for cooperative and apprenticeship programs

1 Do cooperative and apprenticeship agreements with employers help to meet the program objectives?

2 Do trainee cooperative/apprenticeship policies and procedures include a well defined plan for trainee performance, employer–trainee evaluation, and mentoring?

3 Are program staff provided with sufficient time to supervise, coordinate and monitor trainees participating in co–op/apprenticeship activities?

MODEL CURRICULUM OUTLINE

FOR

Entry Level Alternatively Fueled Vehicle (AFV) Automotive Technician Training In Light and Medium Duty CNG and LPG

Prepared by:

American Society of Advanced Fuels Technology, Inc.

for

U.S. Department of Energy

Under

Cooperative Agreement #DE–FC36–94GO10010

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MODEL CURRICULUM OUTLINE
LIGHT/MEDIUM DUTY CNG AND LPG
ENTRY LEVEL TECHNICIAN

INTRODUCTION

This model curriculum outline was developed using a turbo-DACUM (Developing a Curriculum) process which utilizes practicing experts to undertake a comprehensive job and task analysis. The job and task analysis serves to establish current baseline data accurately and to improve both the process and the product of the job through constant and continuous improvement of training.

The DACUM process is based on the following assumptions:

1. Expert workers are the best source for task analysis.
2. Any occupation can be described effectively in terms of tasks.
3. All tasks imply knowledge, skills, and attitudes/values.

A DACUM panel, comprised of six experienced and knowledgeable technicians who are presently working in the field, was given an orientation to the DACUM process. The panel then identified, verified, and sequenced all the necessary job duty areas and tasks. The broad duty categories were rated according to relative importance and assigned percentage ratings in priority order. The panel then rated every task for each of the duties on a scale of 1 to 3. A rating of 3 indicates an "essential" task, a rating of 2 indicates an "important" task, and a rating of 1 indicates a "desirable" task.

These ratings from each of the content experts were averaged to establish a consensus which formed the basis for prioritizing and/or balancing all the essential elements of a training program for the occupation. This consensus can also be used to establish specifications for the assessment of the training program.

The experts also identified and rated physical parameters (positions, mobility, arm/hand use, senses and working conditions), knowledge (calculations and measurements) and communication skills (written, oral and reading). Additionally, characteristics, attributes, attitudes and traits of workers in the occupation were rated and given a consensus ranking by the panel.

The task analysis portion was organized by retrieving each task from a predesigned template. Each step necessary to accomplish a given task was then identified and sequenced by the panel. After all rational physical and decisional steps were identified, all related knowledge (applied mathematics, calculations, applied physics, applied technology, and applied communications) were listed. Additionally, all tools, equipment and resources necessary to accomplish the task were identified. The panel then identified the purpose of the task, the consequences of inaction, and any special care or precautions which should be taken. Safety procedures and equipment were also stipulated.

JOB AND TASK ANALYSIS--AFV Automotive Technician
LEVEL 1--Summary Data

A			CONVERT VEHICLES	Fuel	Level	Tools and Equipment
	2		Prepare vehicle for conversion	P & C	1	1/2" drill and drill bits
	3		Fabricate brackets and hangers	P & C	1	Advancing timing light
	4		Install storage vessels	P&C	1	Air compressor and tools
	5		Install remote fill and relief vent equipment	P&C	1	Basic automotive tools
	6a		Install fittings per manufacturer's specifications (Propane)	P	1	Battery load tester
	8a		Install fuel lines/filters/fuel locks/valves (Propane)	P	1	Bending mandrels
	9a		Install pressure regulation systems--(Propane Converters--Vaporizers--	P	1	Body putty
			Regulators)			Breakout box
	9b		Install pressure regulation systems--(CNG primary and secondary	C	1	Broom
			regulators)			Common hand tools
						Compression tester
B.			MAINTAIN VEHICLE'S GASEOUS FUEL SYSTEM	Fuel	Level	Computers and related equipment
	13		Check/change fluid levels	P & C	1	Cutting fluids
	17		Check/tighten/replace hoses	P & C	1	Cutting tools/torch
	18		Replace air/fuel filters	P & C	1	Deburring tool
						Drill and drill bits
F.			REPAIR SYSTEMS	Fuel	Level	Dust pan
	70		Perform fuel system leak test	P & C	1	DVOM
						Electrical fittings
H.			PERFORM MISCELLANEOUS TASKS	Fuel	Level	Eye protection
	83		Perform documentation	P & C	1	FAX machine/fax--modem
						Fender/seat/steering wheel covers
I.			DEMONSTRATE TECHNICIAN KNOWLEDGE/PERFORM TRAINING	Fuel	Level	Flaring tools
	87		Identify fuel characteristics	P & C	1	Hardware and fittings
	88		Trace history of industry		1	Hole saw
	89		Distinguish differences between gasoline and alternative fuels		1	Hose cutoff saw
	90		Determine need for conversion		1	Hose end mandrel
	91		Identify environmental effects		1	Hose end swage tool
	92		Identify economic benefits		1	Jacks and jack stands
	93		Compare conversion and maintenance cost savings		1	Labor guidelines
	94		Identify R and D companies		1	Leak detector
	95		Identify source of supply and distribution		1	Lighting
	96		Use technical terminology		1	Markers--grease pencils
	97		Remain technically updated		1	Metal brake
						Metal cutting tools
						Metal shears
						Mop and bucket (solvent base)
						Mop and bucket (water base)
						MSDS documentation
						Nibbler
						OEM quality replacement components
						Oil and coolant containment barrier
						OSHA rules and regulations
						Paint
						Pressure gauge
						Reciprocating saw
						Recycling/recovery equipment
						RTV Sealent
						Scan tool
						Shop rags
						Soldering equipment
						Specialized testing equipment
						Swage liner
						Tank flaring and evacuation equipment
						Tap and die
						Tape measure
						Technical manuals
						Telephone
						Thread sealent
						Thread sealing compound
						Torque wrench
						Tubing bender and cutter
						Venting hardware
						Warranty procedure checklists
						Welding equipment

Calculations	Communications	Technology	Purpose/Care	Safety
Addition/subtraction	Fax	Analog and digital circuitry	Accommodate conversion	Accuracy of readings
Angles	Interpret computerized test data	Angles	equipment	Accurate interpretation
Basic geometry	Read charts and graphs	Basic automotive theory	Cosmetics	Comply with NFPA
Basic math functions	Refer to technical manuals	Basic electrical theory	Determine fuel quantity	Component protection
Calculate discharge rates	Use telephone	Basic gaseous fuel theory	Driver safety	Don't smoke
Compute discharge volume	Verbal with client	Basic geometry	Ease of refueling	Exhaust ventilation
Convert English to metric	Verbal with co-workers	Basic mechanical principles	Ensure emissions law compliance	General shop safety
Fractions	Verbal with manufacturer	Basic mechanical theory	Ensure emissions reductions	PPE
Interpret emissions data	Verbal with supervisor	Basic metallurgy	Ensure quality performance	
Measure in inches	Written documentation	Basic physics	Ensure quality performance	
Read gauges		Combustible gas flammability limits	Maintain/validate warranty	
Read rule/measure		DOE Energy Policy Act	Protect all involved parties	
Set and read torque wrench		Dynamometer technology	Protect specialty equipment	
Use calculator		EPA Clean Air Act	Protect vehicle	
		Exhaust gas composition	Provide sufficient vehicle range	
		Fractions	Reduce liability	
		Gaseous fuels theory	Structural integrity	
		Internal combustion engines	Vehicle qualifications	
		Interpret emission control devices	Vehicle serviceability/useability	
		Lubricant specifications	Warranty compliance	
		Measure in inches		
		Metallurgy		
		Pressure and volume		
		Pressure terms and measurements		
		State/local vehicle emissions testing		
		Surface area		
		Torque and horsepower		
		Volume		
		Volume calculations		
		Welding		

JOB AND TASK ANALYSIS--AFV Automotive Technician
LEVEL 1

A			CONVERT VEHICLES	Fuel	Level	Tools and Equipment
	2		**Prepare vehicle for conversion**	P & C	1	
		a	Clean vehicle (under hood and vehicle)			Battery load tester
		b	Protect vehicle interior from soiling			Compression tester
		c	Disconnect battery and ECM			Scan tool
		d	Drain and remove conventional fuel systems, as necessary			DVOM
			for bi-fuel or monofuel applications			Common hand tools
		e	Upgrade ignition components as necessary			Jacks and jack stands
		f	Upgrade suspension as necessary			Fender/seat/steering wheel covers
		g	Upgrade fluids, as necessary			Lighting
		h	Specify vehicle components			Drill and drill bits
		i	Identify location of under-hood components			Air compressor and tools
		j	Select position for fuel storage vessels			Markers--grease pencils
		k	Select position for remote filling and pressure relief devices			Advancing timing light
		l	Reroute exhaust system, if necessary			Eye protection
	3		**Fabricate brackets and hangers**	P & C	1	
		a	Conceptualize bracket and hanger design			1/2" drill and drill bits
		b	Select protected area for installation			Cutting tools/torch
		c	Select appropriate materials			Reciprocating saw
		d	Check for appropriate clearances			Common hand tools
		e	Relocate OEM equipment, as necessary			Metal brake
		f	Bend/cut/drill bracket materials as necessary			Welding equipment
		g	Paint materials, as required			Tap and die
						Metal shears
						Cutting fluids
	4		**Install storage vessels**	P&C	1	
		a	Create bracket template			1/2" drill and drill bits
		b	Drill necessary holes using template			Hole saw
		c	Mount storage vessel bracket on vehicle with appropriate backing			Reciprocating saw
			plates			Common hand tools
		d	Isolate passenger compartment from fuel vapor, as appropriate			Nibbler
		e	Mount storage vessel			Tap and die
		f	Install valve protection equipment as required			Metal shears
		g	Install remote equipment			Cutting fluids
						Paint
	5		**Install remote fill and relief vent equipment**	P&C	1	
		a	Prepare surface	P&C		Thread sealing compound
		b	Modify vehicle to receive equipment	P&C		Hose end swage tool
		c	Install brackets	P&C		Hose end mandrel
		d	Install valving and necessary shielding	P&C		Common hand tools
		e	Install thread sealing compound as needed	P&C		Hose cutoff saw
		f	Install materials per manufacturer's specification	P&C		Torque wrench
		g	Install automatic stop-fill valve	P		Hardware and fittings
		h	Install vent apparatus	P&C		Venting hardware
		i	Install fuel level sending unit	P		Tubing bender and cutter
		j	Protect cut areas from corrosion	P&C		Flaring tools
		k	Install ignition lock switch, if applicable	C		Swage liner
						Deburring tool
						Markers--grease pencils
						Body putty
	6a		**Install fittings per manufacturer's specifications (Propane)**	P	1	
		a	Install flare fittings			Thread sealing compound
		b	Install NPT fittings			Common hand tools
		c	Apply pipe sealants (proper application required)			Hose cutoff saw

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Basic automotive theory	Maintain/validate warranty	Accuracy of readings
Convert English to metric	Verbal with supervisor	Basic gaseous fuel theory	Reduce liability	Accurate interpretation
Basic math functions	Written documentation	Pressure and volume	Vehicle qualifications	PPE
Read rule/measure	Read charts and graphs	Internal combustion engines	Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer	Analog and digital circuitry	Ensure quality performance	General shop safety
	Verbal with co-workers	Interpret emission control devices	Protect vehicle	Component protection
	Fax	Lubricant specifications	Ensure emissions reductions	Comply with NFPA
	Use telephone	Dynamometer technology	Accommodate conversion	Exhaust ventilation
	Interpret computerized test data	Torque and horsepower	equipment	
		Basic mechanical principles		
Measure inches	Refer to technical manuals	Basic automotive theory	Vehicle serviceability/useability	Accuracy of readings
Fractions	Verbal with supervisor	Basic gaseous fuel theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Surface area	Reduce liability	PPE
Angles	Read charts and graphs	Basic metallurgy	Vehicle qualifications	Don't smoke
Basic geometry	Verbal with manufacturer	Welding	Protect all involved parties	General shop safety
	Verbal with co-workers	Basic physics	Ensure quality performance	Component protection
	Use telephone/fax	Basic mechanical principles	Protect vehicle	Comply with NFPA
			Accommodate conversion	Exhaust ventilation
			equipment	
			Structural integrity	
			Cosmetics	
			Driver safety	
Measure inches	Refer to technical manuals	Basic automotive theory	Vehicle serviceability/useability	Accuracy of readings
Fractions	Verbal with supervisor	Basic gaseous fuel theory	Provide sufficient vehicle range	Accurate interpretation
Basic math functions	Written documentation	Volume	Ensure quality performance	PPE
Angles	Verbal with co-workers	Basic metallurgy	Vehicle qualifications	Don't smoke
Basic geometry		Welding	Protect vehicle	General shop safety
Compute discharge volume		Basic physics	Structural integrity	Component protection
		Basic mechanical principles	Driver safety	Comply with NFPA
				Exhaust ventilation
Measure in inches	Refer to technical manuals	Basic automotive theory	Vehicle serviceability/useability	Accuracy of readings
Angles	Verbal with supervisor	Basic gaseous fuel theory	Ease of refueling	Accurate interpretation
Fractions	Written documentation	Volume calculations	Ensure quality performance	PPE
Calculate discharge rates	Verbal with co-workers	Measure in inches	Vehicle qualifications	Don't smoke
Set and read torque wrench		Angles	Protect vehicle	General shop safety
		Fractions	Driver safety	Component protection
			Determine fuel quantity	Comply with NFPA
				Exhaust ventilation
Measure in inches	Refer to technical manuals	Measure in inches	Vehicle serviceability/useability	Accuracy of readings
Angles	Verbal with supervisor	Angles	Ease of refueling	Accurate interpretation
Fractions	Written documentation	Fractions	Ensure quality performance	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect vehicle	General shop safety

A			CONVERT VEHICLES	Fuel	Level	Tools and Equipment
	8a		**Install fuel lines/filters/fuel locks/valves (Propane)**	P	1	
		a	Plan routing and protection of fuel line components			Tape measure
		b	Install necessary tube and hose fittings			RTV sealent
		c	Plumb remote fill			Thread sealent
		d	Plumb remote relief			Basic automotive tools
		e	Install hose bulkhead, if applicable			Metal cutting tools
		d	Install hydrostatic relief valve			Drill and drill bits
		f	Install hose chafing protection, as necessary			Eye protection
		g	Install hose mounting fixtures, according to mfg. specifications			Markers--grease pencils
		h	Install filter and fuel lock or filter/fuel lock, as required			
		i	Install and properly support fuel line; allow for vehicle flexing			
		j	Install heat shields, as required or at assured minimum distance			
		k	Route hoses through vapor seal assembly, as required			
	9a		**Install pressure regulation systems--(Propane Converters--Vaporizers--**	P	1	
			Regulators)			Tape measure
		a	Plan an area for mounting converter, considering possible areas of			Markers--grease pencils
			impact			Thread sealent
		b	Attempt to mount it with the vapor outlet at the			Basic automotive tools
			lowest point of converter body, and below the highest level in the			Metal cutting tools
			cooling system. Also consider component serviceability.			Drill and drill bits
		c	Assemble the converter to the mounting bracket, with the			Eye protection
			fuel lock, if required			
		d	Install all applicable fittings			
		e	If necessary, install starting aids, control valves, etc. to the			
			converter, as per manufacturer's instructions, prior to			
			installation.			
		f	Bolt the assembly to the vehicle, using fender washers for support			
		g	Attach coolant hoses to the converter body, ensuring that one			
			line is suction and one line is pressure.			
		h	On negative pressure systems, use a thermostat on the			
			suction side			
	9b		**Install pressure regulation systems--(CNG primary and secondary**	C	1	
			regulators)			Tape measure
		a	Confirm converter is sized properly as per mfg. recommendations			Bending mandrels
		b	Install the primary regulator on the vehicle, with fittings installed			Tubing cutters
		c	Attach coolant lines to the converter, ensuring that one line is			Basic automotive tools
			pressure and one line is suction.			Metal cutting tools
		d	Attach the low pressure fuel line to the primary regulator fitting			Drill and drill bits
		e	Install the secondary regulator as per manufacturer's instructions			Eye protection
		f	Attach the low pressure fuel line to the secondary regulator fuel fitting			

Calculations	Communications	Technology	Purpose/Care	Safety
Measure in inches	Refer to technical manuals	Basic mechanical theory	Vehicle serviceability/useability	Accuracy of readings
Angles	Verbal with supervisor	Metallurgy	Warranty compliance	Accurate interpretation
Fractions	Written documentation	Basic geometry	Reduce liability	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	
			Cosmetics	
Measure in inches	Refer to technical manuals	Basic mechanical theory	Vehicle serviceability/useability	Accuracy of readings
Angles	Verbal with supervisor	Metallurgy	Warranty compliance	Accurate interpretation
Fractions	Written documentation	Basic geometry	Reduce liability	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	
			Cosmetics	
Measure in inches	Refer to technical manuals	Basic mechanical theory	Vehicle serviceability/useability	Accuracy of readings
Angles	Verbal with supervisor	Metallurgy	Warranty compliance	Accurate interpretation
Fractions	Written documentation		Reduce liability	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	
			Cosmetics	

B.			MAINTAIN VEHICLE'S GASEOUS FUEL SYSTEM	Fuel	Level	Tools and Equipment
	13		**Check/change fluid levels**	P & C	1	
		a	Verify system cooling level and condition			Basic automotive tools
		b	Verify all engine fluid levels			Shop rags
		c	Verify compatibility of fluid types with vehicle			
		d	Follow basic manufacturer's maintenance schedule			
	17		**Check/tighten/replace hoses**	P & C	1	
		a	Check hoses for wear and abrasion, age			Basic automotive tools
		b	Relieve pressure on all hoses prior to further inspection			Leak detector
		c	Ensure hose is properly secured to vehicle with approved clips			
		d	Ensure joining material intact			
		e	Inspect protective grommets			
		f	Ensure that exhaust clearances are maintained			
		g	Inspect that heat shields are maintained			
		h	Verify hose or piping appropriate for application			
		i	Verify connections are accessible and undamaged			
	18		**Replace air/fuel filters**	P & C	1	
		a	Follow vehicle manufacturers specs	P & C		Basic automotive tools
		b	Ensure filters are appropriate size for CFM ratings	C		Leak detector
		c	Retain appropriate air induction	P & C		
		d	Ensure proper filter orientation	P & C		
		e	Ensure crankcase vent line is downstream of filter element	P & C		

Calculations	Communications	Technology	Purpose/Care	Safety
Addition/subtraction	Refer to technical manuals	Basic mechanical theory	Vehicle serviceability/useability	Accuracy of readings
	Verbal with supervisor		Warranty compliance	Accurate interpretation
	Written documentation		Reduce liability	PPE
	Verbal with co-workers		Protect all involved parties	Don't smoke
			Protect vehicle	General shop safety
				Component protection
				Comply with NFPA
				Exhaust ventilation
Addition/subtraction	Refer to technical manuals	Basic automotive theory	Vehicle serviceability/useability	Accuracy of readings
	Verbal with supervisor		Warranty compliance	Accurate interpretation
	Written documentation		Reduce liability	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	
Addition/subtraction	Refer to technical manuals	Basic automotive theory	Vehicle serviceability/useability	Accuracy of readings
	Verbal with supervisor		Warranty compliance	Accurate interpretation
	Written documentation		Reduce liability	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	

F.			REPAIR SYSTEMS	Fuel	Level	Tools and Equipment
	70		**Perform fuel system leak test**	P & C	1	
		a	Verify system under operating pressure			Pressure gauge
		b	Identify area of suspected leak			Basic automotive tools
		c	Look, smell, listen, think			Leak detector
		d	Generously cover fittings with approved leak detector solution			Thread sealent
		e	Electronic leak detection			Tank flaring and evacuation equipment
		f	Bleed system pressure			
		g	Repair leak by disassembling connection			
		h	Inspect for faults			
		i	Reassemble connection			
		j	Repressurize to verify			

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Gaseous fuels theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Pressure terms and measurements	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Combustible gas flammability limits	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

H.			PERFORM MISCELLANEOUS TASKS	Fuel	Level	Tools and Equipment
	83		**Perform documentation**	P & C	1	
		a	Complete pre-conversion check sheet			Telephone
		b	Inform client of discrepancies			FAX machine/fax-modem
		c	Report conversion to appropriate authorities			Computers and related equipment
		d	Submit warranty forms to vendors			MSDS documentation
		e	Document equipment warranty			Technical manuals
		f	Maintain record keeping system			Labor guidelines
		g	Perform post-conversion checklist and attach labels			Warranty procedure checklists

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Basic electrical theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with supervisor	Exhaust gas composition	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	EPA Clean Air Act	Reduce liability	PPE
Read rule/measure	Verbal with co-workers	DOE Energy Policy Act	Protect all involved parties	Don't smoke
Read gauges		State/local vehicle emissions testing	Protect vehicle	General shop safety
Interpret emissions data			Protect specialty equipment	Comply with NFPA
			Ensure emissions law compliance	Exhaust ventilation

I.			DEMONSTRATE TECHNICIAN KNOWLEDGE/PERFORM TRAINING	Fuel	Level	Tools and Equipment
	87		Identify fuel characteristics	P & C	1	
	88		Trace history of industry	P & C	1	Mop and bucket (water base)
	89		Distinguish differences between gasoline and alternative fuels	P & C	1	Mop and bucket (solvent base)
	90		Determine need for conversion	P & C	1	Broom
	91		Identify environmental effects	P & C	1	Dust pan
	92		Identify economic benefits	P & C	1	Oil and coolant containment barrier
	93		Compare conversion and maintenance cost savings	P & C	1	OSHA rules and regulations
	94		Identify R and D companies	P & C	1	Basic automotive tools
	95		Identify source of supply and distribution	P & C	1	MSDS documentation
	96		Use technical terminology	P & C	1	Technical manuals
	97		Remain technically updated	P & C	1	Recycling/recovery equipment
						Basic automotive tools
						DVOM
						Specialized testing equipment
						Breakout box
						Soldering equipment
						Electrical fittings
						OEM quality replacement components

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Basic electrical theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with supervisor	Exhaust gas composition	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	EPA Clean Air Act	Reduce liability	PPE
Read rule/measure	Verbal with co-workers	DOE Energy Policy Act	Protect all involved parties	Don't smoke
Read gauges		State/local vehicle emissions testing	Protect vehicle	General shop safety
Interpret emission data			Protect specialty equipment	Comply with NFPA
			Ensure emissions law compliance	Exhaust ventilation

GLOSSARY

CNG-LPG Model Curriculum Outlines for Entry Level, Journeyman and Master Technician/Trainer.

AIR Bypass/Diverter Actuator -- Thermal Air By-Pass/Thermal Air Diverter Actuator
CFM -- Cubic Feet per Minute
CNG -- Compressed Natural Gas
CKP Sensor -- Crankshaft Position Sensor
CPR -- Cardio-Pulmonary Resuscitation
DB -- Decibels
Digital VOM -- Digital Volt-Ohm Meter
DOE -- Department of Energy (U.S. Government)
DVOM -- Digital Volt-Ohm Meter
ECM -- Engine Control Module
ECT Sensor -- Engine Coolant Temperature Sensor
EEOC -- Equal Employment Opportunity Commission (U.S. Government)
EGR Valve -- Exhaust Gas Recirculation Valve
EGRV Actuator -Exhaust Gas Recirculation Valve Actuator
EPA -- Environmental Protection Agency (U.S. Government)
EVAP Canister Purge Actuator -- Evaporative Emission Canister Purge Actuator
EGR Valve Position Sensor -- Exhaust Gas Recirculation Valve Position Sensor
GVW -- Gross Vehicle Weight
H_2O -- Water
HAZMAT -- Hazardous Materials
IAC Actuator --Idle Air Control Actuator
IAT Sensor -- Intake Air Temperature/Air Change Temperature Sensor
ICM Actuator --Ignition Control Module Actuator
KOEO -- Key On, Engine Off
MAF Sensor -- Mass Air Flow Sensor
MAP Sensor -- Manifold Absolute Pressure Sensor
MSDS -- Material Storage Data Sheets
NFPA -- National Fire Protection Association
NOID Lamp -- Solenoid Lamp
NPT -- National Pipe Thread
OC -- Oxidation Catalytic Convertor
O_2S -- Oxygen Sensor
OBD Tester -- On-Board Diagnostics Tester
OEM -- Original Equipment Manufacturer
OSHA -- Occupational Safety and Health Administration (U.S. Government)
P & C -- Propane and CNG
P -- Propane
PCM -- Powertrain Control Module
PPE -- Personnel Protection Equipment
PRD -- Pressure Relief Device
PSIG -- Pounds per Square Inch Gauge
R & D -- Research and Development
RPM Sensor -- Revolutions Per Minute (Engine Speed) Sensor
RTV Sealant -- Room Temperature Vulcanizing Sealant
SARA -- Title III -- Superfund Amendments and Reauthorization Act

TCC Actuator -- Torque Converter Clutch Actuator
TP Sensor -- Throttle Position Sensor
VIN --Vehicle Identification Number
VS Sensor -- Vehicle Speed Sensor
WOTS -- Wide Open Throttle Switch

MODEL CURRICULUM OUTLINE

FOR

Journeyman Level
Alternatively Fueled Vehicle (AFV)
Automotive Technician Training
In
Light and Medium Duty CNG and LPG

Prepared by:

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MODEL CURRICULUM OUTLINE
LIGHT/MEDIUM DUTY CNG AND LPG
JOURNEYMAN LEVEL TECHNICIAN

INTRODUCTION

This model curriculum outline was developed using a turbo-DACUM (Developing a Curriculum) process which utilizes practicing experts to undertake a comprehensive job and task analysis. The job and task analysis serves to establish current baseline data accurately and to improve both the process and the product of the job through constant and continuous improvement of training.

The DACUM process is based on the following assumptions:

1. Expert workers are the best source for task analysis.
2. Any occupation can be described effectively in terms of tasks.
3. All tasks imply knowledge, skills, and attitudes/values.

A DACUM panel, comprised of six experienced and knowledgeable technicians who are presently working in the field, was given an orientation to the DACUM process. The panel then identified, verified, and sequenced all the necessary job duty areas and tasks. The broad duty categories were rated according to relative importance and assigned percentage ratings in priority order. The panel then rated every task for each of the duties on a scale of 1 to 3. A rating of 3 indicates an "essential" task, a rating of 2 indicates an "important" task, and a rating of 1 indicates a "desirable" task.

These ratings from each of the content experts were averaged to establish a consensus which formed the basis for prioritizing and/or balancing all the essential elements of a training program for the occupation. This consensus can also be used to establish specifications for the assessment of the training program.

The experts also identified and rated physical parameters (positions, mobility, arm/hand use, senses and working conditions), knowledge (calculations and measurements) and communication skills (written, oral and reading). Additionally, characteristics, attributes, attitudes and traits of workers in the occupation were rated and given a consensus ranking by the panel.

The task analysis portion was organized by retrieving each task from a predesigned template. Each step necessary to accomplish a given task was then identified and sequenced by the panel. After all rational physical and decisional steps were identified, all related knowledge (applied mathematics, calculations, applied physics, applied technology, and applied communications) were listed. Additionally, all tools, equipment and resources necessary to accomplish the task were identified. The panel then identified the purpose of the task, the consequences of inaction, and any special care or precautions which should be taken. Safety procedures and equipment were also stipulated.

JOB AND TASK ANALYSIS--AFV Automotive Technician
LEVEL 2--Summary Data

A			CONVERT VEHICLES	Fuel	Level	Tools and Equipment
	1		Perform pre-vehicle conversion assessment	P & C	2	Air compressor and tools
	6b		Install fittings per manufacturer's specifications (CNG)	C	2	Applicable pressure gauges
	7		Bend tubing (CNG)	C	2	Basic automotive tools
	8b		Install fuel lines/filters/fuel locks/valves (CNG)	C	2	Bending mandrels
	10		Install fuel injection/carburetion devices	P&C	2	Breakout box
	11		Install electrical/electronic system	P&C	2	Broom
						Calculator
B.			MAINTAIN VEHICLE'S GASEOUS FUEL SYSTEM	Fuel	Level	Calibration gas bottles
	15		Inspect fuel system	P & C	2	Catalogues
	16		Inspect fuel storage vessels and brackets	P & C	2	Chassis dynamometer
						Check lists
C.			TROUBLESHOOT SUPPLEMENTAL SYSTEMS	Fuel	Level	Common hand tools
	20		Perform preliminary vehicle assessment	P & C	2	Compression tester
	25		Troubleshoot fuel use hour meters	P & C	2	Computer database
	26		Troubleshoot combustible gas detector	P & C	2	Computers and related equipment
	27		Troubleshoot fuel level indicators	P & C	2	Continuity tester
	28		Troubleshoot ignition and starter interlock	P & C	2	Coolant recovery equipment
	29		Troubleshoot bi-fuel selector switch	P & C	2	Coolant storage and recycling
	30		Troubleshoot cooling system interface	P & C	2	Documentation materials
						Drain pan
D.			TROUBLESHOOT FUEL SYSTEM COMPONENTS	Fuel	Level	Drill and drill bits
	31		Troubleshoot tank/cylinder	P & C	2	Drip pans
	32		Troubleshoot pressure relief valve	P & C	2	Dust pan
	33		Troubleshoot filter and lockoff	P & C	2	DVOM
	34		Troubleshoot regulator/converter	P & C	2	Electrical fittings
	35		Troubleshoot air valve mixer	P & C	2	Emergency lighting
	36		Troubleshoot Venturi	P & C	2	Emergency route guides
	37		Troubleshoot spray bar	P & C	2	Engine analyzer
	39		Troubleshoot spud-in mixer	P & C	2	Exhaust analyzer
	40		Troubleshoot base plate venturi mixer	P & C	2	Eye protection
	41		Troubleshoot lift plate mixer	P & C	2	FAX machine/fax-modem
						First aid equipment
F.			REPAIR SYSTEMS	Fuel	Level	Fuel dispensing equipment
	68		Repair/replace ignition systems	P & C	2	Fuel storage tanks and cylinders
	69		Repair/replace cooling system components	P & C	2	Good illumination
						Hardware and fittings
G.			REPAIR/REPLACE EMISSION CONTROL DEVICE	Fuel	Level	Hazardous area markings
	71		Repair/replace thermal reactor/catalytic converter	P & C	2	Hydrometer
	72		Repair/replace input sensors or related equipment	P & C	2	Infra-red exhaust gas analyzer (BAR 90 four gas)
	73		Repair/replace actuators	P & C	2	Lab scope
						Labor guidebooks
H.			PERFORM MISCELLANEOUS TASKS	Fuel	Level	Leak detection equipment
	74		Maintain supply inventory	P & C	2	Logs and inspection records
	75		Operate Digital VOM	P & C	2	Manufacturer's gauge block set
	76		Operate breakout box	P & C	2	Manufacturers set-up gauge set
	77		Perform housekeeping tasks	P & C	2	Markers--grease pencils
	78		Operate emissions analyzer and interpret resulting data	P & C	2	Metal cutting tools
	79		Perform storage and fuel handling	P & C	2	Metal cutting tools
	80		Observe federal and state regulations	P & C	2	Mop and bucket (solvent base)
	81		Communicate with end-users	P & C	2	Mop and bucket (water base)
	82		Handle hazardous materials	P & C	2	MSDS documentation
						OEM quality replacement components
						Oil and coolant containment barrier
						OSHA rules and regulations
						Periodicals and technical bulletins
						Portable combustible gas supply
						Portable heat source
						PPE
						Pressure gauge set
						Pressure gauges
						Pressure tester
						Probes and intercept cables
						Reamer and file
						Recycling / recovery equipment
						Refueling dispensers

Calculations	Communications	Technology	Purpose/Care	Safety
Addition/subtraction	Fax	Administrative procedures	Accommodate conversion equipment	Accuracy of readings
Angles	Interpret computerized test data	Advanced automotive theory	Cosmetics	Accurate interpretation
Basic math functions	Professional courtesy	Analog and digital circuitry	Driver safety	Comply with NFPA
Calculate mileage/range	Read charts and graphs	Basic accounting skills	Ensure emissions law compliance	Component protection
Calculate tank capacities	Refer to technical manuals	Basic automotive theory	Ensure quality performance	Don't smoke
Calculate volume of tanks	Telephone etiquette	Basic electrical theory	Fiscal accountibility	Exhaust ventilation
Clearance gauge	Use telephone	Basic electronics	Identify pre-conversion repairs	General shop safety
Comparative analysis	Verbal with client	Basic gaseous fuel theory	Maintain practical inventory levels	PPE
Convert English to metric	Verbal with co-workers	Basic geometry	Maintain/validate warranty	
Determine usable GVW	Verbal with manufacturer	Basic math skills	Protect all involved parties	
Electrical terminology	Verbal with supervisor	Basic mechanical principles	Protect specialty equipment	
Fractions	Written documentation	Basic mechanical theory	Protect vehicle	
Interpret emissions data		Basic sanitary procedures	Reduce liability	
Measure in inches		Chemical handling procedures	Structural integrity	
Ohm's Law		Cooling system theory	Timely repairs / service	
Perform chemical drying/		Directional flow theory	Vehicle qualifications	
evaporation calculations		DOE Energy Policy Act	Vehicle serviceability/useability	
Pressures/volumes		Dynamometer technology	Warranty compliance	
Read gauges		Electical terminology		
Read rule/measure		Engine theory		
Torque wrench		EPA Clean Air Act		
Use calculator		Equipment proficiency		
		Exhaust gas composition		
		Gaseous fuels theory		
		Gaseous fuels theory		
		Hazardous waste disposal		
		Internal combustion engines		
		Interpret emission control devices		
		Knowledge of combustible gas limits		
		Metallurgy		
		OSHA rules and regulations		
		Pressure terms and measurements		
		Pressures and volumes		
		Solvent handling procedures		
		State/local vehicle emissions testing		
		Torque and horsepower		

						Tools and Equipment
						Replacement connectors
						Ruler or tape measure
			Continued Summary Data			Scan tool
						Scan tool
						Shop manuals
						Shower/eye wash stations
						Signal generator
						Silicone
						Soldering equipment
						Specialized testing equipment
						Specialized tuning equipment
						Spill containment equipment
						Spill equipment
						Supporting cocumentation
						Tape measure
						Technical manuals
						Telephone
						Test lamp
						Thermometer (Pyrometer)
						Thread sealer approved for natural gas
						Tube/pipe bending equipment
						Tubing bender
						Tubing cutters
						Vacuum pump
						Vehicle support and lift device
						Vendor cross–references
						Warranty procedure checklists
						Welding/cutting equipment
						Wire loom
						Wiring diagrams

Calculations	Communications	Technology	Purpose/Care	Safety

JOB AND TASK ANALYSIS--AFV Automotive Technician
LEVEL 2

A			CONVERT VEHICLES	Fuel	Level	Tools and Equipment
	1		**Perform pre-vehicle conversion assessment**	P & C	2	
		a	Conduct visual inspection and take measurements			Engine analyzer
		b	Document vehicle information (VIN)			Chassis dynamometer
		c	Conduct compression test			Infra-red exhaust gas analyzer (BAR 80 four gas)
		d	Check ignition system components			Compression tester
		e	Inspect fluids, belts, hoses, filters			Scan tool
		f	Check ECM for trouble codes			DVOM
		g	Check exhaust system			Common hand tools
		h	Check for function and existence of appropriate emission system			Hydrometer
		i	Test drive/dynamometer			Calculator
		j	Document initial exhaust emissions			
		k	Document all test results			
		l	Request client sign off of test results			
	6b		**Install fittings per manufacturer's specifications (CNG)**	C	2	
		a	Install swage fittings			Hardware and fittings
		b	Install compression fittings			Thread sealer approved for natural gas
		c	Install flare fittings			Markers--grease pencils
		d	Install captive o-ring			Common hand tools
		e	Install high pressure fittings (other)			
		f	Install NPT fittings			
		g	Apply pipe sealants (proper application required)			
	7		**Bend tubing (CNG)**	C	2	
		a	Locate and measure locations			Ruler or tape measure
		b	Use proper bending mandrels			Tubing bender
		c	Prepare tubing			Reamer and file
		d	Cut, debur, and clean tubing			
		e	Bend tubing			
	8b		**Install fuel lines/filters/fuel locks/valves (CNG)**	C	2	
		a	Plan routing and protection of fuel line components			Tape measure
		b	Install necessary tube and hose fittings			Bending mandrels
		c	Plumb remote fill			Tubing cutters
		d	Plumb pressure relief vent			Basic automotive tools
		e	Connect fuel service lines/bend-install tubing to conform to vehicle			Metal cutting tools
		f	Install quarter turn valve			Drill and drill bits
		g	Install tubing bulkhead, if applicable			Eye protection
		i	Install tubing/hose chafing/fretting protection, as necessary			
		j	Install tubing/hose mounting fixtures, according to mfg. specifications			
		k	Install fuel locks, if applicable			
		l	Install and properly support fuel line			
		m	Install heat shields, as required at assured minimum distance			
		n	Install anti-vibration/expansion loops			
		o	Bend/install tubing to conform to vehicle			
		p	Install fuel system transducer, as applicable			
		q	Install pressure gauge			
		r	Apply appropriate anti-tamper paint			

Calculations	Communications	Technology	Purpose/Care	Safety
Read gauges	Refer to technical manuals	Basic automotive theory	Maintain/validate warranty	Accuracy of readings
Use calculator	Verbal with client	Basic gaseous fuel theory	Reduce liability	Accurate interpretation
Convert English to metric	Written documentation	Internal combustion engines	Vehicle qualifications	PPE
Basic math functions	Read charts and graphs	Analog and digital circuitry	Identify pre-conversion repairs	Don't smoke
Calculate costs	Verbal with manufacturer	Interpret emission control devices	Protect all involved parties	General shop safety
Calculate mileage/range	Verbal with co-workers	Dynamometer technology	Ensure quality performance	Component protection
Calculate tank capacities	Fax	Torque and horsepower		Comply with NFPA
Calculate volume of tanks	Use telephone	Basic mechanical principles		Exhaust ventilation
Determine useable GVW	Interpret computerized test data			
			Driver safety	Component protection
Torque wrench	Refer to technical manuals	Basic mechanical theory	Vehicle serviceability/useability	Accuracy of readings
Clearance gauge	Verbal with supervisor	Metallurgy	Warranty compliance	Accurate interpretation
	Written documentation		Reduce liability	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	*Component protection*
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	
			Cosmetics	
Measure in inches	Refer to technical manuals	Basic mechanical theory	Vehicle serviceability/useability	Accuracy of readings
Angles	Verbal with supervisor	Metallurgy	Warranty compliance	Accurate interpretation
Fractions	Written documentation		Reduce liability	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	
			Cosmetics	
Measure in inches	Refer to technical manuals	Basic mechanical theory	Vehicle serviceability/useability	Accuracy of readings
Angles	Verbal with supervisor	Metallurgy	Warranty compliance	Accurate interpretation
Fractions	Written documentation	Basic geometry	Reduce liability	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	
			Cosmetics	

JOB AND TASK ANALYSIS--AFV Automotive Technician

A			CONVERT VEHICLES	Fuel	Level	Tools and Equipment
	10		**Install fuel injection/carburetion devices**	P&C	2	
		a	Reconfirm injection/carburetion application			Tape measure
		b	Reconfirm fuel injection/carburetion device locations			Bending mandrels
		c	Ensure access to fuel injection/carburetion device adjustments			Tubing cutters
		d	Install fuel injection/carburetion device according to mfg. specs			Basic automotive tools
		e	Attach fuel lines to fuel injection/carburetion device, as necessary			Metal cutting tools
		f	Install safety lockoff/relief device			Drill and drill bits
		g	Ensure anti-chafing, as necessary			Eye protection
	11		**Install electrical/electronic system**	P&C	2	
		a	Confirm component application specifications			DVOM
		b	Identify all locations of connections/components as per mfg. directions			Test lamp
		c	Prepare wire ends for connections (make weather-proof)			Wiring diagrams
		d	Route supplemental wiring harness to connections (esthetics)			Soldering equipment
		e	Solder and weatherproof connections in compliance with OEM specs			Good illumination
		f	Ensure protection from abrasion or corrosion			Tape
		g	Ensure proper sized and fuse protected circuits			Silicone
						Wire loom

Calculations	Communications	Technology	Purpose/Care	Safety
Measure in inches	Refer to technical manuals	Basic mechanical theory	Vehicle serviceability/useability	Accuracy of readings
Angles	Verbal with supervisor	Metallurgy	Warranty compliance	Accurate interpretation
Fractions	Written documentation		Reduce liability	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	
			Cosmetics	
Electrical terminology	Refer to technical manuals	Electical terminology	Vehicle serviceability/useability	Accuracy of readings
	Verbal with supervisor	Advanced automotive theory	Warranty compliance	Accurate interpretation
	Written documentation	Analog and digital circuitry	Reduce liability	PPE
	Verbal with co-workers	Basic mechanical principles	Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation

B.			MAINTAIN VEHICLE'S GASEOUS FUEL SYSTEM	Fuel	Level	Tools and Equipment
	15		**Inspect fuel system**	P & C	2	
		a	Check all connections and fuel line for leaks or wear			Basic automotive tools
		b	Verify operation of excess flow and check valves			Leak detection equipment
		c	Repair/replace tank/serviceable items on tank/cylinder			Check lists
		d	Inspect/replace filters			Air compressor and tools
		e	Inspect/repair tank/cylinder venting systems			
		f	Check and clear obstructions from pressure relief valve			
		g	Inspect/replace hose or tubing as necessary			
		h	Check operation of manual shutoff valve and service			
		i	Check operation of fuel lockoff valves, solenoids			
	16		**Inspect fuel storage vessels and brackets**	P & C	2	
		a	Inspect for inspection date			Basic automotive tools
		b	Ensure data plate is legible			Leak detector
		c	Verify working pressures as appropriate for application			Refueling dispensers
		d	Inspect brackets for cracks, fatigue, rust, corrosion			
		e	Inspect mounting bolts, backing plates, etc.			
		f	Tighten and replace as necessary			
		g	Inspect fuel vessels for gouges, nicks, dents, heat damage			
		h	Ensure that all vapor sealing equipment is intact and functional			
		i	Check automatic stop fill valves for operation			

Calculations	Communications	Technology	Purpose/Care	Safety
Addition/subtraction	Refer to technical manuals	Pressures and volumes	Vehicle serviceability/useability	Accuracy of readings
	Verbal with supervisor	Basic automotive theory	Warranty compliance	Accurate interpretation
	Written documentation		Reduce liability	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	
			Vehicle serviceability/useability	Accuracy of readings
Addition/subtraction	Refer to technical manuals	Basic automotive theory	Warranty compliance	Accurate interpretation
	Verbal with supervisor		Reduce liability	PPE
	Written documentation		Vehicle qualifications	Don't smoke
	Verbal with co-workers		Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	

C.			TROUBLESHOOT SUPPLEMENTAL SYSTEMS	Fuel	Level	Tools and Equipment
	20		**Perform preliminary vehicle assessment**	P & C	2	
		a	Interview operator			Basic automotive tools
		b	Collect vehicle history and document (new vehicle, in service,			
			mileage, mono- or bi-fuel, new/old conversion, conversion, and type)			
		c	Determine frequency of occurrence			
		d	Describe driveability condition at time of occurrence			
			(idle, acceleration, cruise, load, deceleration, and startup)			
		e	Describe atmospheric conditions at time of occurrence			
			(rain, cold, heat, humidity, road conditions, and altitude)			
		f	Conduct road test to validate problem			
	25		**Troubleshoot fuel use hour meters**	P & C	2	
		a	Perform vehicle assessment (#20)			DVOM
		b	Inspect power source			Continuity tester
		c	Inspect grounds			Basic automotive tools
		d	Check circuit continuity between sensor and component and			Lab scope
			component and PCM			Soldering equipment
		e	Seek references and sources for assistance			Electrical fittings
		f	Isolate and repair/replace component			
	26		**Troubleshoot combustible gas detector**	P & C	2	
		a	Perform vehicle assessment (#20)			DVOM
		n	Inspect power source			Continuity tester
		c	Inspect grounds			Basic automotive tools
		d	Check input sensor to device; verify in range			Portable combustible gas supply
		e	Check output signal from support component; verify in range			Lab scope
		f	Simulate sensor failure to generate sensor and trouble code			Soldering equipment
		g	Check circuit continuity between sensor and component and			Electrical fittings
			component and PCM			
		h	Seek references and sources for assistance			
		i	Isolate and repair/replace component			
		k	Perform hydrocarbon forced default test			
	27		**Troubleshoot fuel level indicators**	P & C	2	
		a	Perform vehicle assessment (#20)			DVOM
		b	Inspect power source			Continuity tester
		c	Inspect grounds			Basic automotive tools
		d	Check input sensor to device; verify in range			Signal generator
		e	Check output signal from support component; verify in range			Applicable pressure gauges
		f	Simulate sensor failure to generate sensor and trouble code			Lab scope
		g	Check circuit continuity between sensor and component and			Soldering equipment
			component and PCM			Electrical fittings
		h	Seek references and sources for assistance			
		i	Isolate and repair/replace component			
	28		**Troubleshoot ignition and starter interlock**	P & C	2	
		a	Perform vehicle assessment (#20)			DVOM
		b	Perform OEM self diagnostics and read codes			Scan tool
		c	Inspect power source			Continuity tester
		d	Inspect grounds			Basic automotive tools
		e	Check circuit continuity between sensor and component and			Breakout box
			component and PCM			Lab scope
		f	Seek references and sources for assistance			Soldering equipment
		g	Isolate and repair/replace component			Electrical fittings

Calculations	Communications	Technology	Purpose/Care	Safety
Comparative analysis	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
	Verbal with client	Pressures and volumes	Warranty compliance	Accurate interpretation
	Written documentation	Engine theory	Reduce liability	PPE
	Read charts and graphs	Equipment proficiency	Vehicle qualifications	Don't smoke
	Verbal with manufacturer		Protect all involved parties	General shop safety
	Verbal with co-workers		Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Ensure emissions law compliance	
OHM's Law	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Basic math skills	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
	Written documentation		Reduce liability	PPE
	Read charts and graphs		Protect all involved parties	Don't smoke
	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
OHM's Law	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Basic math skills	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
	Written documentation	Knowledge of combustible gas limits	Reduce liability	PPE
	Read charts and graphs		Protect all involved parties	Don't smoke
	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Addition/subtraction	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Pressures and volumes	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Ohm's Law	Written documentation	Knowledge of combustible gas limits	Reduce liability	PPE
	Read charts and graphs		Protect all involved parties	Don't smoke
	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Pressures and volumes	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Ohm's Law	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math skills	Written documentation	Knowledge of combustible gas limits	Reduce liability	PPE
	Read charts and graphs		Protect all involved parties	Don't smoke
	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

C.			TROUBLESHOOT SUPPLEMENTAL SYSTEMS	Fuel	Level	Tools and Equipment
	29		**Troubleshoot bi-fuel selector switch**	P & C	2	
		a	Perform vehicle assessment (#20)			DVOM
		b	Determine switch functions			Continuity tester
			(1) fuel selection; (2) injector shutoff; (3) fuel level sending units			Basic automotive tools
			(4) other circuits operated through fuel select switch			Lab scope
		c	Isolate separate circuits			Soldering equipment
		d	Verify proper switch input for each separate function			Electrical fittings
		e	Verify proper switch output for each separate function			
		f	Inspect power source to each separate circuit			
		g	Inspect grounds to each separate circuit			
		h	Check circuit continuity between switch poles and functions			
		i	Correct cross circuits between cross functions, if necessary			
		j	Repair or replace relays or other output controls operated by			
			switch function			
		k	Seek references and sources for assistance			
		l	Isolate and repair/replace component			
	30		**Troubleshoot cooling system interface**	P & C	2	
		a	Check coolant level and condition			Pressure tester
		b	Conduct pressure test of cooling system			Basic automotive tools
		c	Verify coolant flow direction through converter/regulators			Thermometer (Pyrometer)
		d	Bleed system			DVOM
		e	Verify proper thermostat operation/converter thermostat operation			Portable heat source
		f	Verify proper ECT switch and ECT sensor operation			Coolant recovery equipment
		g	Verify cooling fan operation, if applicable			Drip pans
		h	Check for proper water "Y" orientation			Spill equipment
		i	Use OEM quality components for replacement, if required			

Calculations	Communications	Technology	Purpose/Care	Safety
Pressures and volumes	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Ohm's Law	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math skills	Written documentation	Basic electronics	Reduce liability	PPE
	Read charts and graphs		Protect all involved parties	Don't smoke
	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Pressures and volumes	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Ohm's Law	Verbal with client	Directional flow theory	Warranty compliance	Accurate interpretation
Basic math skills	Written documentation	Cooling system theory	Reduce liability	PPE
	Read charts and graphs		Protect all involved parties	Don't smoke
	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

D			TROUBLESHOOT FUEL SYSTEM COMPONENTS	Fuel	Level	Tools and Equipment
	31		**Troubleshoot tank/cylinder**	P & C	2	
		a	Perform vehicle assessment (#20)			Basic automotive tools
		b	Verify fuel in the tank/cylinder			Leak detector
		c	Verify service valve operation			
		d	Verify manual valve operation			
	32		**Troubleshoot pressure relief valve**	P & C	2	
		a	Verify condition of PRD	P & C		Basic automotive tools
		b	Inspect for displacement of fusible material (CNG)	C		Leak detector
		c	Verify protective cover in place	P		
		d	Verify vent is routed properly and open	P & C		
		e	Replace as necessary	P & C		
	33		**Troubleshoot filter and lockoff**	P & C	2	
		a	Perform vehicle assessment (#20)			Basic automotive tools
		b	Verify fuel pressure to filter			DVOM
		c	Verify fuel flow through filter			Continuity tester
		d	Replace filter or filter element as necessary			Pressure gauge set
		e	Inspect power source/vacuum source			Leak detector
		f	Inspect grounds, if applicable			Soldering equipment
		g	Check circuit continuity/vacuum between lockoff			Electrical fittings
		h	Verify fuel pressure after lockoff			
		i	Verify if fuel flow stops when lockoff is closed			
		j	Isolate and repair/replace component			
		k	Seek references and sources for assistance			
	34		**Troubleshoot regulator/converter**	P & C	2	
		a	Perform vehicle assessment (#20)			Pressure gauge set
		b	Verify inlet pressure for each component according to mfg. specs			Basic automotive tools
		c	Verify outlet pressure for each component according to mfg. specs			DVOM
		d	Seek references and sources for assistance			Manufacturers set-up gauge set
		e	Isolate and repair; replace as necessary			Leak detector
	35		**Troubleshoot air valve mixer**	P & C	2	
		a	Verify conventional fuel shutoff			DVOM
		b	Verify mixer/air flow rating is sufficient for engine load			Basic automotive tools
		c	Verify air cleaner/filter element is sufficient for engine load			Engine analyzer
		d	Verify air flowing through filter			Exhaust analyzer
		e	Verify diaphragm lift/clearance and condition			Specialized tuning equipment
		f	Verify correct air valve application			
		g	Verify length, type, and size of fuel delivery hose			
		h	Verify no leaks in fuel delivery hose to spray bar			
		i	Verify no vacuum leaks			
		j	Reset idle fuel mixture as per mfg. specs, if required			
		k	Reset load fuel mixture as per mfg. specs, if required			
		l	Consult manufacturers' specifications			

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Knowledge of combustible gas limits	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Knowledge of combustible gas limits	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Knowledge of combustible gas limits	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation		Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

D.			TROUBLESHOOT FUEL SYSTEM COMPONENTS	Fuel	Level	Tools and Equipment
	36		**Troubleshoot Venturi**	P & C	2	
		a	Verify conventional fuel shutoff			DVOM
		b	Verify mixer/air flow rating is sufficient for engine load			Basic automotive tools
		c	Verify air cleaner/filter element is sufficient for engine load			Engine analyzer
		d	Verify air flowing through filter			Exhaust analyzer
		e	Verify no vacuum leaks			Specialized tuning equipment
		f	Verify length, type, and size of fuel delivery hose			
		g	Verify no leaks in fuel delivery hose to Venturi			
		h	Reset idle fuel mixture as per mfg. specs, if required			
		i	Reset load fuel mixture as per mfg. specs, if required			
		j	Consult manufacturers' specifications			
	37		**Troubleshoot spray bar**	P & C	2	DVOM
		a	Verify conventional fuel shutoff			Basic automotive tools
		b	Verify spray bar is proper application for engine			Engine analyzer
		c	Verify air cleaner/filter element is sufficient for engine load			Exhaust analyzer
		d	Verify air flowing through filter			Leak detector
		e	Verify no leaks in air intake system above or below spray bar			Specialized tuning equipment
		f	Verify satisfactory seal around spray bar			
		g	Verify spray bar is clean and clear of obstructions			
		h	Verify spray bar orientation			
		i	Verify length, type, and size of fuel delivery hose			
		j	Verify no leaks in fuel delivery hose to spray bar			
		k	Verify no vacuum leaks			
		l	Verify proper calibration and/or fuel mixture adjustments for fuel			
			control, if required			
		m	Verify proper calibration for fuel constituency, if required			
		n	Consult manufacturers' specifications			
	39		**Troubleshoot spud-in mixer**	P & C	2	
		a	Verify conventional fuel shutoff			DVOM
		b	Verify mixer/air flow rating is sufficient for engine load			Basic automotive tools
		c	Verify air cleaner/filter element is sufficient for engine load			Engine analyzer
		d	Verify air flowing through filter			Exhaust analyzer
		e	Verify no vacuum leaks			
		f	Verify proper depth and orientation of spud pipes			
		g	Verify matched pipe orientation specification (dual pipes)			
		h	Verify length, type, and size of fuel delivery hose			
		i	Verify no leaks in fuel delivery hose to spud pipes			
		j	Verify vaporizer/regulator gas supply to mixer			
		k	Reset idle fuel mixture as per mfg. specs, if required			
		l	Reset load fuel mixture as per mfg. specs, if required			
		m	Consult manufacturers' specifications			
	40		**Troubleshoot base plate venturi mixer**	P & C	2	
		a	Verify conventional fuel shutoff			DVOM
		b	Verify mixer/air flow rating is sufficient for engine load			Basic automotive tools
		c	Verify air cleaner/filter element is sufficient for engine load			Engine analyzer
		d	Verify air flowing through filter			Exhaust analyzer
		e	Verify no vacuum leaks			
		f	Verify barrel valve operation			
		g	Verify barrel valve link integrity			
		h	Verify length, type, and size of fuel delivery hose			
		i	Verify no leaks in fuel delivery hose to mixer			
		j	Verify vaporizer/regulator gas supply to mixer			
		k	Reset idle fuel mixture as per mfg. specs, if required			
		l	Reset load fuel mixture as per mfg. specs, if required			
		m	Consult manufacturers' specifications			

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation		Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client		Warranty compliance	Accurate interpretation
Basic math functions	Written documentation		Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

D.			TROUBLESHOOT FUEL SYSTEM COMPONENTS	Fuel	Level	Tools and Equipment
	41		**Troubleshoot lift plate mixer**	P & C	2	
		a	Verify conventional fuel shutoff			DVOM
		b	Verify mixer/air flow rating is sufficient for engine load			Basic automotive tools
		c	Verify air cleaner/filter element is sufficient for engine load			Engine analyzer
		d	Verify air flowing through filter			Exhaust analyzer
		e	Verify no vacuum leaks			Manufacturer's gauge block set
		f	Verify vacuum supply to Vacuum Lift Solenoid (VLS)			
		g	Verify VLS switching			
		h	Verify proper air gap spacing of lift plate to body as per mfg. spec			
		i	Verify length, type, and size of fuel delivery hose			
		j	Verify no leaks in fuel delivery hose to mixer			
		k	Verify vaporizer/regulator gas supply to mixer			
		l	Reset idle fuel mixture as per mfg. specs, if required			
		m	Reset load fuel mixture as per mfg. specs, if required			
		n	Consult manufacturers' specifications as required			

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client		Warranty compliance	Accurate interpretation
Basic math functions	Written documentation		Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

F.			REPAIR SYSTEMS	Fuel	Level	Tools and Equipment
	68		**Repair/replace ignition systems**	P & C	2	
		a	Repair/replace cap, rotor, pickup, distributor, spark plugs, spark plug			Engine analyzer
			wires, ignition coil and ignition control module as needed			DVOM
		b	Repair/replace crank, knock sensor, and or cam sensors, ICM			Specialized testing equipment
			modules, coil pack as needed			Basic automotive tools
		c	Adjust base timing to factory specifications			Lab scope
		d	Verify proper ignition system operation with primary and secondary			Soldering equipment
			oscilloscope tests			Electrical fittings
	69		**Repair/replace cooling system components**	P & C	2	
		a	Pressure test cooling system			Pressure tester
		b	Withdraw coolant from system in proper recycling system			Basic automotive tools
		c	Do not use coolant system leak repair chemicals			Drain pan
		d	Repair leaks, as necessary			Coolant storage and recycling
		e	Pressure test to confirm			Spill containment equipment
		f	Replace thermostat with OEM specified temperature range			
		g	Verify air flow through system			
		h	Confirm correct engine cooling fan operation			
		i	Bleed cooling system after repair, if required			

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Gaseous fuels theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Pressure terms and measurements	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Basic math skills	Reduce liability	PPE
Read rule/measure	Read charts and graphs	Basic electrical theory	Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers		Ensure emissions law compliance	Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Gaseous fuels theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Pressure terms and measurements	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation		Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

G.			REPAIR/REPLACE EMISSION CONTROL DEVICE	Fuel	Level	Tools and Equipment
	71		**Repair/replace thermal reactor/catalytic converter**	**P & C**	**2**	
		a	For replacement, select appropriate catalytic converter for application			Basic automotive tools
			(oxidation or three-way)			Exhaust analyzer
		b	For repair, remove contaminated substrate and replace with proper			Vehicle support and lift device
			volume of appropriate substrate			Eye protection
		c	Reconnect air input or replace sensor if required			Welding/cutting equipment
		d	Tighten clamps			Tube/pipe bending equipment
		e	Check for leaks			
	72		**Repair/replace input sensors or related equipment**	**P & C**	**2**	
		a	Perform diagnostic test			Basic automotive tools
		b	If outside of OEM allowances, repair/replace the following:			DVOM
			--Replace O2 sensor using mfg. manual			Specialized testing equipment
			--Replace MAP sensor, as necessary			Breakout box
			--Replace RPM sensor			Vacuum pump
			--Repair/replace/adjust TP sensor, as necessary			Pressure gauges
			--Replace ECT sensor, as necessary			Soldering equipment
			--Replace IAT sensor, as necessary			Electrical fittings
			--Replace VS sensor, as necessary			OEM quality replacement components
			--Replace knock sensor, as necessary			Replacement connectors
			--Repair/replace/clean EVP sensor			
			--Replace CKP sensor, as necessary			
			--Repair/replace MAF sensor			
	73		**Repair/replace actuators**	**P & C**	**2**	
		a	Perform diagnostic test			Basic automotive tools
		b	If outside of OEM allowances, repair/replace the following:			DVOM
			--Repair/replace IAC			Specialized testing equipment
			--Repair/replace EVAP cannister purge			Breakout box
			--Repair/replace EGRV			Soldering equipment
			--Repair/replace AIR bypass/diverter			Electrical fittings
			--Repair/replace fuel injectors			OEM quality replacement components
			--Repair/replace fuel control regulators			
			--Repair/replace ICM			
			--Repair/replace TCC			

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs	Basic electrical theory	Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers		Ensure emissions law compliance	Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs	Basic electrical theory	Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers		Ensure emissions law compliance	Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs	Basic electrical theory	Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers		Ensure emissions law compliance	Component protection
				Comply with NFPA
				Exhaust ventilation

H			PERFORM MISCELLANEOUS TASKS	Fuel	Level	Tools and Equipment
	74		**Maintain supply inventory**	P & C	2	
		a	Assess inventory needs			Computer database
		b	Verify minimum required inventory			Telephone
		c	Order inventory as required			Fax
		d	Maintain vendor catalogs			Catalogues
		e	Issue and follow up with purchase orders			Vendor cross-references
		f	Maintain inventory for upcoming conversions			
	75		**Operate Digital VOM**	P & C	2	
		a	Perform test for volts, ohms, amps by application			DVOM
		b	Perform test for frequency, temperature, tach, dwell duty cycle by			Shop manuals
			application			
		b	Determine proper probes for application			
		c	Use operating instructions			
	76		**Operate breakout box**	P & C	2	
		a	Select appropriate PCM intercept connector			Breakout box
		b	Select appropriate breakout box			Basic automotive tools
		c	Remove PCM connector and interact breakout box			DVOM
		d	Read and interpret pin voltage charts			Probes and intercept cables
		e	Perform output state and continuity checks, as applicable			
		f	Perform applicable test functions as specified in manufacturer			
			specified routines			
	77		**Perform housekeeping tasks**	P & C	2	
		a	Maintain safe working environment			Mop and bucket (water base)
		b	Maintain clean shop			Mop and bucket (solvent base)
		c	Organize and maintain tools			Broom
		d	Maintain bathrooms			Dust pan
		e	Help maintain ventilation			Oil and coolant containment barrier
		f	Mop floor after spills			OSHA rules and regs
		g	Notify supervisor of spill-related accidents			Basic automotive tools
		h	Ensure proper operation and visual location of emergency safety			
			equipment			
		i	Verify date of fire extinguisher inspection			
	78		**Operate emissions analyzer and interpret resulting data**	P & C	2	
		a	Allow machine to warm up and self-calibrate/span			Engine analyzer
		b	Perform periodic gas calibration, as necessary			Exhaust analyzer
		c	Make proper connections to engine exhaust			Basic automotive tools
		d	Check hose for leaks and maintain filters			Calibration gas bottles
		e	Monitor and record vehicle emissions			Technical manuals
		f	Evaluate vehicle emissions			
		g	Interpret vehicle emissions for diagnosing problems			
		h	Seek assistance, refer to equipment mfg. as needed			
		i	Operate vehicle as required to simulate driving conditions			
		j	Coordinate operations of gas analyzers and dynamometer			
		k	Perform all required pre- and post-conversion tests, if applicable			
		l	Analyze comparison of both conventional and alternative fuel results,			
			if applicable			

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Administrative procedures	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Basic accounting skills	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers		Fiscal accountibility	Component protection
			Maintain practical inventory levels	Comply with NFPA
			Timely repairs/service	Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with supervisor	Basic electrical theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation		Reduce liability	PPE
Read rule/measure	Verbal with co-workers		Protect all involved parties	Don't smoke
Read gauges			Protect vehicle	General shop safety
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with supervisor	Basic electrical theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation		Reduce liability	PPE
Read rule/measure	Verbal with co-workers		Protect all involved parties	Don't smoke
Read gauges			Protect vehicle	General shop safety
				Comply with NFPA
				Exhaust ventilation
Perform chemical drying/	Refer to technical manuals	OSHA rules and regulations	Vehicle serviceability/useability	Accuracy of readings
evaporation calculations	Verbal with supervisor	Basic sanitary procedures	Warranty compliance	Accurate interpretation
	Written documentation	Chemical handling procedures	Reduce liability	PPE
	Verbal with co-workers	Hazardous waste disposal	Protect all involved parties	Don't smoke
		Solvent handling procedures	Protect vehicle	General shop safety
			Protect specialty equipment	Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with supervisor	Basic electrical theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation		Reduce liability	PPE
Read rule/measure	Verbal with co-workers		Protect all involved parties	Don't smoke
Read gauges			Protect vehicle	General shop safety
			Protect specialty equipment	Comply with NFPA
				Exhaust ventilation

H			PERFORM MISCELLANEOUS TASKS	Fuel	Level	Tools and Equipment
	79		**Perform storage and fuel handling**	P & C	2	
		a	Refuel vehicle	P & C		Basic automotive tools
		b	Perform roadside fuel transfer	P		Fuel dispensing equipment
		c	Operate vehicle refueling station	P & C		PPE
		d	Identify working pressures	C		Fuel storage tanks and cylinders
		e	Read fuel level gauges	P & C		Supporting cocumentation
		f	Maintain safe environment	P & C		Technical manuals
		g	Vent systems properly	P & C		
		h	Purge tanks	P & C		
		i	Operate automated metering systems	P & C		
	80		**Observe federal and state regulations**	P & C	2	
		a	Identify emissions standards			Periodicals and technical bulletins
		b	Identify violations that render penalties			OSHA rules and regulations
		c	Identify compliance testing procedures			Technical manuals
		d	Identify upgrade system for compliance			Documentation materials
		e	Remove uncertified components			Logs and inspection records
		f	Comply with OSHA requirements			First aid equipment
		g	Observe vehicle warranty requirements			Emergency route guides
		h	Demonstrate emergency preparedness			Emergency lighting
			--Use proper fire extinguishers for situation			Hazardous area markings
			--Know building escape route			PPE
			--Know all emergency shutoff valves and switches			Shower/eye wash stations
			--Know employee emergency relocation points			
			--Locate eye wash station			
			--Use and locate PPE			
			--Know location of emergency phone numbers for emergency response			
			--Demonstrate CPR proficiency			
			--Demonstrate basic first aid			
			--Know location of emergency first aid equipment/supplies			
		i	Demonstrate knowledge of EEOC regulations			
			--Identify employee rights			
			--Identify employer responsibilities			
	81		**Communicate with end--users**	P & C	2	
		a	Orient end user to alternative fuels			Telephone
		b	Provide driver/fleet/owner orientation			FAX machine/fax--modem
		c	Provide explanation of maintenance requirements			Computers and related equipment
		d	Explain safety--related issues			MSDS documentation
		e	Explain reasons for suggested repair/maintenance			Technical manuals
		f	Provide customer with quotation for services			Labor guidebooks
		g	Secure customer acknowledgment			Warranty procedure checklists
		h	Provide customer with MSDS sheets			
	82		**Handle hazardous materials**	P & C	2	
		a	Contain spills			Mop and bucket (water base)
		b	Dispose of hazardous materials properly			Mop and bucket (solvent base)
		c	Alert supervisor of spills			Broom
		d	Maintain HAZMAT law, as required			Dust pan
		e	Maintain and display emergency numbers			Oil and coolant containment barrier
		f	Maintain proper signage in shop in accordance with regulations			OSHA rules and regulations
		g	Stay current on HAZMAT regulations			Basic automotive tools
		h	Maintain Materials Safety Data Summary (MSDS) sheets			MSDS documentation
		i	Comply with SARA Title III inventory report requirements			Technical manuals
						Recycling / recovery equipment

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with supervisor	Basic electrical theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation		Reduce liability	PPE
Read rule/measure	Verbal with co-workers		Protect all involved parties	Don't smoke
Read gauges			Protect vehicle	General shop safety
			Protect specialty equipment	Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with supervisor	Basic electrical theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Exhaust gas composition	Reduce liability	PPE
Read rule/measure	Verbal with co-workers	EPA Clean Air Act	Protect all involved parties	Don't smoke
Read gauges		DOE Energy Policy Act	Protect vehicle	General shop safety
Interpret emissions data		State/local vehicle emissions testing	Protect specialty equipment	Comply with NFPA
			Ensure emissions law compliance	Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with supervisor	Basic electrical theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Exhaust gas composition	Reduce liability	PPE
Read rule/measure	Verbal with co-workers	EPA Clean Air Act	Protect all involved parties	Don't smoke
Read gauges	Professional courtesy	DOE Energy Policy Act	Protect vehicle	General shop safety
Interpret emissions data	Telephone etiquette	State/local vehicle emissions testing	Protect specialty equipment	Comply with NFPA
			Ensure emissions law compliance	Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with supervisor	Basic electrical theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Exhaust gas composition	Reduce liability	PPE
Read rule/measure	Verbal with co-workers	EPA Clean Air Act	Protect all involved parties	Don't smoke
Read gauges		DOE Energy Policy Act	Protect vehicle	General shop safety
Interpret emissions data		State/local vehicle emissions testing	Protect specialty equipment	Comply with NFPA
			Ensure emissions law compliance	Exhaust ventilation

GLOSSARY

CNG-LPG Model Curriculum Outlines for Entry Level, Journeyman and Master Technician/Trainer.

AIR Bypass/Diverter Actuator -- Thermal Air By-Pass/Thermal Air Diverter Actuator
CFM -- Cubic Feet per Minute
CNG -- Compressed Natural Gas
CKP Sensor -- Crankshaft Position Sensor
CPR -- Cardio-Pulmonary Resuscitation
DB -- Decibels
Digital VOM -- Digital Volt-Ohm Meter
DOE -- Department of Energy (U.S. Government)
DVOM -- Digital Volt-Ohm Meter
ECM -- Engine Control Module
ECT Sensor -- Engine Coolant Temperature Sensor
EEOC -- Equal Employment Opportunity Commission (U.S. Government)
EGR Valve -- Exhaust Gas Recirculation Valve
EGRV Actuator -Exhaust Gas Recirculation Valve Actuator
EPA -- Environmental Protection Agency (U.S. Government)
EVAP Canister Purge Actuator -- Evaporative Emission Canister Purge Actuator
EGR Valve Position Sensor -- Exhaust Gas Recirculation Valve Position Sensor
GVW -- Gross Vehicle Weight
H_2O -- Water
HAZMAT -- Hazardous Materials
IAC Actuator --Idle Air Control Actuator
IAT Sensor -- Intake Air Temperature/Air Change Temperature Sensor
ICM Actuator --Ignition Control Module Actuator
KOEO -- Key On, Engine Off
MAF Sensor -- Mass Air Flow Sensor
MAP Sensor -- Manifold Absolute Pressure Sensor
MSDS -- Material Storage Data Sheets
NFPA -- National Fire Protection Association
NOID Lamp -- Solenoid Lamp
NPT -- National Pipe Thread
OC -- Oxidation Catalytic Convertor
O_2S -- Oxygen Sensor
OBD Tester -- On-Board Diagnostics Tester
OEM -- Original Equipment Manufacturer
OSHA -- Occupational Safety and Health Administration (U.S. Government)
P & C -- Propane and CNG
P -- Propane
PCM -- Powertrain Control Module
PPE -- Personnel Protection Equipment
PRD -- Pressure Relief Device
PSIG -- Pounds per Square Inch Gauge
R & D -- Research and Development
RPM Sensor -- Revolutions Per Minute (Engine Speed) Sensor
RTV Sealant -- Room Temperature Vulcanizing Sealant
SARA -- Title III -- Superfund Amendments and Reauthorization Act

TCC Actuator -- Torque Converter Clutch Actuator
TP Sensor -- Throttle Position Sensor
VIN --Vehicle Identification Number
VS Sensor -- Vehicle Speed Sensor
WOTS -- Wide Open Throttle Switch

MODEL CURRICULUM OUTLINE

FOR

Master Technician/Trainer Level Alternatively Fueled Vehicle (AFV) Automotive Technician Training In Light and Medium Duty CNG and LPG

Prepared by:

American Society of Advanced Fuels Technology, Inc.

for

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Under

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MODEL CURRICULUM OUTLINE
LIGHT/MEDIUM DUTY CNG AND LPG
MASTER TECHNICIAN/TRAINER LEVEL

INTRODUCTION

This model curriculum outline was developed using a turbo-DACUM (Developing a Curriculum) process which utilizes practicing experts to undertake a comprehensive job and task analysis. The job and task analysis serves to establish current baseline data accurately and to improve both the process and the product of the job through constant and continuous improvement of training.

The DACUM process is based on the following assumptions:

1. Expert workers are the best source for task analysis.
2. Any occupation can be described effectively in terms of tasks.
3. All tasks imply knowledge, skills, and attitudes/values.

A DACUM panel, comprised of six experienced and knowledgeable technicians who are presently working in the field, was given an orientation to the DACUM process. The panel then identified, verified, and sequenced all the necessary job duty areas and tasks. The broad duty categories were rated according to relative importance and assigned percentage ratings in priority order. The panel then rated every task for each of the duties on a scale of 1 to 3. A rating of 3 indicates an "essential" task, a rating of 2 indicates an "important" task, and a rating of 1 indicates a "desirable" task.

These ratings from each of the content experts were averaged to establish a consensus which formed the basis for prioritizing and/or balancing all the essential elements of a training program for the occupation. This consensus can also be used to establish specifications for the assessment of the training program.

The experts also identified and rated physical parameters (positions, mobility, arm/hand use, senses and working conditions), knowledge (calculations and measurements) and communication skills (written, oral and reading). Additionally, characteristics, attributes, attitudes and traits of workers in the occupation were rated and given a consensus ranking by the panel.

The task analysis portion was organized by retrieving each task from a predesigned template. Each step necessary to accomplish a given task was then identified and sequenced by the panel. After all rational physical and decisional steps were identified, all related knowledge (applied mathematics, calculations, applied physics, applied technology, and applied communications) were listed. Additionally, all tools, equipment and resources necessary to accomplish the task were identified. The panel then identified the purpose of the task, the consequences of inaction, and any special care or precautions which should be taken. Safety procedures and equipment were also stipulated.

JOB AND TASK ANALYSIS--AFV Automotive Technician
LEVEL 3--Summary Data

A			CONVERT VEHICLES	Fuel	Level	Tools and Equipment
	12		Perform post-conversion procedures	P & C	3	4 gas exhaust analyzer
						Basic automotive tools
B.			MAINTAIN VEHICLE'S GASEOUS FUEL SYSTEM	Fuel	Level	Breakout box
	14		Recertify cylinders/tanks	P & C	3	Chassis dynamometer
	19		Perform emissions testing	P & C	3	Check list
						Continuity tester
C.			TROUBLESHOOT SUPPLEMENTAL SYSTEMS	Fuel	Level	Drill and drill bits
	21		Troubleshoot OEM computer support	P & C	3	DVOM
	22		Troubleshoot ignition timing enhancer	P & C	3	Electrical fittings
	23		Troubleshoot fuel control processor	P & C	3	Engine analyzer
	24		Troubleshoot automatic fuel select device	P & C	3	Exhaust analyzer
						Eye protection
D.			TROUBLESHOOT FUEL SYSTEM COMPONENTS	Fuel	Level	Fuel injector cleaning equipment
	38		Troubleshoot injector	P & C	3	Hand held DVOM
						Lab scope
E.			TROUBLESHOOT EMISSION CONTROL DEVICES	Fuel	Level	Leak detector
	42		Troubleshoot ignition system	P & C	3	Manufacturer's gauge set
	43		Troubleshoot O2 sensor using mfg. manual	P & C	3	Metal fabrication tools
	44		Troubleshoot MAP sensor	P & C	3	NOID lamp
	45		Troubleshoot RPM sensor	P & C	3	OBD test equipment
	46		Troubleshoot TP sensor	P & C	3	OBD tester
	47		Troubleshoot ECT sensor	P & C	3	Oscilliscope
	48		Troubleshoot IAT sensor	P & C	3	PCM safe test light
	49		Troubleshoot VS sensor	P & C	3	Portable fuel supply
	50		Troubleshoot knock sensor	P & C	3	Pressure gauge
	51		Troubleshoot EGR valve position sensor	P & C	3	Pressure gauge set
	52		Troubleshoot CKP sensor	P & C	3	Scan tool
	53		Troubleshoot MAF sensor	P & C	3	Soldering and electrical equipment.
	54		Troubleshoot IAC actuator	P & C	3	Specialized sealant
	55		Troubleshoot EVAP cannister purge actuator	P & C	3	Specialized tester
	56		Troubleshoot EGR valve actuator	P & C	3	Specialized tuning equipment
	57		Troubleshoot AIR bypass/diverter actuator	P & C	3	Stamping dies
	58		Troubleshoot fuel injectors actuator	P & C	3	Tank flaring/evacuation equipment
	59		Troubleshoot fuel control regulators	P & C	3	Tap and die set
	60		Troubleshoot ICM device	P & C	3	Thread sealent
	61		Troubleshoot TCC actuator	P & C	3	Vacuum pump
						Welding and cutting equipment
F.			REPAIR SYSTEMS	Fuel	Level	
	62		Repair/replace valves and gauges	P & C	3	
	63		Repair/replace fuel injection/carburetion system	P & C	3	
	64		Repair/replace electrical connections/components	P & C	3	
	65		Repair/replace pressure regulation devices	P & C	3	
	66		Repair/replace brackets	P & C	3	
	67		Repair/replace venting systems	P & C	3	
L.			DEMONSTRATE TECHNICIAN KNOWLEDGE/PERFORM TRAINING	Fuel	Level	
	84		Plan training sessions	P&C	3	
	85		Deliver training sessions	P&C	3	
	86		Evaluate trainee performance	P&C	3	

Calculations	Communications	Technology	Purpose/Care	Safety
Addition/subtraction	Interpret computerized test data	Advanced automotive theory	Accident/impact protection	Accuracy of readings
Basic math functions	Read charts and graphs	Analog and digital circuitry	Accommodate conversion equipment	Accurate interpretation
Basic math skills	Refer to technical manuals	Basic automotive theory	Component security	Comply with NFPA
Comparative analysis	Use telephone	Basic electrical theory	Cosmetics	Component protection
Convert English to metric	Verbal with client	Basic gaseous fuel theory	Ensure emissions law compliance	Don't smoke
Read gauges	Verbal with co-workers	Basic mechanical principles	Ensure quality performance	Exhaust ventilation
Read rule/measure	Verbal with manufacturer	Dynamometer technology	Protect all involved parties	General shop safety
Use calculator	Written documentation	Engine theory	Protect vehicle	PPE
		Equipment proficiency	Reduce liability	
		Gaseous fuels theory	Structural integrity	
		Internal combustion engines	Vehicle qualifications	
		Interpret emission control devices	Vehicle serviceability/useability	
		Pressure and volume	Warranty compliance	
		Pressure terms and measurements		
		Pressures and volumes		
		Torque and horsepower		

A			CONVERT VEHICLES	Fuel	Level	Tools and Equipment
	12		**Perform post-conversion procedures**	P&C	3	
		a	Purge and pressurize fuel system and check for system integrity			Engine analyzer
		b	Adjust primary regulator pressure as applicable			4 gas exhaust analyzer
		c	Start vehicle; run until it reaches operating temperature			Hand held DVOM
		d	Switch to alternative fuel (if bi-fuel)			Specialized tuning equipment
		e	Make all base adjustments (idle speed, ignition timing, etc.)			OBD test equipment
			as per vehicle or component manufacturer specifications			Chassis dynamometer
		f	Perform fuel systems adjustments, if any, as specified by equipment			Check list
			manufacturer specifications			
		g	Mechanical systems: adjust idle and WOT adjustment, on electronic			
			system, ensure calibration			
		h	Perform comprehensive driveability test to ensure proper functioning of			
			components			
		i	Perform PCM self-diagnostic check and correct any problems prior			
			to delivery of vehicle			
		j	Perform emission check			
		k	Document all post-conversion checks and all discrepancies			
			(have user acknowledge prior to delivery)			

Calculations	Communications	Technology	Purpose/Care	Safety
Comparative analysis	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
	Verbal with client	Basic automotive theory	Warranty compliance	Accurate interpretation
	Written documentation	Basic gaseous fuel theory	Reduce liability	PPE
	Read charts and graphs	Pressure and volume	Vehicle qualifications	Don't smoke
	Verbal with manufacturer	Internal combustion engines	Protect all involved parties	General shop safety
	Verbal with co-workers	Analog and digital circuitry	Ensure quality performance	Component protection
	Use telephone	Interpret emission control devices	Protect vehicle	Comply with NFPA
	Interpret computerized test data	Dynamometer technology		Exhaust ventilation
		Torque and horsepower		
		Basic mechanical principles		

B.			MAINTAIN VEHICLE'S GASEOUS FUEL SYSTEM	Fuel	Level	Tools and Equipment
	14		**Recertify cylinders/tanks**	P & C	3	
		a	At recertification date, remove cylinder/tank			Basic automotive tools
		b	Recertify by authorized agent			Eye protection
		c	Reinstall/replace cylinder/tank			Stamping dies
		d	Documentation			
	19		**Perform emissions testing**	P & C	3	
		a	Ensure that all required emissions control devices are present, intact,			Engine analyzer
			and functional			OBD tester
		b	Extract codes for OEM self diagnostics and documents			4-gas analyzer
		c	Service codes as needed			Specialized tuning equipment
		d	Bring vehicle to appropriate running temperature			Chassis dynamometer
		e	Record and document emissions results--four gases			Basic automotive tools
		f	Adjust fuel mixtures according to manufacturers' requirements			
		g	Confirm that emissions meet local, state, and federal requirements			

Calculations	Communications	Technology	Purpose/Care	Safety
Addition/subtraction	Refer to technical manuals	Pressures and volumes	Vehicle serviceability/useability	Accuracy of readings
	Verbal with supervisor	Advanced automotive theory	Warranty compliance	Accurate interpretation
	Written documentation		Reduce liability	PPE
	Verbal with co-workers		Vehicle qualifications	Don't smoke
			Protect all involved parties	General shop safety
			Ensure quality performance	Component protection
			Protect vehicle	Comply with NFPA
			Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	
			Cosmetics	
Comparative analysis	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
	Verbal with client	Pressures and volumes	Warranty compliance	Accurate interpretation
	Written documentation	Engine theory	Reduce liability	PPE
	Read charts and graphs	Equipment proficiency	Vehicle qualifications	Don't smoke
	Verbal with manufacturer		Protect all involved parties	General shop safety
	Verbal with co-workers		Ensure quality performance	Component protection
	Use telephone		Protect vehicle	Comply with NFPA
	Interpret computerized test data		Accommodate conversion equipment	Exhaust ventilation
			Structural integrity	

C.			TROUBLESHOOT SUPPLEMENTAL SYSTEMS	Fuel	Level	Tools and Equipment
	21		**Troubleshoot OEM computer support**	P & C	3	
		a	Perform vehicle assessment (#20)			Engine analyzer
		b	Perform OEM self diagnostics and read codes			OBD tester
		c	Inspect power source			4-gas analyzer
		d	Inspect grounds			Specialized tuning equipment
		e	Check input sensor to device; verify in range			Chassis dynamometer
		f	Check output signal from support component; verify in range			Basic automotive tools
		g	Simulate sensor failure to generate sensor and trouble code			
		h	Check circuit continuity between sensor and component and			
			component and PCM			
		i	Seek references and sources for assistance			
		j	Isolate and repair/replace component			
	22		**Troubleshoot ignition timing enhancer**	P & C	3	
		a	Perform vehicle assessment (#20)			Engine analyzer
		b	Perform OEM self diagnostics and read codes			OBD tester
		c	Inspect power source			4-gas analyzer
		d	Inspect grounds			Specialized tuning equipment
		e	Check input from reference signal path to enhancer; verify in range			Chassis dynamometer
		f	Check output signal from enhancer to PCM; verify in range			Basic automotive tools
		g	Simulate sensor failure from sensor and trouble code			Continuity tester
		h	Check circuit continuity between enhancer and PCM			
		i	Seek references and sources for assistance			
		j	Isolate and repair/replace component			
	23		**Troubleshoot fuel control processor**	P & C	3	
		a	Perform vehicle assessment (#20)			DVOM
		b	Perform OEM self diagnostics and read codes			Specialized tuning equipment
		c	Inspect power source			Continuity tester
		d	Inspect grounds			Basic automotive tools
		e	Check input sensors to device; verify in range			
		f	Check output signals from fuel controller to actuators; verify in range			
		g	Simulate sensor failure to generate sensor and trouble code			
		h	Simulate actuator failure to generate change in exhaust content			
		i	Check circuit continuity between sensor and component and			
			component and PCM			
		j	Seek references and sources for assistance			
		k	Isolate and repair/replace component			

Calculations	Communications	Technology	Purpose/Care	Safety
Comparative analysis	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Basic math skills	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
	Written documentation		Reduce liability	PPE
	Read charts and graphs		Protect all involved parties	Don't smoke
	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers		Ensure emissions law compliance	Component protection
				Comply with NFPA
				Exhaust ventilation
Comparative analysis	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
	Written documentation		Reduce liability	PPE
	Read charts and graphs		Protect all involved parties	Don't smoke
	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers		Ensure emissions law compliance	Component protection
				Comply with NFPA
				Exhaust ventilation
Comparative analysis	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
	Written documentation		Reduce liability	PPE
	Read charts and graphs		Protect all involved parties	Don't smoke
	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers		Ensure emissions law compliance	Component protection
				Comply with NFPA
				Exhaust ventilation

C.			TROUBLESHOOT SUPPLEMENTAL SYSTEMS	Fuel	Level	Tools and Equipment
	24		**Troubleshoot automatic fuel select device**	P & C	3	
		a	Perform vehicle assessment (#20)			DVOM
		b	Perform OEM self diagnostics and read codes			Specialized tuning equipment
		c	Inspect power source			Continuity tester
		d	Inspect grounds			Basic automotive tools
		e	Check input sensor to device; verify in range			Lab scope
		f	Check output signal from support component; verify in range			Soldering equipment
		g	Simulate sensor failure to generate sensor and trouble code			Electrical fittings
		h	Check circuit continuity between sensor and component and			Scan tool
			component and PCM			
		i	Seek references and sources for assistance			
		j	Isolate and repair/replace component			

Calculation	Communications	Technology	Purpose/Care	Safety
OHM's Law	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Basic math skills	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
	Written documentation		Reduce liability	PPE
	Read charts and graphs		Protect all involved parties	Don't smoke
	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

D			TROUBLESHOOT FUEL SYSTEM COMPONENTS	Fuel	Level	Tools and Equipment
	38		**Troubleshoot injector**	P & C	3	DVOM
		a	Verify conventional fuel shutoff			Basic automotive tools
		b	Verify injector is proper application for engine			Engine analyzer
		c	Verify air cleaner/filter element is sufficient for engine load			Exhaust analyzer
		d	Verify air flowing through filter			Leak detector
		e	Verify no leaks in air intake system above or below spray bar			Specialized sealant
		f	Verify continuity through solenoid coil			
		g	Verify power source to injector			
		h	Verify driver circuit			
		i	Verify satisfactory seal around injector			
		j	Verify injector cleanliness and clear obstructions			
		k	Verify no leaks in fuel delivery hose to injector			
		l	Verify no vacuum leaks			
		m	Verify proper calibration and/or fuel mixture adjustments as required			
		n	Verify proper calibration for fuel constituency, if required			
		o	Consult manufacturers' specifications			

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation		Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

E.			TROUBLESHOOT EMISSION CONTROL DEVICES	Fuel	Level	Tools and Equipment
	42		**Troubleshoot ignition system**	P & C	3	
		a	Conduct pre-vehicle assessment (#20)			OBD tester
		b	Check battery voltage/primary voltage			DVOM
		c	Perform OEM self-diagnostics and read codes			Breakout box
		d	Confirm presence of secondary voltage (check for spark)			Specialized tester
		e	Inspect spark plug condition (electrode, gap, heat range)			Continuity tester
		f	Inspect secondary circuit wiring for continuity and resistance			Oscilliscope
		g	Check ignition module for proper operation			Lab scope
		h	Check cap and rotor condition			Soldering and electrical equipment.
		i	Check mechanical and vacuum advance mechanism, if needed			
		j	Check for proper sensor reference to PCM			
		k	Inspect power control relays			
	43		**Troubleshoot O2 sensor using mfg. manual**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check input from sensor to PCM; verify in range			Specialized tester
		e	Simulate sensor failure to generate sensor and trouble code			Lab scope
		f	Check circuit continuity between sensor and component and			Soldering and electrical equipment.
			component and PCM			Portable fuel supply
		g	Seek references and sources for assistance			
		h	Isolate and repair/replace component			
	44		**Troubleshoot MAP sensor**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Verify proper altitude reference, KOEO			Specialized tester
		e	Check input from sensor to PCM; verify in range			Vacuum pump
		f	Plot sensor output on graph using vacuum pump			Soldering and electrical equipment.
		g	Simulate sensor failure to generate sensor and trouble code			Lab scope
		h	Check circuit continuity between sensor and component and			
			component and PCM			
		i	Seek references and sources for assistance			
		j	Isolate and repair/replace component			
		k	Check for manifold vacuum test			
		l	Verify that sensor holds vacuum			
	45		**Troubleshoot RPM sensor**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check input from sensor to PCM; verify in range			Specialized tester
		e	Monitor square wave with oscilloscope/frequency meter			Lab scope
		f	Simulate sensor failure to generate sensor trouble code			Soldering and electrical equipment.
		g	Check circuit continuity between sensor and component and			
			component and PCM			
		h	Seek references and sources for assistance			
		i	Isolate and repair/replace component			

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Basic electrical theory	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers		Ensure emissions law compliance	Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

E.			TROUBLESHOOT EMISSION CONTROL DEVICES	Fuel	Level	Tools and Equipment
	46		**Troubleshoot TP sensor**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check input from sensor to PCM; verify in range			Specialized tester
		e	Verify range by observing open and closed throttle position			Lab scope
		f	Monitor voltage range for dead spots			Soldering and electrical equipment.
		g	Monitor for initial sensor reference, KOEO			
		h	Simulate sensor failure to generate sensor trouble code			
		i	Check circuit continuity between sensor and component and			
			component and PCM			
		j	Adjust base idle voltage, if possible			
		k	Seek references and sources for assistance			
		l	Isolate and repair/replace component			
	47		**Troubleshoot ECT sensor**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check input from sensor to PCM; verify in range			Specialized tester
		e	Verify range by placing ECT sensor in water of known temperature			
		f	Verify that signal/values matches known temperature			
		g	Simulate sensor failure to generate sensor trouble code			
		h	Check circuit continuity between sensor and component and			
			component and PCM			
		i	Seek references and sources for assistance			
		j	Isolate and repair/replace component			
		k	Check thermostat for correct heat range			
	48		**Troubleshoot IAT sensor**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check input from sensor to PCM; verify in range			Specialized tester
		e	Verify range by placing IAT sensor in air of known temperature			
		f	Verify that signal/values matches known temperature			
		g	Simulate sensor failure to generate sensor trouble code			
		h	Check circuit continuity between sensor and component and			
			component and PCM			
		i	Seek references and sources for assistance			
		j	Isolate and repair/replace component			
		k	Check thermostat for correct heat range			
	49		**Troubleshoot VS sensor**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check input from sensor to PCM; verify in range			Specialized tester
		e	Conduct speed and wave form test, using scan tool/frequency meter			
		f	Simulate sensor failure to generate sensor and trouble code			
		g	Check circuit continuity between sensor and component and			
			component and PCM			
		h	Seek references and sources for assistance			
		i	Isolate and repair/replace component			

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	
Read rule/measure	Read charts and graphs		Protect all involved parties	
Read gauges	Verbal with manufacturer		Protect vehicle	
	Verbal with co-workers			

E.			TROUBLESHOOT EMISSION CONTROL DEVICES	Fuel	Level	Tools and Equipment
	50		**Troubleshoot knock sensor**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check input from sensor to PCM; verify in range			Specialized tester
		e	Simulate sensor failure to generate sensor and trouble code			
		f	Check circuit continuity between sensor and component and			
			component and PCM			
		g	Seek references and sources for assistance			
		h	Isolate and repair/replace component			
	51		**Troubleshoot EGR valve position sensor**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check input from sensor to PCM; verify in range			Specialized tester
		e	Verify range by checking for proper signal when opening valve			
		f	Simulate sensor failure to generate sensor trouble code			
		g	Check circuit continuity between sensor and component and			
			component and PCM			
		h	Seek references and sources for assistance			
		i	Isolate and repair/replace component			
		j	Remove and clean EGR valve			
	52		**Troubleshoot CKP sensor**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check continuity of pick up (magnetic)			Specialized tester
		e	Check input from sensor to PCM; verify in range using frequency			
			meter/oscilloscope			
		f	Simulate sensor failure to generate sensor trouble code			
		g	Check circuit continuity between sensor and component and			
			component and PCM			
		h	Seek references and sources for assistance			
		i	Isolate and repair/replace component			
	53		**Troubleshoot MAF sensor**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check input from sensor to PCM			Specialized tester
		e	Verify in range using DVOM/frequency meter			
		f	Verify vane range, if applicable			
		g	Simulate sensor failure to generate sensor trouble code			
		h	Check circuit continuity between sensor and component and			
			component and PCM			
		i	Seek references and sources for assistance			
		j	Isolate and repair/replace component			

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

E.			TROUBLESHOOT EMISSION CONTROL DEVICES	Fuel	Level	Tools and Equipment
	54		**Troubleshoot IAC actuator**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check drive wire for continuity to PCM			Specialized tester
		e	Check output command from PCM; verify in range			
		f	Simulate actuator function and confirm proper response			
			by appropriate sensor signal			
		g	Seek references and sources for assistance			
		h	Repair/replace/adjust actuator as necessary per OEM specs			
	55		**Troubleshoot EVAP cannister purge actuator**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check drive wire for continuity to PCM			Specialized tester
		e	Check output command from PCM			
		f	Verify in range using DVOM			
		g	Simulate actuator function and confirm proper response			
			by appropriate sensor signal			
		h	Seek references and sources for assistance			
		i	Repair/replace/adjust actuator as necessary per OEM specs			
	56		**Troubleshoot EGR valve actuator**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check drive wire for continuity to PCM			Specialized tester
		e	Check output command from PCM; verify in range			
		f	Simulate actuator function and confirm proper response			
			by appropriate sensor signal			
		g	Seek references and sources for assistance			
		h	Repair/replace/adjust actuator as necessary per OEM specs			
	57		**Troubleshoot AIR bypass/diverter actuator**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check drive wire for continuity to PCM			Specialized tester
		e	Check output command from PCM; verify in range			
		f	Simulate actuator function and confirm proper response			
			by appropriate sensor signal			
		g	Seek references and sources for assistance			
		h	Repair/replace/adjust actuator as necessary per OEM specs			
	58		**Troubleshoot fuel injectors actuator**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check drive wire for continuity to PCM			Specialized tester
		e	Check output command from PCM			NOID lamp
		f	Verify command response with NOID lamp or similar device			
		g	Use test equipment to check spray pattern			
		h	Simulate actuator function and confirm proper response			
			by appropriate sensor signal			
		i	Seek references and sources for assistance			
		j	Repair/replace/adjust actuator as necessary per OEM specs			

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

E.			TROUBLESHOOT EMISSION CONTROL DEVICES	Fuel	Level	Tools and Equipment
	59		**Troubleshoot fuel control regulators**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Check manifold vacuum source			DVOM
		c	Check regulation to rail connection for leaks			Breakout box
		d	Check rail pressure			Specialized tester
		e	Check for proper by-pass to tanks/cylinders			
		f	Check fuel pump for proper operation			
		g	Seek references and sources for assistance			
		h	Repair/replace/adjust actuator as necessary per OEM specs			
	60		**Troubleshoot ICM device**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check drive wire for continuity to PCM			Specialized tester
		e	Check output command from PCM; verify in range			
		f	Simulate device function and confirm proper response			
			by appropriate sensor signal			
		g	Check for minimum spark voltage			
		h	Check for timing advancement			
		i	Check for dwell changes			
		j	Seek references and sources for assistance			
		k	Repair/replace/adjust device as necessary per OEM specs			
	61		**Troubleshoot TCC actuator**	P & C	3	
		a	Perform OEM self-diagnostics and read codes			OBD tester
		b	Inspect power source			DVOM
		c	Inspect grounds			Breakout box
		d	Check drive wire for continuity to PCM			Specialized tester
		e	Check output command from PCM; verify in range			
		f	Simulate actuator function and confirm proper response			
			by appropriate sensor signal			
		g	Seek references and sources for assistance			
		h	Repair/replace/adjust actuator as necessary per OEM specs			

Calculations	Communications	Technology	Purpose/Care	Safety
Convert English to metric	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Basic math functions	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Read rule/measure	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read gauges	Read charts and graphs		Protect all involved parties	Don't smoke
	Verbal with manufacturer		Protect vehicle	General shop safety
				Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read rule/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

F.			REPAIR SYSTEMS	Fuel	Level	Tools and Equipment
	62		**Repair/replace valves and gauges**	P & C	3	Pressure gauge
		a	Identify problem as it relates to system			Leak detector
		b	Deplete vessel of fuel supply			Basic automotive tools
		c	Flare off or transfer fuel to another storage vessel			Tank flaring/evacuation equipment
		d	Repair or service gauge as appropriate for system			
		e	Verify component replacement for system compatibility			
	63		**Repair/replace fuel injection/carburetion system**	P & C	3	
		a	Identify problem area			Basic automotive tools
		b	Remove and service as needed			Engine analyzer
		c	Reinstall system as recommended by manufacturer			Exhaust analyzer
		d	Check for vacuum leaks			Chassis dynamometer
		e	Set up and tune to mfg. specifications as necessary			Fuel injector cleaning equipment
		f	Perform emission checks in compliance with all applicable regulations			Leak dectector
	64		**Repair/replace electrical connections/components**	P & C	3	
		a	Identify problem area, perform OEM self-diagnostics, and read codes			DVOM
		b	Correct all problems in order issued by PCM			Continuity tester
		c	Repeat as necessary until all problems resolved			Breakout box
		d	Perform continuity test on suspected problem area using			Soldering equipment
			appropriate test device			Electrical fittings
		e	Ensure correct electrical interfacing with OEM			Lab scope
			systems as per mfr. instructions			PCM safe test light
		f	Perform output state test on suspected problem area			
		g	Check systems for proper signal and ground			
		h	Verify if component or wiring harness is at fault			
		i	Repair or replace harness or component fault in compliance with			
			OEM warranty specifications			
	65		**Repair/replace pressure regulation devices**	P & C	3	
		a	Check for appropriate working pressure			Pressure gauge set
		b	Isolate or locate problem			Leak detector
		c	Deplete or flare off system pressure			Manufacturer's gauge set
		d	Disassemble and repair as per manufacturers' recommendations			Basic automotive tools
		e	Leak test as per manufacturers' recommendations			Thread sealent
		f	Reinstall or replace			
		g	Purge cooling system lines to assure proper engine coolant flow			
		h	Tune the system (See #19)			
	66		**Repair/replace brackets**	P & C	3	
		a	Identify problem area (see #16)			Basic automotive tools
		b	Repair/replace brackets with cracks, fatigue, rust, corrosion			Metal fabrication tools
			in compliance with all regulations			Drill and drill bits
		c	Replace fasteners, backing plates, etc. as needed to comply with			Welding and cutting equipment
			regulations			Tap and die set
		d	Replace bracket insulator material as needed to meet regulations (CNG)	C		
	67		**Repair/replace venting systems**	P & C	3	
		a	Identify problem			Leak detector
		b	Inspect PRD			Basic automotive tools
		c	Replace PRD according to mfg. specifications as needed			Thread sealent
		d	Inspect vapor containment system			
		e	Replace vapor containment system as needed according mfg. specs			
		f	Inspect vapor pipes for kinks, blockages, etc.	C		
		g	Repair/replace vapor pipes as needed	C		

Calculations	Communications	Technology	Purpose/Care	Safety
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read ruler/measure	Read charts and graphs	Basic electrical theory	Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read ruler/measure	Read charts and graphs	Basic electrical theory	Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read ruler/measure	Read charts and graphs	Basic electrical theory	Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read ruler/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read ruler/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers		Component security	Component protection
			Accident/impact protection	Comply with NFPA
				Exhaust ventilation
Use calculator	Refer to technical manuals	Advanced automotive theory	Vehicle serviceability/useability	Accuracy of readings
Convert English to metric	Verbal with client	Gaseous fuels theory	Warranty compliance	Accurate interpretation
Basic math functions	Written documentation	Pressure terms and measurements	Reduce liability	PPE
Read ruler/measure	Read charts and graphs		Protect all involved parties	Don't smoke
Read gauges	Verbal with manufacturer		Protect vehicle	General shop safety
	Verbal with co-workers			Component protection
				Comply with NFPA
				Exhaust ventilation

I.			DEMONSTRATE TECHNICIAN KNOWLEDGE/PERFORM TRAINING	Fuel	Level	Tools and Equipment
	84		**Plan training sessions**	P&C	3	
		a	Assess needs of trainees through pretesting			
		b	Select and/or prepare instructional materials regarding--			
			--Regulatory/safety policies			
			--Conversion components			
			--Vehicle compatibility analysis			
			--Equipment installation (parts fabrication)			
			--Equipment installation (hands-on installation of tanks/cylinders)			
			--Equipment installation (hands-on installation of regulators)			
			--Equipment installation (hands-on installation of fuel lines and shut off valves)			
			--Equipment installation (hands-on installation of electrical equipment/wiring)			
			--Equipment installation (hands-on installation of carburetion and fuel injection systems)			
			--Vehicle emissions inspection, testing, and safety			
			--Emissions diagnosis and tuning			
			--Driver orientation			
			--Legislative and regulatory policies			
			--Suppliers and manufacturers			
		c	Review and/or develop lesson plans on units			
	85		**Deliver training sessions**	P & C	3	
		a	Conduct group discussions and lectures			
		b	Direct trainee lab experiences			
		c	Coach trainees			
		d	Demonstrate manipulative skills			
		e	Present information with a variety of instructional media (overhead, video, etc.)			
		f	Present information with the chalkboard or flip chart			
	86		**Evaluate trainee performance**	P&C	3	
		a	Assess trainee knowledge using pretests and posttests			
		b	Assess trainee skill performance			
		c	Determine trainee competence			

Calculations	Communications	Technology	Purpose/Care	Safety

GLOSSARY

CNG-LPG Model Curriculum Outlines for Entry Level, Journeyman and Master Technician/Trainer.

AIR Bypass/Diverter Actuator -- Thermal Air By-Pass/Thermal Air Diverter Actuator
CFM -- Cubic Feet per Minute
CNG -- Compressed Natural Gas
CKP Sensor -- Crankshaft Position Sensor
CPR -- Cardio-Pulmonary Resuscitation
DB -- Decibels
Digital VOM -- Digital Volt-Ohm Meter
DOE -- Department of Energy (U.S. Government)
DVOM -- Digital Volt-Ohm Meter
ECM -- Engine Control Module
ECT Sensor -- Engine Coolant Temperature Sensor
EEOC -- Equal Employment Opportunity Commission (U.S. Government)
EGR Valve -- Exhaust Gas Recirculation Valve
EGRV Actuator -Exhaust Gas Recirculation Valve Actuator
EPA -- Environmental Protection Agency (U.S. Government)
EVAP Canister Purge Actuator -- Evaporative Emission Canister Purge Actuator
EGR Valve Position Sensor -- Exhaust Gas Recirculation Valve Position Sensor
GVW -- Gross Vehicle Weight
H_2O -- Water
HAZMAT -- Hazardous Materials
IAC Actuator --Idle Air Control Actuator
IAT Sensor -- Intake Air Temperature/Air Change Temperature Sensor
ICM Actuator --Ignition Control Module Actuator
KOEO -- Key On, Engine Off
MAF Sensor -- Mass Air Flow Sensor
MAP Sensor -- Manifold Absolute Pressure Sensor
MSDS -- Material Storage Data Sheets
NFPA -- National Fire Protection Association
NOID Lamp -- Solenoid Lamp
NPT -- National Pipe Thread
OC -- Oxidation Catalytic Convertor
O_2S -- Oxygen Sensor
OBD Tester -- On-Board Diagnostics Tester
OEM -- Original Equipment Manufacturer
OSHA -- Occupational Safety and Health Administration (U.S. Government)
P & C -- Propane and CNG
P -- Propane
PCM -- Powertrain Control Module
PPE -- Personnel Protection Equipment
PRD -- Pressure Relief Device
PSIG -- Pounds per Square Inch Gauge
R & D -- Research and Development
RPM Sensor -- Revolutions Per Minute (Engine Speed) Sensor
RTV Sealant -- Room Temperature Vulcanizing Sealant
SARA -- Title III -- Superfund Amendments and Reauthorization Act

TCC Actuator -- Torque Converter Clutch Actuator
TP Sensor -- Throttle Position Sensor
VIN --Vehicle Identification Number
VS Sensor -- Vehicle Speed Sensor
WOTS -- Wide Open Throttle Switch

TABLE OF CONTENTS

An eligible training provider must initiate a self-study process which provides an opportunity for the certification applicant to evaluate itself against national standards. There are seven program standards: five mandatory and two non-mandatory. Mandatory standards contain the word "must" and are to be construed as essential requirements. Non-mandatory standards contain the word "should" and are to be construed as highly desirable attributes which add strength and quality to the training program. Within these seven standards, there are 27 categories, which contain questions pertinent to certification and over which 1,000 points have been distributed proportionately. Each standard and category has been weighted by a team of experts for its relative importance in certifying AFV technician training programs.

Seventy-five percent of the points in the five mandatory standards must be achieved on the self-study for the training provider to be eligible for a site visit by the certifying agency review team.

Each category has a series of questions to be answered by the training provider using the criteria defined on the 4-to-1 rating scale as follows:

4=Exceptional, Above Average
3=Average, Acceptable
2=Somewhat Acceptable, Needs Improvement
1=Unacceptable

A low score in the two non-mandatory standards will not be used in determining eligibility for a site visit. However, achievement of high scores on the two non-mandatory standards will be recommending in those instances where compliance with the five mandatory standards is marginal or borderline.

Summary Data

			Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
			Standard Percent Weighting	Category Percent Weighting	Points Possible	Points Possible	Points Earned	Points Earned
Standard		**One--Purpose**	**5%**			**50.0**		**31.3**
	A.	Program Purpose		100%	50.0		31.3	
Standard		**Two--Instruction**	**20%**			**200.0**		**155.2**
	A.	Program Plan		5%	10.0		8.9	
	B.	Individualized Training Plans		5%	10.0		8.8	
	C.	Trainee Recordkeeping System		5%	10.0		10.0	
	D.	Instructional Load		10%	20.0		15.0	
	E.	Curriculum		20%	40.0		30.0	
	F.	Trainee Performance Standards		15%	30.0		22.5	
	G.	Health and Safety Standards		10%	20.0		15.0	
	H.	Provisions for Individual Differences		5%	10.0		7.5	
	I.	Testing		5%	10.0		7.5	
	J.	Program Evaluation		15%	30.0		22.5	
	K.	Training Materials		5%	10.0		7.5	
Standard		**Three--Instructional Staff**	**20%**			**200.0**		**138.3**
	A.	Technical Competence		70%	140.0		93.3	
	B.	Staff Development		30%	60.0		45.0	
Standard		**Four--Trainee Services**	**10%**			**100.0**		**65.0**
	A.	Recruitment, Admissions Counseling, and Program Advisement		60%	60.0		45.0	
	C.	Placement, Followup, and Occupational Enhancement Services		40%	40.0		20.0	
Standard		**Five--Facilities**	**15%**			**150.0**		**108.9**
	A.	Health and Safety		45%	67.5		55.8	
	B.	Maintenance		25%	37.5		28.1	
	C.	Instructional Support Areas		20%	30.0		15.0	
	D.	Facility Security		10%	15.0		10.0	
Standard		**Six--Equipment**	**15%**			**150.0**		**137.5**
	A.	Equipment Safety		50%	75.0		71.9	
	B.	Equipment Type, Quality, and Quantity		50%	75.0		65.6	
Standard		**Seven--Administration**	**15%**			**150.0**		**115.4**
	A.	Administrative Structure		15%	22.5		18.8	
	B.	Written Policies and Procedures		30%	45.0		33.8	
	C.	Program Advisory Committee/Board		20%	30.0		23.6	
	D.	Budget		25%	37.5		28.1	
	E.	Cooperative and Apprenticeship Agreements		10%	15.0		11.3	
		TOTALS	**100%**		**1000.0**	**1000.0**	**751.6**	**751.6**

Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
		5%	50		31.3

Standard One--Purpose

National gaseous fuels training programs must have clearly stated program performance goals and must be related to the needs of the technicians, employers, and vehicle owners/operators.

2.5	100%	50	31.3

A. Program Purpose

--Evidence of clearly stated program performance goals

1 Does the statement of purpose indicate that the training provider's mission is to provide instruction which qualifies people for employment or advancement in the alternatively fueled vehicles (AFV) industry? | 1 |

2 Does the statement of purpose indicate that the program's performance goals reflect the needs of the technicians to be trained and the needs of employers and vehicle owners/operators to have access to trained AFV technicians? | 4 |

Standard Two--Instruction	Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
			20%	200		155.2

Instruction must be systematic and reflect program goals. A task list and specific performance objectives with criterion-referenced measures must be used. Support materials consistent with program goals and performance objectives must be available to staff and trainees

A. Program Plan	3.6	5%	10	8.9

--Evidence that curriculum is logically sequenced
--Evidence that goals articulate with curriculum
--Evidence that goals are measurable

1 Is the instructional program organized to provide trainees with the knowledge and skills development necessary for employment at the level of the training program; that is, entry, journeyman or master technician/trainer?	3
2 Have specific competencies been organized into a logical sequence for the program?	2
3 Have prerequisite knowledges (math, communication, technology, etc.) been identified and integrated, as required, to assure trainee success in the content area?	4
4 Does the program plan reflect the most current technologies (including facilities, instructional staff, curriculum, budget, administration, etc.)?	4
5 Is there evidence that the program content is updated annually?	4
6 Does the instructional program reflect the needs of the vehicle and equipment manufacturers and owners/operators?	4
7 Is there evidence of on-going coordination with and support from the vehicle and equipment manufacturers?	4

	Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
B. Individualized Training Plans		3.5	5%	10	8.8	
–Evidence that trainees are provided a copy of an individualized training plan						
1 Is each trainee provided a planned sequence of courses and/or tasks necessary to complete the program successfully?	3					
2 Are trainees provided with individual progress sheets indicating tasks that have been mastered?	4					
C. Trainee Recordkeeping System		4	5%	10	10.0	
–Evidence of permanent trainee recordkeeping system						
1 Are performance records of trainees permanently maintained?	4					
2 Are transcripts and/or certificates of trainee performance available to trainees and employers (with written permission of trainee)?	4					

Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
	3.0	10%	20	15.0	

D. Instructional Load

–Evidence of appropriate instructional load

–Evidence of appropriate trainee–instructor ratio consistent with quality educational norms and prevailing safety practices

1 Is there a plan to assure that a qualified instructor is available at all times?	3
2 Is the trainee–instructor ratio sufficient for individual interaction and safety?	3
3 Does the instructor workload allow for opportunities to plan, develop, and evaluate the program?	3
4 Do workload assignments accommodate instructors' involvement in administrative activities, including curriculum development, committee work, advising, counseling, tutoring, etc.?	3
5 Is there evidence that the workload permits on–going coordination with industry?	3

Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
	3.0	20%	40	30.0	

E. Curriculum

–Evidence that curriculum is consistent with nationally developed task lists and provides adequate time to accomplish program objectives

–Evidence of an adequate balance between lecture and hands–on lab experiences

1 Is there evidence that the program content contains the duties, tasks, and steps defined in the nationally developed model curriculum outline for the level of training offered; that is, entry, journeyman, master technican/trainer?	3
2 Is the curriculum organized to provide knowledge and skills development necessary for employment at the level of the training provided?	3
3 Have the specific trainee outcomes (or competencies) been identified?	3
4 Is the curriculum organized to ensure individual trainee participation?	3
5 Are courses or units of instruction based upon defined and measurable trainee competencies required for employment?	3
6 Do instructors follow updated lesson plans to assure that all material is covered?	3
7 Is instructional time adjusted to allow for mastery of the content?	3
8 Does the curriculum provide for sufficient classroom time and hands–on lab activities (including but not limited to co–op and apprenticeship) to permit trainees to achieve the learning outcomes?	3
9 Are applied math and science, as well as communications and interpersonal skills, provided for in the program?	3
10 Are there written policies which stipulate the restrictions that apply to live work such as approvals, institutional/organizational liability and handling of funds?	3
11 Is the live work related to training for the acquisition of occupational skills which the program purports to develop, and is it assigned to individuals, or to groups of trainees, for the purpose of such skills development?	3
12 Does the program provide technicians at all levels with clear, concise instruction on the proper and safe operation, installation, repair, and maintenance procedures and techniques for alternatively fueled vehicles?	3

Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
	3.0	15%	30	22.5	

F. Trainee Performance Standards

–Evidence that performance standards are consistent with learning objectives including knowledge, skills, and the ability to perform tasks

1 Is there a system for evaluating trainee achievement based upon established learning outcomes?	3
2 Are specific criteria defined to measure trainee attainment of performance objectives?	3
3 Are trainees evaluated for their knowledge, skills, and ability to perform tasks?	3
4 Are performance standards based upon nationally defined and measurable trainee competencies required for employment?	3

Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
	3.0	10%	20	15.0	

G. Health and Safety Standards

–Evidence that health and safety training is integrated into the instructional program

1 Is health and safety training integrated into all aspects of the instructional program?	3
2 Are health and safety practices, procedures, and facilities in compliance with all applicable federal, state and local regulations?	3
3 Are health and safety training and testing provided prior to lab experiences?	3

Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
	3.0	5%	10	7.5	

H. Provisions for Individual Differences

–Evidence of accommodating learning differences

1 Are learning experiences individualized so that all trainees are provided an opportunity to achieve program objectives?	3
2 Is a formal pretesting process used to assess trainee abilities in reading, mathematics, and mechanical skills to evaluate readiness and to assure a reasonable probability of success?	3
3 Is instruction provided to trainees needing remediation in the areas of reading, mathematics, and mechanical skills?	3
4 Does the program provide for 'reasonable accommodation' as required by the Americans With Disabilities Act (ADA)?	3

Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
	3.0	5%	10	7.5	

I. Testing

–Evidence that written and performance tests are administered
–Evidence that tests are criterion–based

1 Are both written and performance–based tests used to validate trainee competencies?	3
2 Are continuous efforts made to determine if the evaluation methods used to measure trainee achievement are valid and reliable?	3
3 Is there a procedure for evaluating trainee performance on live work projects and/or co–op and apprenticeship projects?	3
4 Are trainees able to pass a national written and performance test based on the national model curriculum outline for the appropriate level; that is, entry, journeyman, or master technician/trainer?	3

Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
	3.0	15%	30	22.5	

J. Program Evaluation

–Evidence of a systematic course and instructor evaluation process that includes trainee input

–Evidence of an on–going program monitoring and evaluation process

1 Is there a continuous and systematic process to evaluate the curriculum, the lab tools and equipment, and the competencies of each trainee who completes the program?	3
2 Are trainee evaluations used to assess instructor effectiveness and program quality?	3
3 Is the advisory committee/board actively involved in program planning and evaluation?	3
4 Do instructors use trainee followup data to make judgments regarding program content, length and relevancy?	3
5 Does the history of trainee enrollments, retention, job placement, and followup data indicate that adequate planning and evaluation are integral components of the program?	3
6 Is job followup information collected on completers annually for a three–year period?	3
7 Is followup information collected on dropouts regarding reasons for leaving?	3
8 Is followup information on each completer or dropout used as a means of measuring the success of the institution/organization in meeting the training program objectives?	3
9 Is the followup information collected sufficient to identify salary ranges, sex, race, etc., of former trainees?	3
10 Is there evidence to indicate that the placement and followup information is used to improve the quality of the training program?	3
11 Does the followup process include information on employer satisfaction with trainees as compared to the performance of employees who have not had similar training?	3
12 Is the trainee pass rate on the national test used in evaluating program effectiveness?	3

Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
	3.0	5%	10	7.5	

K. Training Materials

–Evidence of appropriate instructional materials (training aids, audiovisual materials, lab components)

–Evidence of current technical materials

1	Are quality instructional materials available and provided to the trainees in quantities sufficient to meet program objectives?	3
2	Are the instructional materials of sufficient variety to accommodate different trainee learning styles?	3
3	Are current service information and technical bulletins available and accessible to trainees in the lab area?	3
4	Are textbook copyright dates within five years?	3
5	Are current and industry–related periodicals available for trainee and instructor use?	3
6	Is there evidence that available instructional materials are nondiscriminatory in content?	3
7	Are consumable supplies and related training materials adequate and in quantities sufficient to meet program objectives?	3
8	Are AFV technical components and equipment used in support of the program legally certified and reviewed annually by the instructional staff?	3
9	Is documentation regarding certification of technical components and equipment available and on file?	3
10	Are donators of technical components and equipment required to provide certification documentation?	3

Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
		20%	200		138.3

Standard Three – Instructional Staff

The instructional staff must have technical competency and must be afforded regular opportunities for professional/technical development

2.7	70%	140	93.3

A. Technical Competence

–Evidence that instructional staff is technically competent using the following criteria (1) adequate work experience; (2) holding appropriate certification(s); and (3) possessing appropriate communication and teaching skills

1 Do instructors have documented relevant work experience, have they successfully completed relevant technical coursework, and have they completed an appropriate train–the–trainer program successfully?	3
2 Do instructors hold appropriate and valid certification(s) or equivalents for their content area (including but not limited to state certifications, industry certifications in electrical, engine performance, engines, advanced engine performance, and gaseous fuels, such as CNG)?	3
3 Do instructors possess appropriate communications and teaching skills as attested to by such mechanisms as instructor peer review and trainee evaluations of instruction?	2

Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
	3.0	30%	60	45.0	

B. Staff Development

–Evidence of instructor(s) maintaining technical and teaching proficiency and participating in professional development activities

1 Are instructors provided with opportunities for inservice training and professional skills development at least annually?	3
2 Are instructors provided with recent, up–to–date technical and training materials to enable them to maintain currency in their content field?	3

	Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
Standard Four--Trainee Services			10%	100		65.0

Appropriate trainee services should be provided by the institution/organization, including but not limited to admissions counseling, program advisement, recordkeeping, placement and followup.

A. Recruitment, Admissions Counseling, and Program Advisement	3.0	60%	60	45.0

--Evidence of systematic and consistent recruitment activities and admissions counseling and program advisement services

1 Are admissions policies and standards clearly expressed, openly displayed and readily available to applicants, trainees, and the general public?	3
2 Are admissions policies and standards free of bias, discrimination and role stereotyping that would adversely affect protected classes?	3
3 Are recruitment and admissions materials up--to--date and do they clearly describe the program completion requirements, all associated costs, licensing and/or certification requirements (state and federal), and potential job opportunities?	3
4 Are job--related tests or test batteries available to assist with the selection and placement of trainees in programs for which there is a reasonable chance for success?	3
5 Are comprehensive admissions counseling and program advisement services provided to trainees?	3

Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
	2.0	40%	40	20.0	

B. Placement, Followup and Occupational Enhancement Services

–Evidence of organized, systematic placement, followup and career enhancement services

1 Does the institution/organization offer job counseling, placement and followup services to trainees?	3
2 Is there an up–to–date inventory of employers and employment opportunities to facilitate placement of current trainees?	2
3 Does the institution/organization provide co–op or apprenticeship opportunities for trainees?	2
4 Are trainees encouraged to take industry recognized certification tests for which they are eligible?	2
5 Does the institution/organization have an operational plan which describes its available placement services?	1

Standard Five--Facilities	Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
			15%	150		108.9

The physical facilities must permit achievement of the program goals and performance objectives and must comply with all applicable federal, state and local regulations.

A. Health and Safety					
	3.3	45%	68	55.8	

--Evidence of appropriate facilities and equipment including:

Adequate ventilation	
1 Is there an adequate ventilation system?	3
First aid	
1 Are emergency eye--wash stations available in all training areas housing caustic or toxic substances?	3
2 Are first aid kits available, properly stocked, easily accessible, and clearly marked?	3
3 Is there a plan whereby instructors and trainees know what to do and whom to contact in case of medical emergency or injury?	2
Hazardous materials storage and use	
1 Are storage facilities adequate to accommodate solvents, flammable gases, combustible liquids, paints and solvents, etc.?	3
2 Does the program comply with Right--to--Know regulations, including Materials Storage Data Sheets (MSDS)?	3
3 Are hazardous materials appropriately labeled?	3
4 Is the storage area secured?	3
5 Are adequate spill response materials immediately available?	3
6 Are hazardous and toxic substances properly stored and separated appropriately?	3
Facility Signage	
1 Are hazardous materials storage and work areas and substances clearly identified?	3
2 Are all exits clearly marked and free from obstructions?	4

	Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
Fire Protection						
1 Do all buildings contain fire protection devices?	4					
2 Is all fire extinguishing equipment currently inspected and certified?	4					
3 Is there appropriate fire suppression and safety equipment (including but not limited to fire blankets, automated fire suppression equipment, emergency shut–off valves and switches)?	4					
4 Do instructional areas contain operating smoke detectors, gas sensors, etc.?	4					
Lighting						
1 Is there explosion–proof lighting installed?	4					
2 Is emergency lighting installed as required?	4					
3 Is lighting adequate for safety and task performance?	4					
Safety inspections						
1 Are all required safety inspections performed and documented (including but not limited to electrical, fire extinguishing equipment, gas safety sensors, smoke detectors)?	3					
Traffic area identification						
1 Are traffic areas clearly marked and color coded?	3					
Availability of electrical disconnect systems						
1 Are emergency shut–off switches for machines and equipment easily identified and reasonably accessible from the operator's position?	3					
2 Do emergency disconnect systems operate properly?	3					

Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
	3.0	25%	38	28.1	

B. Maintenance

–Evidence of regular maintenance program to ensure usability of facilities

1 Is there an effective plan for operating, maintaining and upgrading the facility and its related equipment?	3
2 Does the institution/organization place emphasis on proper maintenance, housekeeping, and inspection of all emergency and safety equipment?	3
3 Does the institution/organization provide adequate materials, equipment, supplies and personnel to operate and maintain its facilities?	3
4 Are all floors kept in good repair, free from protruding nails, splinters, holes, loose boards, obstructions, and are they treated to prevent slipping?	3
5 Are electrical receptacles and plugs in the facility, as well as those on machinery and equipment, in safe operating condition?	3
6 Are the shops and classrooms kept clean and orderly?	3
7 Is the parking lot clean, orderly, safe and secure?	3
8 Are all storage areas (vehicle, equipment and hazardous/toxic materials) clean and orderly?	3

Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
	2.0	20%	30	15.0	

C. Instructional and Support Areas

–Evidence of adequate training stations, lab space, classroom and related facilities

1 Is the legally required minimum space (square feet) per trainee allocated for laboratory experiences?	2
2 Is the legally required minimum space (square feet) per trainee allocated for classroom learning experiences?	2
3 Is there sufficient space in labs and shops to minimize hazards associated with nearby machinery and/or equipment?	2
4 Are classrooms and labs separated? If not separated, are activities scheduled to prevent simultaneous usage?	2
5 Are instructors provided with adequate office space?	2
6 Are adequate and accessible restroom facilities provided for trainee and staff use?	2

Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
	2.7	10%	15	10.0	

D. Facility Security

–Evidence that the facility is secure from vandalism and theft

1 Does the institution/organization have a security program?	3
2 Is there a method of accountability for hazardous materials, equipment, tools, supplies, keys, and vehicles?	2
3 Is there a method to assure security of trainee and staff personal materials?	3

Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
		15%	150		137.5

Standard Six--Equipment

Equipment and tools used in the training program must be of the type and quality found in the industry and must also be the type needed to provide training to meet the program goals and performance objectives

3.8	50%	75	71.9	

A. Equipment Safety

--Evidence of safety equipment
--Evidence of OSHA regulation compliance

1 Are machinery, tools, and/or other equipment maintained in a clean and safe operating condition?	4
2 Are instructional tools, instruments, machinery and equipment properly cleaned, and as appropriate, oiled, with cutting edges sharpened, stored and ready for use?	4
3 Are personal protection devices such as rubber gloves, eye and ear protectors, aprons, respirators, etc., available and used?	4
4 Where applicable, are all machinery and equipment secured to assure proper operation and safety?	4
5 Are all machinery and equipment provided with proper safety devices which are in working order and used whenever the machinery and equipment are operated?	4
6 Are equipment and machinery work areas clearly marked?	3

Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
	3.5	50%	75	65.6	

B. Equipment Type, Quality and Quantity

–Evidence of appropriate inspection, diagnostic, and evaluation equipment and accessories

1 Are sufficient equipment and/or learning stations provided to allow each trainee adequate scheduled time for practice?	3
2 Are all required equipment and materials, as specified in the model curriculum outlines, available and in sufficient quantities for the number of trainees enrolled in the program?	3
3 Are training supplies (such as consumable materials, oil, coolants, etc.) available in sufficient quantities?	4
4 Is there a plan for ordering, purchasing and maintaining the necessary inventory of equipment, parts, supplies and tools?	4

Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
		15%	200		115.4

Standard Seven--Administration

Program administration should ensure that administrative activities support and promote the goals of the program

3.3	15%	23	18.8

A. Administrative Structure

--Evidence of well functioning administrative structure
--Evidence of well defined roles, responsibilities and authority of all personnel
--Evidence of commitment to diversity and affirmative action

1 Does the institution/organization have a legal governing board/body responsible for its policies and procedures?	3
2 Have the goals and priorities of the institution/organization been identified and clearly expressed?	3
3 Does the legal governing board/body delegate authority for implementation of policy to persons responsible for the operation of the institution/organization?	3
4 Is the administration comprised of a chief executive officer/administrator (CEO/CAO) and other administrative personnel to perform duties required for the operation of the institution/organization?	3
5 Are lines of authority and responsibility clearly defined?	2
6 Are all personnel informed of the existing administrative structure, systems, policies and procedures?	4
7 Are all personnel policies and practices, including but not limited to, hiring, promotion, and dismissal in compliance with applicable civil rights and affirmative action regulations?	4
8 Is there a strategic plan and planning process for the institution/organization?	4
9 Is the strategic plan reviewed and updated quarterly?	4

Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
	3.0	30%	45	33.8	

B. Written Policies and Procedures

–Evidence of written policies and procedures regarding the operation of the training program

1 Are there clearly written job descriptions for all employees including professional and support personnel? 3

2 Are institutional/organizational policies and procedures published and distributed including but not limited to: 3

–employee recruitment
–job descriptions
–personnel hiring
–promotion
–dismissal
–benefits
–compensation
–safety
–liability
–lab/shop operation
–purchasing and inventory management
–financial and accounting procedures and controls?

3 Is there evidence of compliance with these policies and procedures? 3

Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
	3.1	20%	30	23.6	

C. Program Advisory Committee/Board

–Evidence of a functioning program advisory committee/board

1 Is there an active advisory committee/board for the program?	3
2 Does the advisory committee/board include diverse representation?	3
3 Does the advisory committee/board meet regularly?	3
4 Does the advisory committee/board include program completers, representatives from business and industry, trainees, instructors, administrators and staff?	3
5 Are minutes of advisory committee/board meetings on file?	3
6 Is the advisory committee/board involved in the strategic planning process?	3
7 Are advisory committee/board recommendations considered and implemented when appropriate?	4

Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
	3.0	25%	38	28.1	

D. Budget

–Evidence of fiscal responsbility and control

1 Is there an adequate operating program budget?	3
2 Are budget status reports periodically made available to the instructional staff?	3
3 Does the instructional staff have input into the program's budgetary process?	3
4 Is the budgeting process integrated into the strategic planning process?	3

Committee Rating 4, 3, 2 or 1	Average Rating	Weighted Percentage Standard	Points Possible Standard	Points Earned	Points Earned Standard
	3.0	10%	15	11.3	

E. **Cooperative and Apprenticeship Agreements**

–Evidence of written policies and procedures for cooperative and apprenticeship programs

1 Do cooperative and apprenticeship agreements with employers help to meet the program objectives?	3
2 Do trainee cooperative/apprenticeship policies and procedures include a well defined plan for trainee performance, employer–trainee evaluation, and mentoring?	3
3 Are program staff provided with sufficient time to supervise, coordinate and monitor trainees participating in co–op/apprenticeship activities?	3

TRAINING PROVIDERS' GUIDEBOOK TO CERTIFICATION OF ALTERNATIVELY FUELED VEHICLE TECHNICIAN TRAINING PROGRAMS

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for
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TRAINING PROVIDERS' GUIDEBOOK TO CERTIFICATION OF ALTERNATIVELY FUELED VEHICLE TECHNICIAN TRAINING PROGRAMS

CERTIFICATION OVERVIEW

The certification of technician training programs dealing with alternatively fueled vehicles (AFVs) is required under the Energy Policy Act of 1992, Title IV, Section 411, "Certification of Training Programs." *"The Secretary shall ensure that the Federal Government establishes and carries out a program for the certification of training programs for technicians who are responsible for motor vehicle installation of equipment that converts gasoline or diesel-fueled motor vehicles into dedicated vehicles or dual fueled motor vehicles, and for the maintenance of such converted motor vehicles. A training program shall not be certified under the program established under this section unless it provides technicians with instruction on the proper and safe installation procedures and techniques, adherence to specifications (including original equipment manufacturer specifications), motor vehicle operating procedures, emissions testing, and other appropriate mechanical concerns applicable to these motor vehicle conversions."*

Certification Objectives

The Program Standards section contains standards and categories against which a training provider evaluates itself. The certification is intended to impose upon training providers uniformity in instructional content, physical facilities and equipment, and level of technical competence of their instructional staff. Certification also requires evidence that measurable, performance-based outcomes have been met by the trainees. However, each training provider will be judged in light of its own administrative structure, instructional program delivery and evaluation methods, and physical facilities.

General Policies--All Training Providers

1. A listing of certified training providers is published annually by the certifying agency. Supplements showing newly-certified training providers are issued periodically.

2. Annual reports are required of all certified training providers. The certifying agency may seek continuing evidence of compliance with standards and may request special reports from some or all certified training providers.

3. Inclusion of a separate facility within the certified status of a training provider becomes effective upon approval by the certifying agency.

4. Upon awarding of certification, a tentative time shall be set for a recertification process, but the maximum period for recertification shall be five years. Complete or partial review or fact-finding site visits may be required earlier than five years by the certifying agency whenever a training provider appears to be out of compliance with certification standards.

5. Training providers may enter into contractual arrangements with business, industrial or governmental agencies for group training purposes. However, all specific certifying criteria must apply to all such group contracts.

6. Certification is the property of the certifying agency, and is to be surrendered by the training provider upon termination of its certified status. If termination of certified status occurs, the training provider must delete all references and claims of such certification from its catalogs, advertising and promotional materials immediately and in no event later than 30 days after termination.

Specific Policies--Public and Non-proprietary Training Providers

1. Training providers shall notify the certifying agency immediately of additions or major changes to courses, facilities, and other items that could materially affect the training provider's policies, staff, curricula, reputation, legal or financial status.

Specific Policies--Proprietary Training Providers

1. Certification does not automatically transfer with changes in ownership or affiliation.

2. Training providers shall notify the certifying agency immediately of changes in ownership, management, contractual affiliations with other training providers, as well as additions or major changes to courses, facilities, and other items that could materially affect the training provider's policies, staff, curricula, reputation, legal or financial status.

CERTIFICATION PROCESS

Training Program Eligibility

A training provider must meet the following criteria to be eligible for certification of alternatively fueled vehicle (AFV) technician training programs dealing with CNG and LPG systems.

1. All AFV training providers may be eligible to seek certification.

2. A training provider must be legally established (as a corporation, partnership, sole proprietorship, etc.) and reported as such to the appropriate agencies.

3. A training provider must be in compliance with federal, state, and local government requirements. At the time of application, the training provider should have trainees who have completed the program. However, for new training programs seeking initial certification, provisional certification may be requested.

Application for Certification

Step 1: Request Certification Information

Training providers should request the application form and information packet from the Certifying Agency.

Step 2: Complete Application Form and Related Documentation

To establish its eligibility for certification, a training provider must submit (1) a letter of intent to seek initial or continuing certification, (2) a completed "*Application Form*" that provides basic information about the training program, (3) the appropriate documentation attesting that all preconditions are met, (4) all data/attachments requested on the "*Application Form*", and (5) a non-refundable application fee.

Step 3: Attend Certification Workshop

A designated person, acting on behalf of the chief executive officer and responsible for the day-to-day operation of a training provider applying for initial certification or renewal of certification, is required to attend a certification workshop prior to undertaking a self-study.

Step 4: Conduct Self-Study and Submit Report to Certifying Agency

An eligible training provider must initiate a self-study process which provides an opportunity for the training provider to evaluate itself against national certification standards. There are seven program standards: five mandatory and two non-mandatory. Within these seven standards, there are 27 categories, which contain questions pertinent to certification and over which 1,000 points have been distributed proportionately. Mandatory standards contain the word "must" and are to be construed as essential requirements. Non-mandatory standards contain the word "should" and are to be construed as highly desirable because compliance with these standards adds strength and quality to the program. Each standard and category has been weighted by a team of experts for its relative importance in certifying AFV technician training programs.

Seventy-five percent of the points in the five mandatory standards must be achieved on the self-study for the training provider to be eligible for a site visit by the certifying agency review team.

A low score in the two non-mandatory standards will not be used in determining eligibility for a site visit. However, achievement of high scores on the two non-mandatory standards will be recommending in those instances where compliance with the five mandatory standards is marginal or borderline.

Step 5: Conduct On-site Review

For training providers deemed eligible for a site visit, a three-person Certifying Agency Review Team (CART) will conduct an on-site visit. The CART will be comprised of (1) a master AFV technician, (2) a professional educator/trainer, and (3) an educational/training administrator.

The master AFV technician will focus on the categories related to curriculum; health and safety standards; trainee materials; individualized training plans; technical competence of instructional staff; professional staff development; physical facilities; maintenance and security; instructional and support areas; equipment safety, type, quality and quantity; and cooperative and apprenticeship agreements.

The professional educator/trainer will focus on the categories related to the program plan; individualized training plans; trainee performance standards; provisions for individual differences; testing; and program evaluation.

The educational/training administrator will focus on the categories relating to program purpose; instructional load; recruitment, admissions counseling and program advisement; trainee recordkeeping, placement, follow-up and occupational enhancement services; facility security; administrative structure; written policies and procedures; program advisory committee/board; budget; and cooperative and apprenticeship agreements.

While on site, the team will interview instructors, trainees, administrators, program completers, employers, program advisors, and others involved in the training program and will review written documentation. The CART will document discrepancies between the training provider's self-study and its own on-site findings.

Step 6: Conduct Exit Interview

The CART will conduct an exit interview with the chief administrative and instructional officers to inform the training provider of its preliminary findings.

Step 7: Prepare and Disseminate Official CART Report

Following the on-site review by the CART, an official written report of the team's findings will be compiled by the team chair. The report will indicate the degree to which the standards were met. The report also will list strengths and weaknesses as identified by the responses to the questions within each category.

The report will be submitted to the certifying agency and to the training provider simultaneously. The training provider is required to acknowledge receipt of the report and is given an opportunity to comment on it. Within 30 days of receipt of the report, the training provider may supply the certifying agency with supplemental materials pertinent to the facts and conclusions found in the written report.

Step 8: Certification Decision

The certifying agency will then take action on certification. Four types of certification decisions are possible:

1. Full Certification for initial or continuing certification, which might be accompanied by statements of weakness, but nonetheless is unequivocal.

2. Provisional Certification for new training programs without completers, or for continuing certification of training programs for which critical deficiencies have been identified that must be addressed and corrected by the training provider prior to granting full recertification.

3. Denial, which prohibits initial or continuing certification.

4. Revocation, which terminates current certification.

APPEALS PROCESS

Any training provider may appeal an adverse certification decision only on the grounds that (1) the Program Standards were disregarded, (2) stated on-site review procedures were not followed, (3) evidence favorable to the training provider was provided to the certifying agency but was not considered, or (4) evidence was presented to the certifying agency in rebuttal form but was not considered. The status of the appellant remains unchanged during the time when the review process is taking place.

Each appeal will be heard by an Appeals Panel consisting of five members selected by the certifying agency. Prior to the Appeals Panel meeting, the training provider is advised of the names and affiliations of members of the Appeals Panel. If the training provider has good cause to believe any member of the Appeals Panel should not hear the appeal, it must promptly notify the certifying agency of its contention and the reasons for it.

The following provisions govern the appeals process:

1. Any training provider electing to appeal an adverse decision of the certifying agency must present written notification of its intention to appeal within 15 days after it receives notice of the adverse decision.

2. No later than 30 days from the date that it submits its notification, the training provider must submit a brief to the certifying agency which sets forth the specifics of its appeal and includes full documentation.

3. The certifying agency will appoint an Appeals Panel to hear the appeal. One of the appointees will be designated as chair.

4. The Appeals Panel will act on the appeal no later than 30 days after submission of the appellant's brief.

5. If the appeal leads to an affirmation of the certifying agency's original decision, the appellant will be liable for the expenses of the Appeals Panel.

6. A training provider may reapply six months from the date on which the revocation or denial of certification becomes effective.

Certification Fees

To be determined

CERTIFICATION PROGRAM STANDARDS

There are seven program standards: five mandatory and two non-mandatory. Mandatory standards contain the word "must" and are to be construed as essential requirements. Non-mandatory standards contain the word "should" and are to be construed as highly desirable attributes which add strength and quality to the training program. Within these seven standards, there are 27 categories, which contain questions pertinent to certification and over which 1,000 points have been distributed proportionately. Each standard and category has been weighted by a team of experts for its relative importance in certifying AFV technician training programs.

Seventy-five percent of the points in the five mandatory standards must be achieved on the self-study for the training provider to be eligible for a site visit by the certifying agency review team.

Each category has a series of questions to be answered by the certification applicant using the criteria defined on the 4-to-1 rating scale as follows:

4. Exceptional, Above Average
3. Acceptable, Average
2. Somewhat Acceptable, Needs Improvement
1. Unacceptable

A low score in the two non-mandatory standards will not be used in determining eligibility for a site visit. However, achievement of high scores on the two non-mandatory standards will be recommending in those instances where compliance with the five mandatory standards is marginal or borderline.

Standard One--Purpose
National gaseous fuels training programs must have clearly stated program performance goals and must be related to the needs of the technicians, employers, and vehicle owners/operators.

A. Program Purpose
Evidence of clearly stated program performance goals

1. Does the statement of purpose indicate that the training provider's mission is to provide instruction which qualifies people for employment or advancement in the alternatively fueled vehicles (AFV) industry?

2. Does the statement of purpose indicate that the program's performance goals reflect the needs of the technicians to be trained and the needs of employers and vehicle owners/operators to have access to trained AFV technicians?

Standard Two--Instruction

Instruction must be systematic and reflect program goals. A task list and specific performance objectives with criterion-referenced measures must be used. Support materials consistent with program goals and performance objectives must be available to staff and trainees

A. Program Plan

-Evidence that curriculum is logically sequenced
-Evidence that goals articulate with curriculum
-Evidence that goals are measurable

1. Is the instructional program organized to provide trainees with the knowledge and skills development necessary for employment at the level of the training program; that is, entry, journeyman or master technician/trainer?

2. Have specific competencies been organized into a logical sequence for the program?

3. Have prerequisite knowledges (math, communication, technology, etc.) been identified and integrated, as required, to assure trainee success in the content area?

4. Does the program plan reflect the most current technologies (including facilities, instructional staff, curriculum, budget, administration, etc.)?

5. Is there evidence that the program content is updated annually?

6. Does the instructional program reflect the needs of the vehicle and equipment manufacturers and owners/operators?

7. Is there evidence of on-going coordination with and support from the vehicle and equipment manufacturers?

B. Individualized Training Plans

-Evidence that trainees are provided a copy of an individualized training plan

1. Is each trainee provided a planned sequence of courses and/or tasks necessary to complete the program successfully?

2. Are trainees provided with individual progress sheets indicating tasks that have been mastered?

C. Trainee Recordkeeping System

-Evidence of permanent trainee recordkeeping system

1. Are performance records of trainees permanently maintained?

2. Are transcripts and/or certificates of trainee performance available to trainees and employers (with written permission of trainee)?

D. Instructional Load

-Evidence of appropriate instructional load

-Evidence of appropriate trainee-instructor ratio consistent with quality educational norms and prevailing safety practices

1. Is there a plan to assure that a qualified instructor is available at all times?

2. Is the trainee-instructor ratio sufficient for individual interaction and safety?

3. Does the instructor workload allow for opportunities to plan, develop, and evaluate the program?

4. Do workload assignments accommodate instructors' involvement in administrative activities, including curriculum development, committee work, advising, counseling, tutoring, etc.?

5. Is there evidence that the workload permits on-going coordination with industry?

E. Curriculum

-Evidence that curriculum is consistent with nationally developed task lists and provides adequate time to accomplish program objectives

-Evidence of an adequate balance between lecture and hands-on lab experiences

1. Is there evidence that the program content contains the duties, tasks, and steps defined in the nationally developed model curriculum outline for the level of training offered; that is, entry, journeyman, master technican/trainer?

2. Is the curriculum organized to provide knowledge and skills development necessary for employment at the level of the training provided?

3. Have the specific trainee outcomes (or competencies) been identified?

4. Is the curriculum organized to ensure individual trainee participation?

5. Are courses or units of instruction based upon defined and measurable trainee competencies required for employment?

6. Do instructors follow updated lesson plans to assure that all material is covered?

7. Is instructional time adjusted to allow for mastery of the content?

8. Does the curriculum provide for sufficient classroom time and hands-on lab activities (including but not limited to co-op and apprenticeship) to permit trainees to achieve the learning outcomes?

9. Are applied math and science, as well as communications and interpersonal skills, provided for in the program?

10. Are there written policies which stipulate the restrictions that apply to live work such as approvals, institutional/organizational liability and handling of funds?

11. Is the live work related to training for the acquisition of occupational skills which the program purports to develop, and is it assigned to individuals, or to groups of trainees, for the purpose of such skills development?

12. Does the program provide technicians at all levels with clear, concise instruction on the proper and safe operation, installation, repair, and maintenance procedures and techniques for alternatively fueled vehicles?

F. Trainee Performance Standards

-Evidence that performance standards are consistent with learning objectives including knowledge, skills, and the ability to perform tasks

1. Is there a system for evaluating trainee achievement based upon established learning outcomes?

2. Are specific criteria defined to measure trainee attainment of performance objectives?

3. Are trainees evaluated for their knowledge, skills, and ability to perform tasks?

4. Are performance standards based upon nationally defined and measurable trainee competencies required for employment?

G. Health and Safety Standards

-Evidence that health and safety training is integrated into the instructional program

1. Is health and safety training integrated into all aspects of the instructional program?

2. Are health and safety practices, procedures, and facilities in compliance with all applicable federal, state and local regulations?

3. Are health and safety training and testing provided prior to lab experiences?

H. Provisions for Individual Differences

-Evidence of accommodating learning differences

1. Are learning experiences individualized so that all trainees are provided an opportunity to achieve program objectives?

2. Is a formal pretesting process used to assess trainee abilities in reading, mathematics, and mechanical skills to evaluate readiness and to assure a reasonable probability of success?

3. Is instruction provided to trainees needing remediation in the areas of reading, mathematics, and mechanical skills?

4. Does the program provide for 'reasonable accommodation' as required by the Americans With Disabilities Act (ADA)?

I. Testing

-Evidence that written and performance tests are administered
-Evidence that tests are criterion-based

1. Are both written and performance-based tests used to validate trainee competencies?

2. Are continuous efforts made to determine if the evaluation methods used to measure trainee achievement are valid and reliable?

3. Is there a procedure for evaluating trainee performance on live work projects and/or co-op and apprenticeship projects?

4. Are trainees able to pass a national written and performance test based on the national model curriculum outline for the appropriate level; that is, entry, journeyman, or master technician/trainer?

J. Program Evaluation

-Evidence of a systematic course and instructor evaluation process that includes trainee input
-Evidence of an on-going program monitoring and evaluation process

1. Is there a continuous and systematic process to evaluate the curriculum, the lab tools and equipment, and the competencies of each trainee who completes the program?

2. Are trainee evaluations used to assess instructor effectiveness and program quality?

3. Is the advisory committee/board actively involved in program planning and evaluation?

4. Do instructors use trainee followup data to make judgments regarding program content, length and relevancy?

5. Does the history of trainee enrollments, retention, job placement, and followup data indicate that adequate planning and evaluation are integral components of the program?

6. Is job followup information collected on completers annually for a three-year period?

7. Is followup information collected on dropouts regarding reasons for leaving?

8. Is followup information on each completer or dropout used as a means of measuring the success of the institution/organization in meeting the training program objectives?

9. Is the followup information collected sufficient to identify salary ranges, sex, race, etc., of former trainees?

10. Is there evidence to indicate that the placement and followup information is used to improve the quality of the training program?

11. Does the followup process include information on employer satisfaction with trainees as compared to the performance of employees who have not had similar training?

12. Is the trainee pass rate on the national test used in evaluating program effectiveness?

K. Training Materials

-Evidence of appropriate instructional materials (training aids, audiovisual materials, lab components)

-Evidence of current technical materials

1. Are quality instructional materials available and provided to the trainees in quantities sufficient to meet program objectives?

2. Are the instructional materials of sufficient variety to accommodate different trainee learning styles?

3. Are current service information and technical bulletins available and accessible to trainees in the lab area?

4. Are textbook copyright dates within five years?

5. Are current and industry-related periodicals available for trainee and instructor use?

6. Is there evidence that available instructional materials are nondiscriminatory in content?

7. Are consumable supplies and related training materials adequate and in quantities sufficient to meet program objectives?

8. Are AFV technical components and equipment used in support of the program legally certified and reviewed annually by the instructional staff?

9. Is documentation regarding certification of technical components and equipment available and on file?

10. Are donators of technical components and equipment required to provide certification documentation?

Standard Three--Instructional Staff
The instructional staff must have technical competency and must be afforded regular opportunities for professional/technical development

A. Technical Competence
-Evidence that instructional staff is technically competent using the following criteria (1) adequate work experience; (2) holding appropriate certification(s); and (3) possessing appropriate communication and teaching skills

1. Do instructors have documented relevant work experience, have they successfully completed relevant technical coursework, and have they completed an appropriate train-the-trainer program successfully?

2. Do instructors hold appropriate and valid certification(s) or equivalents for their content area (including but not limited to state certifications, industry certifications in electrical, engine performance, engines, advanced engine performance, and gaseous fuels, such as CNG)?

3. Do instructors possess appropriate communication and teaching skills as attested to by such mechanisms as instructor peer review and trainee evaluations of instructors?

B. Staff Development
-Evidence of instructor(s) maintaining technical and teaching proficiency and participating in professional development activities

1. Are instructors provided with opportunities for inservice training and professional skills development at least annually?

2. Are instructors provided with recent, up-to-date technical and training materials to enable them to maintain currency in their content field?

Standard Four--Trainee Services

Appropriate trainee services should be provided by the institution/organization, including but not limited to admissions counseling, program advisement, recordkeeping, placement and followup.

A. Recruitment, Admissions Counseling, and Program Advisement

-Evidence of systematic and consistent recruitment activities and admissions counseling and program advisement services

1. Are admissions policies and standards clearly expressed, openly displayed and readily available to applicants, trainees, and the general public?

2. Are admissions policies and standards free of bias, discrimination and role stereotyping that would adversely affect protected classes?

3. Are recruitment and admissions materials up-to-date and do they clearly describe the program completion requirements, all associated costs, licensing and/or certification requirements (state and federal), and potential job opportunities?

4. Are job-related tests or test batteries available to assist with the selection and placement of trainees in programs for which there is a reasonable chance for success?

5. Are comprehensive admissions counseling and program advisement services provided to trainees?

B. Placement, Followup and Occupational Enhancement Services

-Evidence of organized, systematic placement, followup and career enhancement services

1. Does the institution/organization offer job counseling, placement and followup services to trainees?

2. Is there an up-to-date inventory of employers and employment opportunities to facilitate placement of current trainees?

3. Does the institution/organization provide co-op or apprenticeship opportunities for trainees?

4. Are trainees encouraged to take industry recognized certification tests for which they are eligible?

5. Does the institution/organization have an operational plan which describes its available placement services?

Standard Five--Facilities
The physical facilities must permit achievement of the program goals and performance objectives and must comply with all applicable federal, state and local regulations.

A. Health and Safety
-Evidence of appropriate facilities and equipment including:

Adequate ventilation

1. Is there an adequate ventilation system?

First aid

1. Are emergency eye-wash stations available in all training areas housing caustic or toxic substances?

2. Are first aid kits available, properly stocked, easily accessible, and clearly marked?

3. Is there a plan whereby instructors and trainees know what to do and whom to contact in case of medical emergency or injury?

Hazardous materials storage and use

1. Are storage facilities adequate to accommodate solvents, flammable gases, combustible liquids, paints and solvents, etc.?

2. Does the program comply with Right-to-Know regulations, including Materials Storage Data Sheets (MSDS)?

3. Are hazardous materials appropriately labeled?

4. Is the storage area secured?

5. Are adequate spill response materials immediately available?

6. Are hazardous and toxic substances properly stored and separated appropriately?

Facility Signage

1. Are hazardous materials storage and work areas and substances clearly identified?

2. Are all exits clearly marked and free from obstructions?

Fire Protection

1. Do all buildings contain fire protection devices?

2. Is all fire extinguishing equipment currently inspected and certified?

3. Is there appropriate fire suppression and safety equipment (including but not limited to fire blankets, automated fire suppression equipment, emergency shut-off valves and switches)?

4. Do instructional areas contain operating smoke detectors, gas sensors, etc.?

Lighting

1. Is there explosion-proof lighting installed?

2. Is emergency lighting installed as required?

3. Is lighting adequate for safety and task performance?

Safety inspections

1. Are all required safety inspections performed and documented (including but not limited to electrical, fire extinguishing equipment, gas safety sensors, smoke detectors)?

Traffic area identification

1. Are traffic areas clearly marked and color coded?

Availability of electrical disconnect systems

1. Are emergency shut-off switches for machines and equipment easily identified and reasonably accessible from the operator's position?

2. Do emergency disconnect systems operate properly?

B. Maintenance

-Evidence of regular maintenance program to ensure usability of facilities

1. Is there an effective plan for operating, maintaining and upgrading the facility and its related equipment?

2. Does the institution/organization place emphasis on proper maintenance, housekeeping, and inspection of all emergency and safety equipment?

3. Does the institution/organization provide adequate materials, equipment, supplies and personnel to operate and maintain its facilities?

4. Are all floors kept in good repair, free from protruding nails, splinters, holes, loose boards, obstructions, and are they treated to prevent slipping?

5. Are electrical receptacles and plugs in the facility, as well as those on machinery and equipment, in safe operating condition?

6. Are the shops and classrooms kept clean and orderly?

7. Is the parking lot clean, orderly, safe and secure?

8. Are all storage areas (vehicle, equipment and hazardous/toxic materials) clean and orderly?

C. Instructional and Support Areas

-Evidence of adequate training stations, lab space, classroom and related facilities

1. Is the legally required minimum space (square feet) per trainee allocated for laboratory experiences?

2. Is the legally required minimum space (square feet) per trainee allocated for classroom learning experiences?

3. Is there sufficient space in labs and shops to minimize hazards associated with nearby machinery and/or equipment?

4. Are classrooms and labs separated? If not separated, are activities scheduled to prevent simultaneous usage?

5. Are instructors provided with adequate office space?

6. Are adequate and accessible restroom facilities provided for trainee and staff use?

D. Facility Security

-Evidence that the facility is secure from vandalism and theft

1. Does the institution/organization have a security program?

2. Is there a method of accountability for hazardous materials, equipment, tools, supplies, keys, and vehicles?

3. Is there a method to assure security of trainee and staff personal materials?

Standard Six--Equipment

Equipment and tools used in the training program must be of the type and quality found in the industry and must also be the type needed to provide training to meet the program goals and performance objectives

A. Equipment Safety

-Evidence of safety equipment

-Evidence of OSHA regulation compliance

1. Are machinery, tools, and/or other equipment maintained in a clean and safe operating condition?

2. Are instructional tools, instruments, machinery and equipment properly cleaned, and as appropriate, oiled, with cutting edges sharpened, stored and ready for use?

3. Are personal protection devices such as rubber gloves, eye and ear protectors, aprons, respirators, etc., available and used?

4. Where applicable, are all machinery and equipment secured to assure proper operation and safety?

5. Are all machinery and equipment provided with proper safety devices which are in working order and used whenever the machinery and equipment are operated?

6. Are equipment and machinery work areas clearly marked?

B. Equipment Type, Quality and Quantity

-Evidence of appropriate inspection, diagnostic, and evaluation equipment and accessories

1. Are sufficient equipment and/or learning stations provided to allow each trainee adequate scheduled time for practice?

2. Are all required equipment and materials, as specified in the model curriculum outlines, available and in sufficient quantities for the number of trainees enrolled in the program?

3. Are training supplies (such as consumable materials, oil, coolants, etc.) available in sufficient quantities?

4. Is there a plan for ordering, purchasing and maintaining the necessary inventory of equipment, parts, supplies and tools?

Standard Seven--Administration
Program administration should ensure that administrative activities support and promote the goals of the program

A. Administrative Structure
-Evidence of well functioning administrative structure
-Evidence of well defined roles, responsibilities and authority of all personnel
-Evidence of commitment to diversity and affirmative action

1. Does the institution/organization have a legal governing board/body responsible for its policies and procedures?

2. Have the goals and priorities of the institution/organization been identified and clearly expressed?

3. Does the legal governing board/body delegate authority for implementation of policy to persons responsible for the operation of the institution/organization?

4. Is the administration comprised of a chief executive officer/administrator (CEO/CAO) and other administrative personnel to perform duties required for the operation of the institution/organization?

5. Are lines of authority and responsibility clearly defined?

6. Are all personnel informed of the existing administrative structure, systems, policies and procedures?

7. Are all personnel policies and practices, including but not limited to, hiring, promotion, and dismissal in compliance with applicable civil rights and affirmative action regulations?

8. Is there a strategic plan and planning process for the institution/organization?

9. Is the strategic plan reviewed and updated quarterly?

B. Written Policies and Procedures

-Evidence of written policies and procedures regarding the operation of the training program

1. Are there clearly written job descriptions for all employees including professional and support personnel?

2. Are institutional/organizational policies and procedures published and distributed including but not limited to:

   -employee recruitment
   -job descriptions
   -personnel hiring
   -promotion
   -dismissal
   -benefits
   -compensation
   -safety
   -liability
   -lab/shop operation
   -purchasing and inventory management
   -financial and accounting procedures and controls?

3. Is there evidence of compliance with these policies and procedures?

C. Program Advisory Committee/Board

-Evidence of a functioning program advisory committee/board

1. Is there an active advisory committee/board for the program?

2. Does the advisory committee/board include diverse representation?

3. Does the advisory committee/board meet regularly?

4. Does the advisory committee/board include program completers, representatives from business and industry, trainees, instructors, administrators, and staff?

5. Are minutes of advisory committee/board meetings on file?

6. Is the advisory committee/board involved in the strategic planning process?

7. Are advisory committee/board recommendations considered and implemented when appropriate?

D. Budget

-Evidence of fiscal responsibility and control

1. Is there an adequate operating program budget?
2. Are budget status reports periodically made available to the instructional staff?
3. Does the instructional staff have input into the program's budgetary process?
4. Is the budgeting process integrated into the strategic planning process?

E. Cooperative and Apprenticeship Agreements

-Evidence of written policies and procedures for cooperative and apprenticeship programs

1. Do cooperative and apprenticeship agreements with employers help to meet the program objectives?
2. Do trainee cooperative/apprenticeship policies and procedures include a well defined plan for trainee performance, employer-trainee evaluation, and mentoring?
3. Are program staff provided with sufficient time to supervise, coordinate and monitor trainees participating in co-op/apprenticeship activities?

APPLICATION FOR CERTIFICATION

Please check box, as appropriate

_____ Initial Full Certification
_____ Provisional Certification
_____ Renewal (recertification)

Name of Training Provider: _____

Address: _____

City, State, ZIP _____

Telephone Number: _____ Fax Number: _____

1. The training provider has been training individuals continuously (except for regular scheduled vacation periods) since _____ (month/year) and approximately _____ trainees have completed the AFV technician training offered by the training provider.

2. Please list all states that currently license the training provider, the original date of license became effective and the expiration date (if any):

STATE(S)	ORIGINAL EFFECTIVE DATE	EXPIRATION DATE

3. Is the training provider or any of its owners or administrators directly or indirectly affiliated with any other training provider? Yes_____ No _____
If yes, please attach a list of all affiliations, including name, address, type of training provider, and certifying/accrediting agency.

4. Does the training provider have any separate facilities? Yes ____ No ____
If yes, please attach a list of the names and locations of all separate facilities, including branches and separate classrooms.

5. Is the training provider certified/accredited or is it a candidate for certification/accreditation by any other certifying/accrediting commission?
Yes _____ No _____ If yes, please complete the following:

CERTIFYING/ACCREDITING AGENCY	DATE OF INITIAL CERTIFICATION/ ACCREDITATION	DATE OF LAST REVIEW	NEXT SCHEDULED REVIEW DATE

6. Has the training provider ever been denied certification/accreditation, removed from certification/accreditation or voluntarily withdrawn its certification/accreditation?
Yes ____ No ____

If yes, please complete the following and provide a detailed explanation of the circumstances involved in the action:

CERTIFYING/ACCREDITING AGENCY	DATE OF ACTION	NATURE OF ACTION AND REASONS

This application is submitted by the owner and/or chief executive officer of the training provider for which certification is sought, and that official attests to the following:

Type of Training Provider

Please indicate the following as appropriate:

1. ____ public a. (postsecondary) b. (secondary)
   ____ private a. (non-proprietary) b. (proprietary)
   ____ other: _____

2. Training provider officials have reviewed the program standards for certification and supporting materials of the certifying agency.

3. Training provider officials fully accept and support the concept of certification as a process involving peer review and a necessary degree of confidentiality in decision-making and recordkeeping.

4. Training provider officials understand that, in applying for certification, the training provider:

   a. submits itself to a periodic review and a reasoned judgment by the certifying agency as to the training provider's qualifications;

   b. has every opportunity, as part of the certification process, to present itself in its best light and to respond to every concern;

   c. assumes an obligation to be forthcoming, complete and accurate in presenting information to, and answering questions from, the certifying agency;

   d. can exercise the right to appeal an adverse decision rendered by the certifying agency, thereby assuring an appellate review; and

   e. accepts responsibility to comply with the Certification Program Standards.

5. This training provider is legally established (as a corporation, partnership, sole proprietorship, etc.) and reported as such to the appropriate state agencies, U.S. Department of Education, and other certifying/accrediting bodies.

6. The training provider describes itself in identical terms to each certificating/accrediting body with regard to identify, purpose, governance, programs, degrees, diplomas, certificates, personnel, finances, constituents served, and keeps each certifying/accrediting body apprised of any change in status.

I attest that the information supplied herein and attached hereto is correct:

Name: _____ **Title:** _____

Signature: _____ **Date:** _____

This application is submitted by the owner and/or chief executive officer of the training provider for which certification is sought, and that official agrees to the following:

1. The designated person, acting on behalf of the chief executive officer and responsible for the day-to-day operation of the training provider applying for initial certification, is required to attend a certification workshop prior to the submission of the Self-Study.

2. This training provider will not make any promotional use of its application for certification prior to actual certification.

3. The certifying agency has permission to contact the appropriate state agencies, the state and federal departments of education, other certifying/accrediting agencies, or any other organizations deemed appropriate for review of this application.

Name _____ Title: _____
(Owner/Chief Executive Officer)

Signature: _____ Date: _____

Attachments to this Application:

1. Check for $_____ (non-refundable) processing fee.

2. Copy of the training provider's catalog and/or program announcement.

3. Copy of the training provider's enrollment agreement.

4. Copies of the training provider's current promotional and enrollment materials (including radio, television, and newsprint advertisement).

5. Copy of the training program's state license.

6. A list of current sites offering the training program.

7. If a private proprietary corporation, list the names, addresses and percentages of ownership for each person or organization owning ten percent or more of the voting stock. If a public proprietary corporation, submit a copy of the most recent annual report.

THIS APPLICATION BECOMES INVALID SIX (6) MONTHS FROM THE DATE OF SUBMISSION IF NOT ACCEPTED.