U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

400 Seventh Street, S.W.
Washington, D.C. 20590

Dear Crash Data Researchers/Users:

Thank you for choosing crash data from the National Highway Traffic Safety Administration (NHTSA) for your research or other use. The information contained in this motor vehicle crash report is collected, maintained and distributed in accordance with Public Law 89-564. In accordance with this Public Law, NHTSA is required not to release any case information until completion of quality control procedures. These procedures include a review of the case material to extract all names, licenses and registration numbers, non-coded interview material, non-research related researcher comments in the margins, non-factual data, and the production number portion of the vehicle identification number (VIN).

If you requested NHTSA to query its database files in order to identify a specific crash, then that query was made using non-personal descriptors you provided for use in our search. This motor vehicle crash may have been identified from a data search and matches the general, non-personal descriptors you provided, but we cannot confirm that this is the specific crash report you requested.

If you have any questions with regard to the above procedures, please contact the Field Operations Branch, Crash Investigation Division, National Center for Statistics and Analysis at 202-366-4820. Again, please be advised that we cannot confirm that this is the case that you have specifically requested nor can we certify the information to be correct.

*** *** ***

DYNAMIC SCIENCE, INC.
In-Depth Accident Investigation

Contract DTNH22-94-D-27058
Case DSI-94-EV-14

1994

TECHNICAL SUMMARY

CONTRACTOR:	Dynamic Science, Inc.
CONTRACT NUMBER:	DTNH22-94-D-27058
CASE NUMBER:	Case DSI-94-EV-14

This battery-fire incident occurred on 1994 at 0635 hours in the city of Vehicle 1, a battery-operated 1994 Ford Ecostar van, was parked at a designated recharging station. The batteries were in the process of being recharged.

A small fire broke out in the battery. According to Ford, "This was caused by a high resistance condition within a looping element that had previously activated to bypass a group of weak cells (The battery has 480 cells divided into 80 groups of 6 each, which are then connected together to form the total battery). Each looping element will allow the battery to bypass a group of six cells if a problem is present within the group. If a problem occurs, the looping element, which is normally open, will close and the six cells with then be excluded from the total battery. Analysis of the failed battery determined that an activated looping element reopened causing an increase due to high resistance in the group of weak cells causing the fire. The most probable cause for an activated looping element to develop high resistance after months of proper operation is motion of the looping element contacts due to thermal and/or mechanical stresses in the battery."

The fire burned through the wooden floor above the battery. The floorboard carpet also caught on fire.

The fire department was called and did respond. Initially, fire personnel attempted to extinquish the fire using a metal-x class D extinquishing agent[1] and water from a handline. Neither technique was successful.

A fire official on the scene detected the smell of sulfur in the air and requested that the building adjacent to the vehicle be evacuated and fans set up to ventilate the area.

A second fire unit arrived and attempted to extinquish the fire using the metal-x extinquisher. There was again no success, but the fire appeared less intense than before.

An official associated with the local facility indicated to fire personnel that the fire would subside in approximately 45 minutes as the batteries decreased in strength. He also indicated that the use of water to decrease the intensity of the fire was acceptable.

The fire was extinquished and the fire department ceased operations at 0850 hours.

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[1]Met-l-x is a class D fire extinguisher specifically for use with metal fires such as magnesium. It and lith-x are the only agents currently used for that purpose. Met-l-x is a specific patented trade name agent as is lith-x. Lith-x is mostly graphite and clay, met-l-x is salt based with an inert agent and a chemical to make it react in heat to form a skin over the burning metal.

Vehicle 1 sustained moderate interior damage, including the carpet and floor board. The level of damage to the battery itself is not known, but it can be assumed that it is no longer usable. Vehicle 1 was eventually removed from the scene by an enclosed moving van and presumably transported from to

This research was supported (in part) by the National Highway Traffic Safety Administration (NHTSA), U.S. Department of Transportation, under contract number DTNH22-94-D-27058. The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the NHTSA.

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

DYNAMIC SCIENCE, INC.
ACCIDENT INVESTIGATION
CASE NUMBER: DSI-94-EV-14

TABLE OF CONTENTS

Abbreviations Used In Scene And Photographic Documentation

ft	Feet
in	Inches
AIS	Abbreviated Injury Scale
BLF	Begin Left Front
BLR	Begin Left Rear
BRF	Begin Right Front
BRR	Begin Right Rear
CBE	Cab Behind Engine
CCW	Counterclockwise
CDC	Collision Deformation Classification
CG	Center of Gravity
CM	Centimeter
COE	Cab Over Engine
CW	Clockwise
E, EB	East, Eastbound
ELF	End Left Front
ELR	End Left Rear
ERF	End Right Front
ERR	End Right Rear
FRP	Final Rest Position
I	Interstate Highway
IP	Intermediate Point
KG	Kilogram
KPH	Kilometers Per Hour
LF	Left Front
LR	Left Rear
M	Meter
N, NB	North, Northbound
NE	Northeast
NW	Northwest
PDOF	Principal Direction of Force
POI	Point of Impact
RF	Right Front
RL	Reference Line
RP	Reference Point
RR	Right Rear
S, SB	South, Southbound
SE	Southeast
SW	Southwest
U.S.	United States Highway
V1	Vehicle Number 1
W, WB	West, Westbound

ACCIDENT DATA:

Location:	
Area/Type:	Urban/Private property
Date/Time:	1994 / 0635
Accident Type:	Fire

AMBIENCE:

Viewing Conditions:	NA
Cloud Cover:	Unknown
Precipitation:	None
Temperature:	16 to 23° C (60 to 74° F)

VEHICLES:

		VEHICLE 1
Description:		1994 Ford Ecostar Electric Van
Odometer:		Unknown
Engine:		Single air-cooled 3-phase AC induction
Battery:		
	Manufacturer	Asea Brown-Boveri (ABB)
	Type	sodium/sulfur
	No. of cells	480
	Total weight	349 kgs (770 lbs)
	Total volume	9.0 cu ft
	Total voltage	330 @ approx 80 amps
	Maximum power	50 kW
	Operating temperature	290-350° C (554-662° F)
	Cooling	recirculated dibenzyltoluene
	Heating	internal resistance heater
Charging		
	Charger	110 to 250 V AC
	Recharge time, from 20%	
	110 V, 15 A	18-24 hrs
	240 V, 30 A	6-7 hrs
Vehicle Modifications:		Electric
Tire Condition:		Unknown
Manual Restraints:		Unknown
Automatic Restraints:		Unknown
Reported Defects:		None
Cargo:		None
Windshield Damage:		None

Fleet:	Ford Motor Company
Tow Status:	Unknown

VEHICLE DAMAGE:

Vehicle 1 sustained moderate interior damage, including the carpet and floor board. The level of damage to the battery itself is not known, but it can be assumed that it is no longer usable. Vehicle 1 was eventually removed from the scene by an enclosed moving van and presumably transported from to

INCIDENT SEQUENCE:

Vehicle 1, a battery-operated 1994 Ford Ecostar van, was parked at a designated recharging station. The batteries were in the process of being recharged. A small fire broke out in the battery. According to Ford, "This was caused by a high resistance condition within a looping element that had previously activated to bypass a group of weak cells (The battery has 480 cells divided into 80 groups of 6 each, which are then connected together to form the total battery). Each looping element will allow the battery to bypass a group of six cells if a problem is present within the group. If a problem occurs, the looping element, which is normally open, will close and the six cells with then be excluded from the total battery. Analysis of the failed battery determined that an activated looping element reopened causing an increase due to high resistance in the group of weak cells causing the fire. The most probable cause for an activated looping element to develop high resistance after months of proper operation is motion of the looping element contacts due to thermal and/or mechanical stresses in the battery."

The fire department was called and did respond. Initially, fire personnel attempted to extinquish the fire using a metal-x class D extinquishing agent and water from a handline. Neither technique was successful. A fire official on the scene detected the smell of sulfur in the air and requested that the building adjacent to the vehicle be evacuated and fans set up to ventilate the area. A second fire unit arrived and attempted to extinquish the fire using the metal-x extinquisher. There was again no success, but the fire appeared less intense than before. An official associated with the local facility indicated to fire personnel that the fire would subside in approximately 45 minutes as the batteries decreased in strength. He also indicated that the use of water to decrease the intensity of the fire was acceptable.

The fire was extinquished and the fire department ceased operations at 0850 hours.

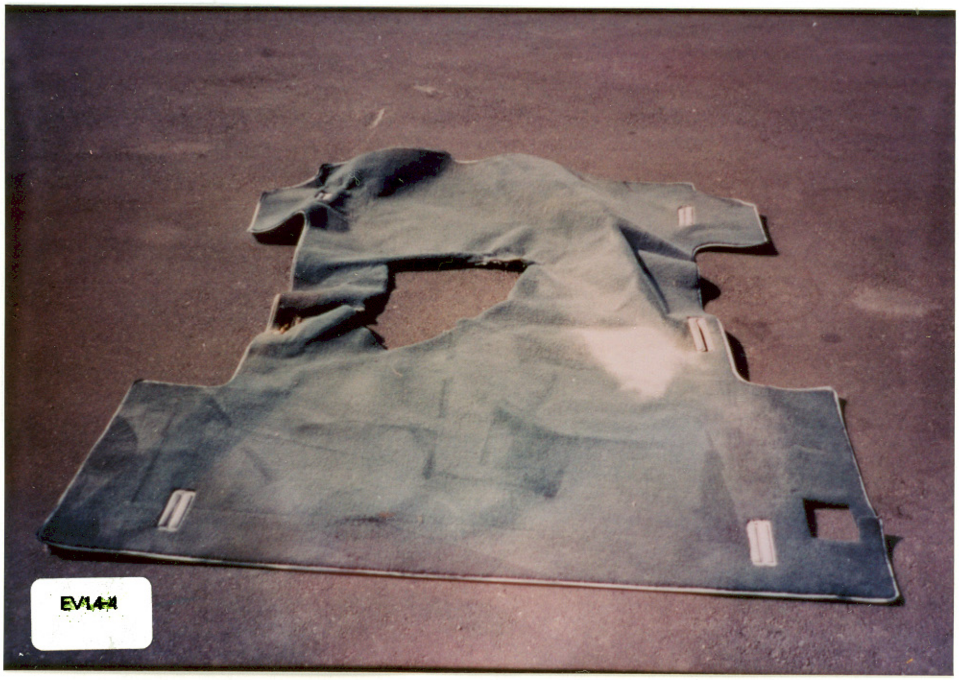
PHOTO INDEX

Case No. DSI-94-EV-14

PHOTO NO.	VEHICLE NO.	DIRECTION OF PICTURE	SUBJECT MATTER
1	1	NA	Interior view showing cargo area facing rear of vehicle.
2	1	NA	Interior view showing cargo area facing front of vehicle.
3-4	1	NA	Views of burned carpet.
5-6	1	NA	Views of vehicle undercarriage as viewed from left side.
7-9	1	NA	Views of damaged battery as viewed from rear of vehicle.
10	1	NA	Exterior of case vehicle.

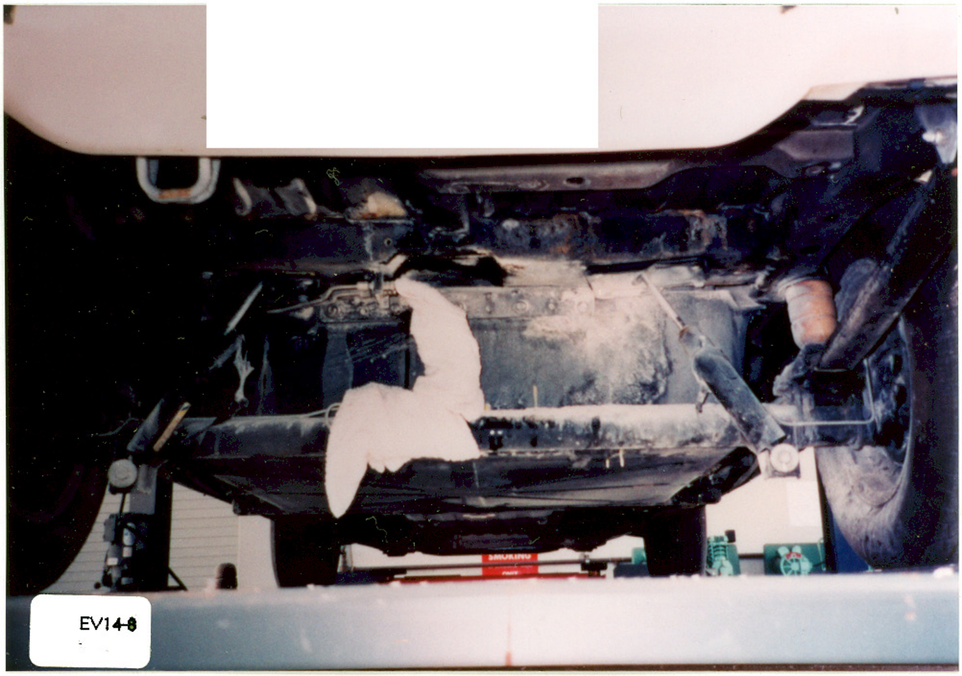
BEST AVAILABLE


EV14-3


EV14-4

BEST AVAILABLE


EV14-7


EV14-8


EV14-9

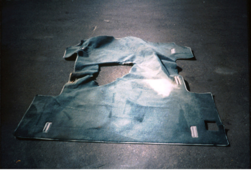
CASE NUMBER DS 9414

MISSING SLIDES

THE FOLLOWING SLIDES ARE NOT INCLUDED IN THIS CASE:

SLIDE NUMBER(S)

#1
#2

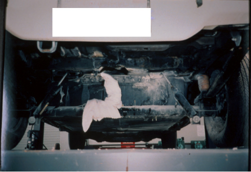


DS9414 #3

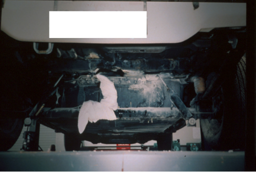
DS9414 #4

DS9414 #5

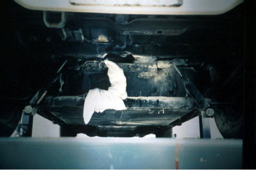
DS9414 #6



DS9414 #7



DS9414 #8



DS9414 #9

U.S. Department of Transportation

National Highway Traffic Safety Administration

ACCIDENT FORM

NATIONAL ACCIDENT SAMPLING SYSTEM
CRASHWORTHINESS DATA SYSTEM

1. Primary Sampling Unit Number __ __
2. Case Number - Stratum E V 1 4

IDENTIFICATION

3. Number of General Vehicle Forms Submitted ϕ 1
4. Date of Accident (Month,Day,Year) __ __ ____ 9 4
5. Time of Accident ϕ 6 3 5

Code reported military time of accident.

NOTE: Midnight = 2400
Unknown = 9999

SPECIAL STUDIES - INDICATORS

Check (✓) each special study (SS14-SS18 below) that has been completed; code 1 for the checked special studies and 0 for the special studies not checked.

6. ___SS15 Administrative Use ϕ
7. ___SS16 Pedestrian Crash Data Study ϕ
8. ___SS17 Impact Fires ϕ
9. ___SS18 ________ ϕ
10. ___SS19 ________ ϕ

NUMBER OF EVENTS

11. Number of Recorded Events in This Accident ϕ 1

Code the number of events which occurred in this accident.

ACCIDENT EVENTS

For each event that occurred in the accident, code the lowest numbered vehicle in the left columns and the other involved vehicle or object on the right.

Accident Event Sequence Number	Vehicle Number	Class Of Vehicle	General Area of Damage	Vehicle Number or Object Contacted	Class Of Vehicle	General Area of Damage
12. 0 1	13. ϕ 1	14. 1 3	15. N	16. 3 2	17. ϕ ϕ	18. ϕ
19. 0 2	20. __ __	21. __ __	22. __	23. __ __	24. __ __	25. __
26. 0 3	27. __ __	28. __ __	29. __	30. __ __	31. __ __	32. __
33. 0 4	34. __ __	35. __ __	36. __	37. __ __	38. __ __	39. __
40. 0 5	41. __ __	42. __ __	43. __	44. __ __	45. __ __	46. __

IF GREATER THAN FIVE EVENTS, CONTINUE CODING ON THE ACCIDENT EVENT SUPPLEMENT

BEST AVAILABLE

CODES FOR CLASS OF VEHICLE

(00) Not a motor vehicle
(01) Subcompact/mini (wheelbase < 254 cm)
(02) Compact (wheelbase ≥ 254 but < 265 cm)
(03) Intermediate (wheelbase ≥ 265 but < 278 cm)
(04) Full size (wheelbase ≥ 278 but < 291 cm)
(05) Largest (wheelbase ≥ 291 cm)
(09) Unknown passenger car size
(11) Compact utility vehicle
(12) Large utility vehicle (≤ 4,500 kgs GVWR)
(13) Passenger van (≤ 4,500 kgs GVWR)
(14) Other van (≤ 4,500 kgs GVWR)
(15) Pickup truck (≤ 4,500 kgs GVWR)
(18) Other truck (≤ 4,500 kgs GVWR)
(19) Unknown light truck type
(20) School bus
(21) Other bus
(22) Truck (> 4,500 kgs GVWR)
(23) Tractor without trailer
(24) Tractor-trailer(s)
(25) Motored cycle
(28) Other vehicle
(99) Unknown

CODES FOR GENERAL AREA OF DAMAGE (GAD)

CDS APPLICABLE AND OTHER VEHICLES

(0) Not a motor vehicle
(N) Noncollision
(F) Front
(R) Right side
(L) Left side
(B) Back
(T) Top
(U) Undercarriage
(9) Unknown

TDC APPLICABLE VEHICLES

(0) Not a motor vehicle
(N) Noncollision
(F) Front
(R) Right side
(L) Left side
(B) Back of unit with cargo area (rear of trailer or straight truck)
(D) Back (rear of tractor)
(C) Rear of cab
(V) Front of cargo area
(T) Top
(U) Undercarriage
(9) Unknown

CODES FOR VEHICLE NUMBER OR OBJECT CONTACTED

(01-30) — Vehicle Number

Noncollision
(31) Overturn — rollover
(32) Fire or explosion
(33) Jackknife
(34) Other intraunit damage (specify): ____________
(35) Noncollision injury
(38) Other noncollision (specify): ____________
(39) Noncollision — details unknown

Collision With Fixed Object
(41) Tree (≤ 10 cm in diameter)
(42) Tree (> 10 cm in diameter)
(43) Shrubbery or bush
(44) Embankment

(45) Breakaway pole or post (any diameter)

Nonbreakaway Pole or Post
(50) Pole or post (≤ 10 cm in diameter)
(51) Pole or post (> 10 cm but ≤ 30 cm in diameter)
(52) Pole or post (> 30 cm in diameter)
(53) Pole or post (diameter unknown)

(54) Concrete traffic barrier
(55) Impact attenuator
(56) Other traffic barrier (includes guardrail) (specify): ____________
(57) Fence
(58) Wall
(59) Building
(60) Ditch or culvert
(61) Ground
(62) Fire hydrant
(63) Curb
(64) Bridge
(68) Other fixed object (specify): ____________
(69) Unknown fixed object

Collision with Nonfixed Object
(71) Motor vehicle not in-transport
(72) Pedestrian
(73) Cyclist or cycle
(74) Other nonmotorist or conveyance ____________
(75) Vehicle occupant
(76) Animal
(77) Train
(78) Trailer, disconnected in transport
(79) Object fell from vehicle in-transport
(88) Other nonfixed object (specify): ____________
(89) Unknown nonfixed object

(98) Other event (specify): ____________
(99) Unknown event or object

U.S. Department of Transportation

National Highway Traffic Safety Administration

GENERAL VEHICLE FORM

NATIONAL ACCIDENT SAMPLING SYSTEM
CRASHWORTHINESS DATA SYSTEM

1. Primary Sampling Unit Number __ __

2. Case Number - Stratum E V 1 4

3. Vehicle Number Ø 1

VEHICLE IDENTIFICATION

4. Vehicle Model Year 9 3
   Code the last two digits of the model year
   (99) Unknown

5. Vehicle Make (specify): FORD 1 2
   Applicable codes are found in your NASS Data Collection, Coding and Editing Manual.
   (99) Unknown

6. Vehicle Model (specify): ECOSTAR 4 4 1
   Applicable codes are found in your NASS Data Collection, Coding and Editing Manual.
   (999) Unknown

7. Body Type 2 Ø
   Note: Applicable codes may be found on the back of this page.

8. Vehicle Identification Number

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	F	T	C	V	1	Ø	E	3	P	3						

Left justify; Slash zeros and letter Z (Ø and Ƶ)
No VIN—Code all zeros
Unknown—Code all nines

OFFICIAL RECORDS

9. Police Reported Vehicle Disposition 9
   (0) Not towed due to vehicle damage
   (1) Towed due to vehicle damage
   (9) Unknown

10. Police Reported Travel Speed 9 9 9
    Code to the nearest kph (NOTE: 000 means less than 0.5 kph)
    (160) 159.5 kph and above
    (999) Unknown

    __ __ mph X 1.6093 = __ __ __ kph

11. Police Reported Alcohol Presence 8
    (0) No alcohol present
    (1) Yes (alcohol present)
    (7) Not reported
    (8) No driver present
    (9) Unknown

    Note: See variables 37 through 55 (Page 4) for information on Other Drugs

12. Alcohol Test Result For Driver 9 8
    Code actual value (decimal implied before first digit—0.xx)
    (95) Test refused
    (96) None given
    (97) AC test performed, results unknown
    (98) No driver present
    (99) Unknown

    Source: ______

ACCIDENT RELATED

13. Speed Limit Ø Ø Ø
    (000) No statutory limit
    Code posted or statutory speed limit in kph
    (999) Unknown

    __ __ mph X 1.6093 = __ __ __ kph

14. Attempted Avoidance Maneuver 9 7
    (01) No avoidance actions
    (02) Braking (no lockup)
    (03) Braking (lockup)
    (04) Braking (lockup unknown)
    (05) Releasing brakes
    (06) Steering left
    (07) Steering right
    (08) Braking and steering left
    (09) Braking and steering right
    (10) Accelerating
    (11) Accelerating and steering left
    (12) Accelerating and steering right
    (97) No driver present
    (98) Other action (specify): ______
    (99) Unknown

15. Accident Type Ø Ø
    Applicable codes may be found on the back of page two of this field form
    (00) No impact
    Code the number of the diagram that best describes the accident circumstance
    (98) Other accident type (specify): ______
    (99) Unknown

BEST AVAILABLE

****** SKIP TO VARIABLE GV37 IF GV07 DOES NOT EQUAL 01-49 ******

HS Form 435 (Rev. 1/94)

CODES FOR BODY TYPE

BEST AVAILABLE

CDS APPLICABLE VEHICLES

Automobiles

(01) Convertible (excludes sun-roof, t-bar)
(02) 2-door sedan, hardtop, coupe
(03) 3-door/2-door hatchback
(04) 4-door sedan, hardtop
(05) 5-door/4-door hatchback
(06) Station wagon (excluding van and truck based)
(07) Hatchback, number of doors unknown
(08) Other automobile type (specify): ____________________
(09) Unknown automobile type

Automobile Derivatives

(10) Auto based pickup (includes El Camino, Caballero, Ranchero, Brat, and Rabbit pickup)
(11) Auto based panel (cargo station wagon, auto based ambulance/hearse)
(12) Large limousine - more than four side doors or stretched chassis
(13) Three-wheel automobile or automobile derivative

Utility Vehicles (≤ 4,500 kgs GVWR)

(14) Compact utility (Jeep CJ-2 - CJ-7, Scrambler, Golden Eagle, Renegade, Laredo, Wrangler, Cherokee [84 and after], Dispatcher, Raider, Bronco II, Bronco [76 and before], Explorer, S-10 Blazer, Geo Tracker, Bravada, S-15 Jimmy, Thing, Pathfinder, Trooper, Trooper II, Rodeo, Amigo, Navajo, 4-Runner, Montero, Samurai, Sidekick, Rocky)
(15) Large utility (includes Jeep Cherokee [83 and before], Ramcharger, Trailduster, Bronco-fullsize [78 and after], fullsize Blazer, fullsize Jimmy, Landcruiser, Rover, Scout)
(16) Utility station wagon (Chevy Suburban, GMC Suburban, Travelall, Grand Wagoneer, includes suburban limousine)
(19) Utility, unknown body type

Van Based Light Trucks (≤ 4,500 kgs GVWR)

(20) Minivan (Chrysler Town and Country, Caravan, Grand Caravan, Voyager, Grand Voyager, Mini-Ram, Dodge/Plymouth Vista, Aerostar, Villager, Lumina APV, Trans Sport, Silhouette, Astro, Safari, Toyota Van, Toyota Minivan, Previa, Nissan Minivan, Quest, Mitsubishi Minivan, Vanagon/Camper.)
(21) Large van (B150-B350, Sportsman, Royal, Maxiwagon, Ram, Tradesman, Voyager [83 and before], E150-E350, Econoline, Clubwagon, Chateau, G10-G30, Chevy Van, Beauville, Sport Van, G15-G35, Rally Van, Vandura.)
(22) Step van or walk-in van (≤ 4,500 kgs GVWR)
(23) Van based motorhome (≤ 4,500 kgs GVWR)
(24) Van based school bus (≤ 4,500 kgs GVWR)
(25) Van based other bus (≤ 4,500 kgs GVWR)
(28) Other van type (Hi-Cube Van, Kary) (specify): ____________________
(29) Unknown van type

Light Conventional Trucks (Pickup style cab, ≤ 4,500 kgs GVWR)

(30) Compact pickup (D50, Colt P/U, Ram 50, Dakota, Arrow Pickup [foreign], Ranger, Courier, S-10 , T-10, LUV, S-15, T-15, Sonoma, Datsun/Nissan Pickup, P'up, Mazda Pickup, Toyota Pickup, Mitsubishi Pickup)
(31) Large Pickup (Jeep Pickup, Comanche, Ram Pickup, D100-D350, W100-W350, F100-F350, C10-C35, K10-K35, R10-R35, V10-V35, Silverado, Sierra, R100-R500,)
(32) Pickup with slide-in camper
(33) Convertible pickup
(39) Unknown pickup style light conventional truck type

Other Light Trucks (≤ 4,500 kgs GVWR)

(40) Cab chassis based (includes rescue vehicles, light stake, dump, and tow truck)
(41) Truck based panel
(42) Light truck based motorhome (chassis mounted)
(45) Other light conventional truck type
(48) Unknown light truck type
(49) Unknown light vehicle type (automobile, utility, van, or light truck)

OTHER VEHICLES

Buses (Excludes Van Based)

(50) School bus (designed to carry students, not cross country or transit)
(58) Other bus type (e.g., transit, intercity, bus based motorhome) (specify): ____________________
(59) Unknown bus type

Medium/Heavy Trucks (> 4,500 kgs GVWR)

(60) Step van (> 4,500 kgs GVWR)
(61) Single unit straight truck (4,500 kgs < GVWR ≤ 8,850 kgs)
(62) Single unit straight truck (8,850 kgs < GVWR ≤ 12,000 kgs)
(63) Single unit straight truck (> 12,000 kgs GVWR)
(64) Single unit straight truck, GVWR unknown
(65) Medium/heavy truck based motorhome
(67) Truck-tractor with no cargo trailer
(68) Truck-tractor pulling one trailer
(69) Truck-tractor pulling two or more trailers
(70) Truck-tractor (unknown if pulling trailer)
(78) Unknown medium/heavy truck type
(79) Unknown truck type (light/medium/heavy)

Motored Cycles (Does Not Include All-Terrain Vehicles/Cycles)

(80) Motorcycle
(81) Moped (motorized bicycle)
(82) Three-wheel motorcycle or moped
(88) Other motored cycle (minibike, motorscooter) (specify): ____________________
(89) Unknown motored cycle type

Other Vehicles

(90) ATV (All-Terrain Vehicle) and ATC (All-Terrain Cycle)
(91) Snowmobile
(92) Farm equipment other than trucks
(93) Construction equipment other than trucks
(97) Other vehicle type
(99) Unknown body type

OCCUPANT RELATED

16. Driver Presence in Vehicle ___ Φ
- (0) Driver not present
- (1) Driver present
- (9) Unknown

17. Number of Occupants This Vehicle ___ Φ Φ
- (00-96) Code actual number of occupants for this vehicle
- (97) 97 or more
- (99) Unknown

18. Number of Occupant Forms Submitted ___ Φ Φ

VEHICLE WEIGHT ITEMS

19. Vehicle Curb Weight 1, 5 1 0
- _____Code weight to nearest 10 kilograms.
- (045) Less than 450 kilograms
- (610) 6,100 kilograms or more
- (999) Unknown

3,3 2 Φ lbs X .4536 = 1,5 Φ 6 kgs

Source:________________________

20. Vehicle Cargo Weight 9, 9 9 0
- _____Code weight to nearest 10 kilograms.
- (000) Less than 5 kilograms
- (450) 4,500 kilograms or more
- (999) Unknown

___,___ ___ ___ lbs X .4536 = ___,___ ___ ___ kgs

RECONSTRUCTION DATA

21. Towed Trailing Unit ___ Φ
- (0) No towed unit
- (1) Yes—towed trailing unit
- (9) Unknown

22. Documentation of Trajectory Data for This Vehicle ___ Φ
- (0) No
- (1) Yes

23. Post Collision Condition of Tree or Pole (For Highest Delta V) ___ Φ
- (0) Not collision (for highest delta V) with tree or pole
- (1) Not damaged
- (2) Cracked/sheared
- (3) Tilted <45 degrees
- (4) Tilted ≥45 degrees
- (5) Uprooted tree
- (6) Separated pole from base
- (7) Pole replaced
- (8) Other (specify): ________________________
- (9) Unknown

24. Rollover ___ Φ
- (0) No rollover (no overturning)

Rollover (primarily about the longitudinal axis)
- (1) Rollover, 1 quarter turn only
- (2) Rollover, 2 quarter turns
- (3) Rollover, 3 quarter turns
- (4) Rollover, 4 or more quarter turns (specify): ________________________
- (5) Rollover--end-over-end (i.e., primarily about the lateral axis)
- (9) Rollover (overturn), details unknown

OVERRIDE/UNDERRIDE (THIS VEHICLE)

25. Front Override/Underride (this Vehicle) ___ Φ

26. Rear Override/Underride (this Vehicle) ___ Φ
- (0) No override/underride, or not an end-to-end impact

Override (see specific CDC)
- (1) 1st CDC
- (2) 2nd CDC
- (3) Other not automated CDC (specify): ________________________

Underride (see specific CDC)
- (4) 1st CDC
- (5) 2nd CDC
- (6) Other not automated CDC (specify): ________________________
- (7) Medium/heavy truck or bus override
- (9) Unknown

HEADING ANGLE AT IMPACT FOR HIGHEST DELTA V

Values: (000)-(359) Code actual value
- (997) Noncollision
- (998) Impact with object
- (999) Unknown

27. Heading Angle For This Vehicle 9 9 7

28. Heading Angle For Other Vehicle 9 9 7

BEST AVAILABLE

Category	Configuration	ACCIDENT TYPES (Includes Intent)					
I. Single Driver	A. Right Roadside Departure	01 DRIVE OFF ROAD	02 CONTROL/ TRACTION LOSS	03 AVOID COLLISION WITH VEH., PED., ANIM.		04 SPECIFICS OTHER	05 SPECIFICS UNKNOWN
	B. Left Roadside Departure	06 DRIVE OFF ROAD	07 CONTROL/ TRACTION LOSS	08 AVOID COLLISION WITH VEH., PED., ANIM.		09 SPECIFICS OTHER	10 SPECIFICS UNKNOWN
	C Forward Impact	11 PARKED VEH.	12 STA. OBJECT	13 PEDESTRIAN/ ANIMAL	14 END DEPARTURE	15 SPECIFICS OTHER	16 SPECIFICS UNKNOWN
II Same Trafficway Same Direction	D Rear-End	20 STOPPED 21, 22, 23	24 SLOWER 25, 26, 27	28 DECEL. 29, 30, 31		(EACH • 32) SPECIFICS OTHER	(EACH • 33) SPECIFICS UNKNOWN
	E Forward Impact	34 35 CONTROL/ TRACTION LOSS	36 37 CONTROL/ TRACTION LOSS	38 39 AVOID COLLISION WITH VEH.	40 41 AVOID COLLISION WITH OBJECT	(EACH • 42) SPECIFICS OTHER	(EACH • 43) SPECIFICS UNKNOWN
	F. Sideswipe Angle	44 45	46 45 47			(EACH • 48) SPECIFICS OTHER	(EACH • 49) SPECIFICS UNKNOWN
III Same Trafficway Opposite Direction	G Head-On	50 51 LATERAL MOVE	(EACH • 52) SPECIFICS OTHER			(EACH • 53) SPECIFICS UNKNOWN	
	H Forward Impact	54 55 CONTROL/ TRACTION LOSS	56 57 CONTROL/ TRACTION LOSS	58 59 AVOID COLLISION WITH VEH.	60 61 AVOID COLLISION WITH OBJECT	(EACH • 62) SPECIFICS OTHER	(EACH • 63) SPECIFICS UNKNOWN
	I. Sideswipe/ Angle	64 65 LATERAL MOVE	(EACH • 66) SPECIFICS OTHER			(EACH • 67) SPECIFICS UNKNOWN	
IV. Change Trafficway Vehicle Turning	J. Turn Across Path	68 69 INITIAL OPPOSITE DIRECTIONS	70 71 72 73 INITIAL SAME DIRECTIONS			(EACH • 74) SPECIFICS OTHER	(EACH • 75) SPECIFICS UNKNOWN
	K. Turn Into Path	76 77 78 79 TURN INTO SAME DIRECTION	80 81 82 83 TURN INTO OPPOSITE DIRECTIONS			(EACH • 84) SPECIFICS OTHER	(EACH • 85) SPECIFICS UNKNOWN
V Intersecting Paths (Vehicle Damage)	L. Straight Paths	86 87	88 89			(EACH • 90) SPECIFICS OTHER	(EACH • 91) SPECIFICS UNKNOWN
VI. Miscellaneous	M. Backing Etc.	92 BACKING VEH.	93 OTHER VEH. OR OBJECT			98 Other Accident Type 99 Unknown Accident Type 00 No Impact	

29. Basis for Total Delta V (highest) 5

Delta V Calculated
(1) CRASH program—damage only routine
(2) CRASH program—damage and trajectory routine
(3) Missing vehicle algorithm

Delta V Not Calculated
(4) At least one vehicle (which may be this vehicle) is beyond the scope of an acceptable reconstruction program, regardless of collision conditions.
(5) All vehicles within scope (CDC applicable) of CRASH program but one of the collision conditions is beyond the scope of the CRASH program or other acceptable reconstruction technique, regardless of adequacy of damage data.
(6) All vehicle and collision conditions are within scope of one of the acceptable reconstruction programs, but there is insufficient data available.

COMPUTER GENERATED DELTA V

Highest

30. Total Delta V 9 9 9

________ Nearest kph (highest)

________ Nearest kph (secondary)

(NOTE: 000 means less than 0.5 kph)
(160) 159.5 kph and above
(999) Unknown

31. Longitudinal Component of Delta V ± 9 9 9

________ Nearest kph (highest)

________ Nearest kph (secondary)

(NOTE: __000 means greater than −0.5 kph and less than +0.5 kph)
(±160) ±159.5 kph and above
(__999) Unknown

Highest

32. Lateral Component of Delta V ± 9 9 9

________ Nearest kph (highest)

________ Nearest kph (secondary)

(NOTE: __000 means greater than −0.5 kph and less than +0.5 kph)
(±160) ±159.5 kph and above
(__999) Unknown

33. Energy Absorption 9 9 9, 9 0 0

________ Nearest 100 joules (highest)

________ Nearest 100 joules (secondary)

(NOTE: 0000 means less than 50 joules)
(9997) 999,650 joules or more
(9999) Unknown

34. Confidence In Reconstruction Program Results (For Highest Delta V) 0
(0) No reconstruction
(1) Collision fits model — results appear reasonable
(2) Collision fits model — results appear high
(3) Collision fits model — results appear low
(4) Borderline reconstruction — results appear reasonable

35. Type of Vehicle Inspection 2
(0) No inspection
(1) Complete inspection
(2) Partial inspection (specify): Photos

36. Is this an AOPS Vehicle? 0
(0) No
(1) Yes - researcher determined
(2) VIN determined air bag system
(3) VIN determined automatic (passive) belts
(4) VIN determined air bag and automatic (passive) belts

IS OLDMISS APPLICABLE FOR THIS VEHICLE? [ ] YES [✓] NO

IF YES: IS A COMPLETED OLDMISS PROGRAM SUMMARY INCLUDED? [ ] YES [ ] NO

37. Police Reported Other Drug Presence 8
(0) No other drug(s) present
(1) Yes [other drug(s) present]
(7) Not reported
(8) No driver present
(9) Unknown

38. Police Reported Drug Evaluation Classification (DEC) Test For Driver 8
(0) No DEC process available or given
(1) DEC process given, results known
(2) DEC process given, results unknown
(3) DEC process available, unknown if given
(8) No driver present

39. Other Drug Specimen Test Type For Driver 8
(0) No specimen test given
(1) Blood test
(2) Urine test
(3) Other specimen tests (specify): ______
(7) Unspecified specimen test
(8) No driver present
(9) Unknown if specimen test given

DRUG EVALUATION CLASSIFICATION
OTHER DRUGS TEST RESULTS FOR DRIVER

	DEC Test Results	Specimen Test Results
Narcotic Drug	40. 8	41. 8
Depressant Drug	42. 8	43. 8
Stimulant Drug	44. 8	45. 8
Hallucinogen Drug	46. 8	47. 8
Cannabinoid Drug	48. 8	49. 8
Phencyclidine (PCP)	50. 8	51. 8
Inhalant Drug	52. 8	53. 8
Other Drug (Excluding Nicotine, Aspirin, Alcohol, Drugs Administered Post-Crash)	54. 8	55. 8

Codes For DEC Test Results

(0) No DEC test given
(1) Passed DEC test
(2) Failed DEC test
(3) DEC test given—results unknown
(8) No driver present
(9) Unknown if DEC test given

Codes for Specimen Test Results

(0) No specimen test given
(1) Drug not found in specimen
(2) Drug found in specimen
(7) Specimen test given, results unknown or not obtained
(8) No driver present
(9) Unknown if specimen test given

BEST AVAILABLE

CODES FOR ROLLOVER INITIATION OBJECT CONTACTED

(00) No rollover
(01-30) — Vehicle Number

Noncollision
(31) Turn-over — fall-over
(33) Jackknife

Collision With Fixed Object
(41) Tree (≤ 10 cm in diameter)
(42) Tree (> 10 cm in diameter)
(43) Shrubbery or bush
(44) Embankment

(45) Breakaway pole or post (any diameter)

Nonbreakaway Pole or Post
(50) Pole or post (≤ 10 cm in diameter)
(51) Pole or post (> 10 cm but ≤ 30 cm in diameter)
(52) Pole or post (> 30 cm in diameter)
(53) Pole or post (diameter unknown)

(54) Concrete traffic barrier
(55) Impact attenuator
(56) Other traffic barrier (includes guardrail) (specify):________________

(57) Fence
(58) Wall
(59) Building
(60) Ditch or culvert
(61) Ground
(62) Fire hydrant
(63) Curb
(64) Bridge
(68) Other fixed object (specify):

____

(69) Unknown fixed object

Collision with Nonfixed Object
(71) Motor vehicle not in-transport
(76) Animal
(77) Train
(78) Trailer, disconnected in transport
(79) Object fell from vehicle in-transport
(88) Other nonfixed object (specify):

____

(89) Unknown nonfixed object

(98) Other event (specify):

____

(99) Unknown event or object

OTHER DATA

56. Driver's Zip Code ∅ ∅ ∅ ∅ ∅

(00000) Driver not present
(00001) Driver not a resident of U.S. or territories
_______ Code actual 5-digit zip code
(99999) Unknown

57. Driver's Race/Ethnic Origin ∅
(0) Driver not present
(1) White (non-Hispanic)
(2) Black (non-Hispanic)
(3) White (Hispanic)
(4) Black (Hispanic)
(5) American Indian, Eskimo or Aleut
(6) Asian or Pacific Islander
(8) Other (specify): ________
(9) Unknown

58. Vehicle Special Use (This Trip) ∅
(0) No special use
(1) Taxi
(2) Vehicle used as school bus
(3) Vehicle used as other bus
(4) Military
(5) Police
(6) Ambulance
(7) Fire truck or car
(8) Other (specify): ________
(9) Unknown

ROLLOVER DATA

If GV07 (Body Type) ≠ 1-49, leave GV59-GV63 blank.
If GV24 (Rollover) = 0, then GV59-GV63 must equal 0.
If GV24 = 9, then GV59-GV63 must equal 9.

59. Rollover Initiation Type ∅
(0) No rollover
(1) Trip-over
(2) Flip-over
(3) Turn-over
(4) Climb-over
(5) Fall-over
(6) Bounce-over
(7) Collision with another vehicle
(8) Other rollover initiation type specify): ________
(9) Unknown rollover initiation type

60. Location of Rollover Initiation ∅

(0) No rollover
(1) On roadway
(2) On shoulder—paved
(3) On shoulder—unpaved
(4) On roadside or divided trafficway median
(9) Unknown

61. Rollover Initiation Object Contacted ∅ ∅

62. Location on Vehicle Where Initial Principal Tripping Force Is Applied ∅

(0) No rollover
(1) Wheels/tires
(2) Side plane
(3) End plane
(4) Undercarriage
(5) Other location on vehicle (specify): ________
(8) Non-contact rollover forces (specify): ________
(9) Unknown

63. Direction of Initial Roll ∅

(0) No rollover
(1) Roll right - primarily about the longitudinal axis
(2) Roll left - primarily about the longitudinal axis
(5) End-over-end (i.e., primarily about the lateral axis)
(9) Unknown roll direction

PRECRASH DATA

64. Pre-Event Movement (Prior to Recognition of Critical Event) 9 8

(01) Going straight
(02) Slowing or stopping in traffic lane
(03) Starting in traffic lane
(04) Stopped in traffic lane
(05) Passing or overtaking another vehicle
(06) Disabled or parked in travel lane
(07) Leaving a parking position
(08) Entering a parking position
(09) Turning right
(10) Turning left
(11) Making a U-turn
(12) Backing up (other than for parking position)
(13) Negotiating a curve
(14) Changing lanes
(15) Merging
(16) Successful avoidance maneuver to a previous critical event
(97) Other (specify): ________
(98) No driver present
(99) Unknown

PRECRASH DATA (Continued)

65. Critical Precrash Event 98

This Vehicle Loss of Control Due To:
(01) Blow out or flat tire
(02) Stalled engine
(03) Disabling vehicle failure (e.g., wheel fell off) (specify): ______
(04) Non-disabling vehicle problem (e.g., hood flew up) (specify): ______
(05) Poor road conditions (puddle, pot hole, ice, etc.) (specify): ______
(06) Traveling too fast for conditions
(08) Other cause of control loss (specify): ______
(09) Unknown cause of control loss

This Vehicle Traveling
(10) Over the lane line on left side of travel lane
(11) Over the lane line on right side of travel lane
(12) Off the edge of the road on the left side
(13) Off the edge of the road on the right side
(14) End departure
(15) Turning left at intersection
(16) Turning right at intersection
(17) Crossing over (passing through) intersection
(19) Unknown travel direction

Other Motor Vehicle In Lane
(50) Stopped
(51) Traveling in same direction with lower speed (i.e., lower steady speed or decelerating)
(52) Traveling in same direction with higher speed
(53) Traveling in opposite direction
(54) In crossover
(55) Backing
(59) Unknown travel direction of other motor vehicle in lane

Other Motor Vehicle Encroaching Into Lane
(60) From adjacent lane (same direction)—over left lane line
(61) From adjacent lane (same direction)—over right lane line
(62) From opposite direction—over left lane line
(63) From opposite direction—over right lane line
(64) From parking lane
(65) From crossing street, turning into same direction
(66) From crossing street, across path
(67) From crossing street, turning into opposite direction
(68) From crossing street, intended path not known
(70) From driveway, turning into same direction
(71) From driveway, across path
(72) From driveway, turning into opposite direction
(73) From driveway, intended path not known
(74) From entrance to limited access highway
(78) Encroachment by other vehicle—details unknown

Pedestrian or Pedalcyclist, or Other Nonmotorist
(80) Pedestrian in roadway
(81) Pedestrian approaching roadway
(82) Pedestrian—unknown location
(83) Pedalcyclist or other nonmotorist in roadway (specify): ______
(84) Pedalcyclist or other nonmotorist approaching roadway (specify): ______
(85) Pedalcyclist or other nonmotorist—unknown location (specify): ______

Object or Animal
(87) Animal in roadway
(88) Animal approaching roadway
(89) Animal—unknown location
(90) Object in roadway
(91) Object approaching roadway
(92) Object—unknown location

(98) Other critical precrash event (specify): ______
(99) Unknown

For Corrective Actions Attempted see variable GV14 (Attemped Avoidance Manuever)

66. Precrash Stability After Avoidance Maneuver 8
(0) No avoidance maneuver
(1) Tracking
(2) Skidding longitudinally—rotation less than 30 degrees
(3) Skidding laterally—clockwise rotation
(4) Skidding laterally—counterclockwise rotation
(7) Other vehicle loss-of-control (specify): ______
(8) No driver present
(9) Precrash stability unknown

67. Precrash Directional Consequences of Avoidance Maneuver (Corrective Action) 8
(0) No avoidance maneuver
(1) Vehicle stayed in travel lane where avoidance maneuver was initiated
(2) Vehicle stayed on roadway but left travel lane where avoidance maneuver was initiated
(3) Vehicle stayed on roadway, not known if left travel lane where avoidance maneuver was initiated
(4) Vehicle departed roadway
(5) Avoidance maneuver initiated off roadway
(8) No driver present
(9) Directional consequences unknown

***** IF THE CDS APPLICABLE VEHICLE WAS NOT INSPECTED (I.E., GV35 = 0), *** DO NOT COMPLETE THE EXTERIOR AND INTERIOR VEHICLE FORMS.**

***** IF GV07 DOES NOT EQUAL 01-49, DO NOT COMPLETE *** THE EXTERIOR VEHICLE, INTERIOR VEHICLE, OCCUPANT ASSESSMENT, AND OCCUPANT INJURY FORMS.**

FIRE INCIDENT REPORTING SYSTEM
INCIDENT REPORT

SECTION A

1 FDID | INCIDENT NUMBER

2 CORRECTIONS | MULTI-AGENCY INCIDENT NO. - -

3	INCIDENT DATE 94	DISPATCH TIME 0635.00	ARRIVAL TIME 0643.00	END TIME 0850.00	ADD'L DAYS 00	FIRST IN COMPANY	DISTRICT
4	SITUATION(S) FOUND #1 14 #2 #3 #4	AUTOMATIC OR MUTUAL AID 8	METHOD OF ALARM 1	TYPE WEATHER	AIR TEMPERATURE 000	PROPERTY MANAGEMENT 3	

5 INCIDENT ADDRESS/LOCATION

6 ROOM/APARTMENT | ZIP CODE | CENSUS TRACT 0000.00 | FIRE HAZARD SEVERITY ZONE

7 TOTAL FIRE SERVICE PERSONNEL RESPONDED Career 0009 Vol. 0000 | NO. APPARATUS RESPONDED Engine 002 Truck 00 Rescue Med. 00 Other 02

8 CODE | NAME | TELEPHONE

9 ADDRESS/CITY | STATE | ZIP CODE

10 CODE | NAME | TELEPHONE

11 ADDRESS/CITY | STATE | ZIP CODE

12 GENERAL PROPERTY USE 52 | SPECIFIC PROPERTY USE 529 | BUILDING CODE OCCUPANCY TYPE | STRUCTURE TYPE | STRUCTURE STATUS | OCCUPIED AT TIME OF INCIDENT 1

13 FOR MOBILE PROPERTY INVOLVED: Type | Vehicle License No. | State | Year | Make
Model | I.C.C./D.O.T. Permit No.
Vehicle Identification No. | Drivers License No. | State

SECTION B — FIRES

1 TYPE OF ACTION(S) TAKEN #1 15 #2 63 #3 #4 | FIRE ORGIN Area 82 Level A01 Horizontal Distance From | FORM OF HEAT 40 | IGNITION FACTOR 60

2 SEX | AGE | SEX | AGE | MATERIAL FIRST IGNITED Type 41 Form 60 | CONTRIBUTING FACTOR(S) #1 #2 | METHOD OF EXTINGUISHMENT 3

3 ESTIMATED PROPERTY LOSS 100,000 | ESTIMATED CONTENTS LOSS 0 | FUEL MODEL | ACRES BURNED

4 IF EQUIPMENT INVOLVED IN IGNITION: Type | Model | Year
Make | Serial No.

SECTION C — STRUCTURE FIRES

1 CONSTRUCTION TYPE | ROOF COVERING | NUMBER OF STORIES | EXTENT OF DAMAGE Flame Smoke

2 MATERIAL GENERATING MOST SMOKE Type Form | AVENUE OF SMOKE TRAVEL | DETECTION SYSTEM Type Power Supply Performance Reason For Failure

3 EXTINGUISHING SYSTEM Type Performance Reason for Failure | SPRINKLER HEAD(S) Type Number Activated

SECTION D — CASUALTIES

1 FIRE SERVICE CASUALTY Injuries 000 Fatalities 000 | NON-FIRE SERVICE FIRE CASUALTY Injuries 000 Fatalities 000

SECTION E — E.M.S.

1 NUMBER OF PATIENTS | HIGHEST LEVEL OF CARE CAPABLE OF BEING PROVIDED ON SCENE Fire Other | HIGHEST LEVEL OF CARE PROVIDED ON SCENE Fire Other

2 E.M.S. TYPE OF SITUATIONS FOUND #1 #2 #3 #4 | NO. OF PATIENTS TRANSPORTED BY Fire Dept. Pvt. Amb. Coroner Other

SECTION F — HAZ MAT

1 OES CTRL NUMBER | HAZ MAT RELEASE Area Level | RELEASE FACTORS #1 #2 #3 #4 | CONTRIBUTING FACTOR(S) #1 #2

2 EST. NO. CHEMICALS RELEASED | TYPE OF EQUIPMENT INVOLVED IN RELEASE | HAZ MAT ACTION(S) TAKEN #1 #2 #3 #4 | DISPOSITION OF INCIDENT

3 HAZ MAT I.D. SOURCES Personnel #1 #2 Reference Material #1 #2 | FIRE SERVICE HAZ MAT CASUALTY Injuries Fatalities | NON-FIRE SERVICE HAZ MAT CASUALTY Injuries Fatalities

4 CHEMICAL OR TRADE NAME | DOT I.D. NO. | DOT HAZARD CLASS | CAS NO.

5 PHYSICAL STATE Stored Released | QUANTITY RELEASED | UNIT OF MEASURE | EXTENT OF RELEASE | SUSPECTED ENVIRONMENTAL CONTAMINATION

6 CONTAINER Type Material | Description Use | Feature | Capacity | UNIT OF MEASURE

SECTION G — OTHER | SPECIAL STUDIES: Local — Statewide

TYPE OF ACTION(S) TAKEN #1 #2 #3 #4 | 1a b c d | 2a b c d | 3a b c d | 4a b c d | 5a b c d | 6a b c d

MEMBER MAKING REPORT | DATE | REVIEWED BY

REPRODUCED BY: *fire service software*

INCIDENT
PAGE NO. 1
INCIDENT REPORT

SECTION A - COMPLETE FOR ALL INCIDENTS
...A1 thru A4...
FDID INCIDENT NUMBER MULTIAGENCY NO
DATE 94 DISPATCH 0635.00 ARRIVAL 0643.00 END 0850.00
ADD DAYS 00 FIRST IN COMPANY DISTRICT
SITUATIONS FOUND 14 AUTOMATIC OR MUTUAL AID 8 METHOD OF ALARM 1
WEATHER AIR TEMPERATURE 000 PROPERTY MANAGEMENT 3
...A5 thru A11...
INCIDENT ADDRESS/LOCATION
ROOM/APARTMENT ZIP CODE CENSUS 0000.00
RESPONDED: CAREER 0009 VOL 0000 ENGINE TRUCK 00 RESCUE/MED 00 OTHER 02
...A12 thru A13...
GENERAL PROPERTY USE 62 SPECIFIC PROPERTY USE OCCUPANCY TYPE
STRUCTURE TYPE STRUCTURE STATUS OCCUPIED AT TIME OF INCIDENT 1

SECTION B - COMPLETE FOR ALL FIRES
...B1 thru B2...
ACTIONS TAKEN 15 63 AREA OF FIRE ORIGIN 82 LEVEL OF FIRE ORIGIN A01
FROM TRAVELED SURFACE FORM OF HEAT OF IGNITION 40 IGNITION FACTOR 60
CONTRIBUTING PERSONS: #1 SEX/AGE #2 SEX/AGE
TYPE OF MATERIAL FIRST IGNITED 41 FORM OF MATERIAL FIRST IGNITED 60
CONTRIBUTING FACTORS METHOD OF EXTINGUISHMENT 3
...B3 thru B4...
PROPERTY LOSS 000100000 CONTENTS LOSS 000000000

MEMBER MAKING REPORT REVIEWER

SIGNATURE ______________________ SIGNATURE ______________________

INCIDENT/FIRE SUPPLEMENTS
ALARM TIME ALARM TYPE 2/VEHICLE FIRE
ZONE STATION SHIFT A
MAP NO.
PROPERTY VALUE 000000000 CONTENT VALUE 000000000

CONTINUED...

INDEX OF 901 CODES

A SITUATIONS FOUND
1 - FIRE, EXPLOSION
14 - FIRE IN MOBILE PROPERTY OUTSIDE A STRUCTURE
AUTOMATIC OR MUTUAL AID
8 - NO AUTOMATIC/MUTUAL AID
METHOD OF ALARM
1 - TELEPHONE DIRECT TO FIRE DEPARTMENT
WEATHER
PROPERTY MANAGEMENT
3 - CITY, TOWN, VILLAGE OR OTHER LOCAL GOVERNMENT
GENERAL PROPERTY USE
6 - BASIC INDUSTRY, UTILITY, DEFENSE, AGRICULTURAL
62 - RESEARCH
SPECIFIC PROPERTY USE
6 - BASIC INDUSTRY, UTILITY, DEFENSE, AGRICULTURAL
62 - LABORATORIES
629 - NOT CLASSIFIED
BUILDING CODE OCCUPANCY TYPE
STRUCTURE TYPE
STRUCTURE STATUS
OCCUPIED AT TIME OF INCIDENT
1 - YES

B TYPE OF ACTIONS TAKEN
15 - EXTINGUISHMENT
63 - NOTIFY OTHER AGENCIES
FIRE ORIGIN
AREA
8 - TRANSPORTATION, VEHICLE AREAS
82 - TRUNK, LOAD CARRYING AREA
FORM OF HEAT OF IGNITION
4 - HEAT FROM HOT OBJECT
40 - UNABLE TO CLASSIFY FURTHER
IGNITION FACTOR
6 - DESIGN, CONSTRUCTION, INSTALLATION DEFICIENCY
60 - UNABLE TO CLASSIFY FURTHER
MATERIAL FIRST IGNITED
TYPE OF MATERIAL
4 - PLASTICS
41 - RIGID PLASTICS
FORM OF MATERIAL
6 - POWER TRANSFER EQUIPMENT, FUEL
60 - UNABLE TO CLASSIFY FURTHER
METHOD OF EXTINGUISHMENT
3 - PORTABLE EXTINGUISHER

CONTINUED...

JNIT/STAFF SUPPLEMENT

1 UNIT ID
RESPONSE 3/EMERGENCY RESPONSE
MILEAGE 0

TIMES:	DISPATCH	ROLLOUT	ARRIVAL	BACK IN	COMPLETION
	0635	0000	0643	0000	0850
MINUTES:	REACTION	ENROUTE	OUT SVC	TOTAL	
	0	0	0	135	

2 UNIT ID
RESPONSE 3/EMERGENCY RESPONSE
MILEAGE 0

TIMES:	DISPATCH	ROLLOUT	ARRIVAL	BACK IN	COMPLETION
	0706	0000	0710	0000	0812
MINUTES:	REACTION	ENROUTE	OUT SVC	TOTAL	
	0	0	0	66	

3 UNIT CHEV SUBURBAN
RESPONSE 2/RESPOND DIRECT NON CODE 3
MILEAGE 0

TIMES:	DISPATCH	ROLLOUT	ARRIVAL	BACK IN	COMPLETION
	0635	0000	0643	0000	0849
MINUTES:	REACTION	ENROUTE	OUT SVC	TOTAL	
	0	0	0	134	

4 UNIT HEALTH HAZ MAT
RESPONSE 2/RESPOND DIRECT NON CODE 3
MILEAGE 0

TIMES:	DISPATCH	ROLLOUT	ARRIVAL	BACK IN	COMPLETION
	0715	0000	0000	0000	0000
MINUTES:	REACTION	ENROUTE	OUT SVC	TOTAL	
	0	0	0	0	

INCIDENT
PAGE NO. 4
NARRATIVE - CONFIDENTIAL

Alarm: Vehicle Fire
Upon arrival reported a vehicle fire. requested the Battalion Chief to respond to the incident code 2. Upon arrival, I was informed that the vehicle involved was a battery operated vehicle and the fire was continuing to burn after attempts to extinguish it with metal-x class D extinguishing agent and then water from a handline were unsuccessful.
I then requested to respond code 3 with their metal-x extinguisher, and Health Hazmat to respond. Because of the smell of sulfur in the air, I requested the building, adjacent to the vehicle, be evacuated and fans be set up to ventilate.
Upon arrival, the metal-x extinguisher was used in an attempt to extinguish the fire. Again no success, however the fire appeared to be less intense then before. I then requested the metal-x extinguisher from

Capt. talked to
indicated that the fire would subside in approx. 45 mins. as the batteries decreased in strength. Once that occurred metal-x could be applied to cover the batteries. He also indicated that the use of water to decrease the intensity of the fire was acceptable.
Health Hazmat supervisor arrived on scene and was appraised of the situation.
The fire was extinguished.
The fire department finished it's operation at 0850 and left the scene in the care of Hazmat Supervisor

1993 FORD ECOSTAR
LIC.
I.D.# 1FTCV

BEST AVAILABLE

Office

Environmental and
Safety Engineering

TRANSMISSION AUTOMOTIVE SAFETY OFFICE
TELEPHONE: PRODUCTION VEHICLE SAFETY
AND COMPLIANCE

DATE: 1994

TIME: 3:05PM

Please deliver to:

Name: , Associate Administrator for Enforcement

Organization: National Highway Traffic Safety Admin.

Room # and Building:

Telephone:

Number of Sheets being Transmitted (including this one): 7

Special Instructions/Notes:

Information Letter

Transmission sent by (Name/Address/Telephone):

(FAX)

BEST AVAILABLE

Executive Director
Automotive Safety and Engineering Standards Office
Environmental and Safety
Engineering Staff

1994

Associate Administrator for Enforcement
National Highway Traffic Safety Administration
400 Seventh Street, S.W.
Washington, D.C. 20590

Dear

NHTSA has expressed interest in the background of two incidents of sodium sulphur battery fires involving 1993 electric vehicles being operated in field tests in As you know, issued a public announcement about these incidents on 1994. This is to report that we and the supplier of the batteries, have concluded our investigations. On the basis of the best information available, Electric Vehicle Engineering and the supplier have determined that the two incidents were unrelated, having risen from different causal factors.

It was concluded that the first incident was caused by a reweld process used in the manufacture of a battery cell. This reweld was employed to replace a positive terminal on a previously filled and sealed battery cell. The weld energy likely fractured the cell's ceramic seals allowing sulfur to escape from the cell and corrode copper components within a nearby looping element. Despite warning indicators to the driver, continued vehicle operation led to the destruction of the battery. The battery manufacturer's records indicate that this is the only battery in the test fleet that was reworked in this manner. The second incident was found to have resulted from a malfunction of the internal fusing system of the battery. This was caused by a high resistance condition within a looping element that had previously activated to bypass a group of weak cells (The battery has 480 cells divided into 80 groups of 6 each, which are then connected together to form the total battery). Each looping element protects a group of cells and each group is fused for proper operation. A looping element will allow the battery to bypass a group of six cells if a problem is present within the group. If a problem occurs, the looping element, which is normally open, will close and the six cells will then be excluded from the total battery. Analysis of the failed battery determined that an activated looping element reopened causing an increase in temperature due to high resistance in the group of weak cells causing the fire. The most probable cause for an activated looping element to develop high resistance after months of proper operation is motion of the looping element contacts due to thermal and/or mechanical stresses in the battery.

first received information on 1994 that there had been a battery fire in one of the vehicles, and our Electric Vehicle Engineering activity and were able to determine relatively soon that the battery involved was one that had been subject to a rewelding process not employed in the manufacture of any other battery being used in the test fleet. When the second incident occurred on 1994, requested that all vehicles be taken out of operation until further notice (Copies of the notice to participants and the news release are attached). By 1994 all participants had been notified telephonically to return the leased vehicles to while a complete investigation took place. Once a countermeasure strategy for the concern represented by the second incident is finalized, the vehicles will be appropriately modified and returned to the lessees. The countermeasure under development contemplates automatic cooling of any battery that exhibits excessive heat levels. Upon return to service, the close monitoring that has been a key part of the experimental vehicle program to date will continue.

Very truly yours,

IMMEDIATE ACTION REQUIRED

1994

TO: ALL PARTICIPANTS

IN ADDITION TO THE PHONE CALL MADE TO EACH PARTICIPANT TODAY THE FOLLOWING INFORMATION IS PROVIDED.

AS THE RESULT OF A SECOND FIRE THAT OCCURRED TODAY AT THE AIR RESOURCES BOARD PLEASE TAKE THE FOLLOWING PRECAUTIONARY MEASURES:

PARK ALL OUTSIDE AND PLACE THEM ON EITHER NORMAL OR CONVENIENCE CHARGE. DO NOT DRIVE THE VEHICLES UNTIL DIRECTED OTHERWISE BY THE PROGRAM OFFICE.

VERIFY THAT CHARGE HAS BEGUN, THEN PERIODICALLY MONITOR THE VEHICLES OVER THE WEEKEND. (AN HOURLY VISUAL CHECK IS RECOMMENDED).

IF ANY VEHICLE EXHIBITS ANY WARNING LIGHTS CONTACT THE HOTLINE IMMEDIATELY

WILL CONDUCT A CONFERENCE CALL AT 12:00 NOON EDT. TO JOIN THE CONFERENCE CALL PLEASE DIAL THEN DIAL ACCESS CODE AT THE PROMPT.

A NEWS RELEASE IS INCLUDED WITH THIS COMMUNICATION.

AS ADDITIONAL INFORMATION BECOMES AVAILABLE IT WILL BE COMMUNICATED TO YOU BY FAX.

PROGRAM MANAGER

IMMEDIATE RELEASE

Contact:

ITS TEST FLEET TO INVESTIGATE BATTERY CONCERN

today asked customers participating in its electric vehicle test program to park their vehicles outdoors and refrain from using them while the company investigates the cause of an apparent second battery fire that occurred this morning.

The fire involved an being tested by the Air Resources Board at its offices. The vehicle was parked and charging when the fire began at approximately 6:40 a.m. (PDT). No one was injured and no property, beyond the vehicle, was damaged. The local fire department was called to the scene and used water to extinguish the fire.

This incident was similar to one on when the battery in the being leased by the in caught fire. and battery supplier began an immediate investigation.

Working with initially determined that the battery cells involved in the earlier fire were built with a different production procedure and that no other battery in today's fleet employed cells built with the same production processes. As a result, and believed that the battery fire in the vehicle was an isolated incident. Extensive details about the ongoing investigation were and continue to be communicated to customers.

However, because of this second occurrence, has decided to suspend use the vehicles until it understands, and can correct, the underlying cause of the problem. company's investigatory team is working with on both incidents.

uses an advanced sodium-sulfur battery. It is the only advanc battery available so far for larger-scale fleet testing. To date, has delivered a tota 34 of the electric vans to 12 customers nationwide. The fleet has accumulated more th 50,000 on-road miles.

###

1994

on Fax

Grounds Electric Vans After 2nd Fire

1994
By: STAFF WRITER
Edition: Home Edition Section: Business Page: 1 Pt. D Col. 5
Word Count: 310

TEXT:

grounded its fleet of electric vans following an early-morning fire that erupted in a vehicle battery as it was being charged at a facility in

The fire is the second to occur in the last month in a the company's electric-powered test vehicle. On a electric vehicle was damaged by a similar battery fire in

No one was hurt in either incident. In fire, damage was mostly confined to the batteries, which are at the rear of the vehicle under the van bed.

The vehicles are powered by sodium-sulfur batteries made by a electrical engineering firm with battery operations in and

Sodium-sulfur batteries provide good range and acceleration. But safety has been a concern throughout their development, because the batteries must be kept at a constant temperature of 600 degrees Fahrenheit.

has 34 electric vehicles being tested nationwide by 12 customers, mostly utilities. In the wake of incident, it has asked the customers not to use the vehicles and to park them outside until the cause of the fires can be determined.

After the first fire, said the problem had been traced to faulty welds in the battery cells. But the second fire is forcing and to re-evaluate. "We thought the first fire was an isolated incident," spokeswoman said. "We want to proceed very cautiously."

Other batteries built using the same procedure have not been placed in service.

spokesman said the agency--the driving force behind requirement that auto makers sell zero-emission vehicles in the state by 1998--had been testing the for a couple of weeks. An employee discovered the fire upon arriving at work about 6:40 a.m. The local fire department extinguished the fire.

DESCRIPTORS: ELECTRIC VEHICLES; FIRES; PRODUCT SAFETY

Vans After 2nd Fire

1994

By: STAFF WRITER
Edition: Home Edition Section: Business Page: 1 Pt. D Col. 5
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Heading #1 Search: 1994 22:10
^S/^Q: start/stop; ^C/<ESC>: interrupt; ^T: Paging ON/OFF
DIALOG(R)File 630:

Sticks With Electric Car Battery Design Despite 2 Fires

1994

By: From
Edition: Home Edition Section: Business Page: 6 Pt. D Col. 1
Story Type: Wire
Word Count: 200

TEXT:
said that the sodium sulfur battery remains promising for commercial electric cars despite two fires in test vehicles using the high-heat propulsion system.

Ford last week grounded its fleet of 36 test vehicles made with the sodium sulfur battery pending an investigation into the cause of the fires.

Some have questioned the safety of using a battery that operates at 600 degrees Fahrenheit, but a spokeswoman said that the battery has too many advantages, such as performance and relatively low cost, to be abandoned. "The stakes are too high," said.

Auto makers are racing to build a commercially attractive electric car by 1998, when will require that 2% of all cars sold in the state be zero-emission vehicles.

All the major car makers have developed electric cars, but each model has problems that the makers fear will make them unappealing to the public.

said the fire last in an in was similar to one a month ago at the in but she said the second fire disproved an earlier theory that a bad batch of battery cells was to blame.

DESCRIPTORS: PRODUCT DEVELOPMENT

1992 v43 n9 p126(7)

Title: Electric vehicles.

Authors:

Subjects: Automobiles, Electric_Design and construction

Reference #:

===

Abstract: and other states that are adopting similar laws, will require Zero Emissions Vehicles by the year 1998. Automakers in and the are developing electric vehicles in order to comply with these regulations. An overview of the batteries, motors and finished products is presented.

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What with (and maybe other portions of the country as well) requiring Zero Emissions Vehicles by 1998, electric vehicles--EVs, for short--are definitely on the way. Two months ago (see we had a brief overview of it all. Here, let's give a plug to this potentially shocking field of current technology. And now that I have all these horrible electrical puns out of my system, we can get down to serious business.

And serious it is. There has always been a freako electric car fringe (typical bumpersticker: "I go 45 mph and I don't pollute ..."). But the coming regulations dictate significant numbers of EVs in hands perhaps as ordinary as yours and mine. Thus, as enthusiasts of things automotive, we need to incorporate into our collective databank a whole raft of EV terms:

NaS, NiCad, PM and brush DC, AC induction, MOSFET and IGBT, the works. Lots of neat technology here from the likes of BMW, Clean Air Transport, Ford, General Motors, its Hughes Aircraft component, Honda, Mazda, Mitsubishi, Nissan, Solar Electric Engineering, Suzuki, Tokyo Electric and Unique Mobility. What's more, there may even be an EV for the enthusiast.

The subject breaks down rather nicely into a pentad of batteries, motors, controllers, vehicles and infrastructure. Let's examine each in turn.

Compared with liquid fuels, batteries are a woefully poor means of storing energy. What's more, they're likely to remain so. As an engineering rule of thumb, figure on batteries accounting for 30 percent of an EV's weight, versus something like 3 percent for a gasoline counterpart's topped-off fuel tank.

But remember two essential points: EV use is being driven by environmental concerns--not by quests for greater efficiency. Also, emissions from a stationary source, namely, the electric power facility, are easier to control and monitor than those from millions of smaller mobile sources. Thus, there's some rationale for EVs, at least until more advanced technology comes along, of which more anon.

Stripped to its basic physics, any two dissimilar materials placed in a suitable medium can form a battery. Witness the potato digital clock, but don't expect Idaho to become the next Middle East. Some of the real contenders are shown in the table nearby. It makes sense to compare them on several criteria. Energy, for example, gives an indication of potential range. Power hints at acceleration ability. Cycle life measures how often the battery can be brought back to its fully charged state; and be aware that the nature of discharge sometimes matters. Cost obviously reflects the relative abundance of the material (too bad about meager energy resources...) as well as manufacturing and other aspects. Furthermore, to be environmentally correct, we consider the recyclability of the materials involved as well.

The first on our list, lead-acid batteries, are good for EV acceleration, mediocre for range, heavy as, er...lead, familiar to the infrastructure--and the only game in town in the near-near term, i.e., now to just around the calendar. All entrepreneurs use them in their current EVs. Both Clean Air Transport and GM use them in their advanced designs, at least in part because each wants to hit the streets by the mid-Nineties.

One disadvantage of a conventional lead-acid battery is its preference for shallow discharges, precisely the sort of thing every starter battery gets regularly. Lead-acid proponents claim this can be engineered around; others say lead-acid cycle-life inherently falls off with frequent deep discharging.

Nickel-cadmium is a Japanese favorite, the choice in research vehicles shown by Mitsubishi, Nissan and Tokyo Electric. Scaled-up versions of premium drycells, NiCads provide really excellent power, better range than lead-acid and long life. But cadmium is scarce and highly toxic. And nickel isn't cheap either.

There's also the highly publicized NiCad memory effect, wherein frequent shallow discharges reduce capacity. Proponents counter this by noting it's generally a one-step degradation, critical in a voltage-sensitive device like a computer, perhaps less so to an EV's controller hardware.

NiCad is mentioned as a midterm possibility, well before the decade's end, though concerns about cadmium's toxicity raise lots of eyebrows on this side of the Pacific Rim.

Sodium-sulfur, NaS, offers something like three times the energy of lead-acid, albeit with only modest power capabilities. NaS cost is reasonable; in fact, it's questionable whether recycling would be economical. But the real drawback of a NaS battery is its superhigh operating temperature, 550 to 650 degrees Fahrenheit, needed to keep the sodium and sulfur molten within insulated capsules.

Nevertheless, BMW and Ford have expressed enthusiasm for NaS, especially in the midterm. Even with today's technology, a 150-watt source (i.e., a couple of light bulbs) is sufficient to maintain the heat when the battery is not in use. This power must come from somewhere, though, either as a parasitic loss or from a remote hookup. Once in use, the NaS battery generates its own heat; indeed, like all batteries, so much heat that it requires cooling of some sort.

Another one warranting mention is the zinc-air battery. It offers plenty of energy, and thus range, but so little power that it's used as part of a hybrid battery package. Another downside is that it doesn't use just any air. Its air supply must be carefully scrubbed of carbon dioxide.

Nickel-hydride batteries are already an option to NiCads in premium applications. But these are in AA size, and upscaling is nontrivial. There is a lot of potential seen in the long term.

Lithium iron disulfide looks great, until you note that its temperature window is roughly 100 Fahrenheit degrees hotter than NaS's. Similar heat-control technology applies, however.

Lithium polymer is the least mature of the bunch. It works at ambient temperature, though, and can be shaped for packaging and optimal recharge. Specialists point to this one in the far term, say 2005 and beyond, though they also concede that hydrogen fuel cells may evolve every bit as quickly.

As for hydrogen itself, be aware that it's not a bad fuel for internal combustion (see 1989). However, there are problems galore, not the least of which is the following: Unless a hydrogen-powered car carries its own oxygen supply as well, combustion still produces oxides of nitrogen--and if the car emits [NO.sub.X], it isn't ZEV.

In the strictest sense, part electric/part gasoline-powered hybrids can't be termed ZEVs either. One type is the "parallel" hybrid, with a small gasoline engine driving the wheels independently under some optimal conditions. The Clean Air Transport LA301 is a parallel-hybrid EV.

Or the added powerplant can drive a generator charging the battery directly. Such a "series" hybrid is less likely, though. Unless the generator is particularly large (and heavy), it can't provide more than a trickle charge. The LA301, for instance, has an additional get-home mode, in which 20 minutes of stationary running will get you an additional 5-6 miles of range.

And, as a last aside, solar cells have the same problem of middling power. A week of good sunlight might recharge an EV battery pack, but genuine solar-powered vehicles depend on hyper lightweight construction (not to say hyper lightweight pilots as well).

In summary, if ZEV is the end-of-decade goal, batteries of one sort or another are the only game in town.

Electric motors have good torque even from zero rpm, ridiculously few moving parts, excellent noise and vibration characteristics, sealed lubrication, laudable durability--it's a pity they don't run on gasoline. Three principal types are regularly discussed for street-going EVs: DC with brush, AC induction and DC with permanent magnet.

Brush DC motors are the stalwarts of past and current EVs, golf carts, industrial forklifts and the like. They're sturdy, inexpensive, well understood and easy to control; this last, because batteries inherently provide direct-current power.

Conventional DC disadvantages include brush wear, low motor speed (roughly 3000-4000 rpm) and poor part-load efficiency. These last two often dictate fitting a multispeed transmission, an added complication not required with more sophisticated motor technology.

AC induction motors are high-revving (12,000-14,000 rpm is not uncommon) and their part-load efficiency is good. They're expensive to manufacture, however. And, powered by alternating current, they require inverters and controllers that are complex compared with classic DC counterparts.

Permanent magnet DC motors are brushless, with more performance than their DC siblings, but more expensive as well. PM DCs rev to 6000-7000 rpm and their part-load efficiency may be even better than AC induction's.

In truth, PM DC motors are actually crossbreeds, in that their input current has an alternating wave form; i.e., they're sort of AC.

A word about revs: Power, you'll recall, is torque times rpm. And it's power that accelerates any vehicle, be it EV or conventional. Thus, the higher revs of advanced designs translate into improved performance. Also, part-load efficiencies allow relatively simple planetary-gear reduction, rather than multispeed gearboxes.

All these efficiencies are crucial for EVs, because we're not talking gobs of power here. A typical brush DC motor is rated at 20-25 hp. BMW's state-of-the-art PM DC motor, supplied by Unique produces 45 hp. GM's advanced AC induction motor puts out 30 hp with 57-hp peak (i.e., for brief periods only); the Impact is powered by a pair of them.

The controller is an EV's engine-management system. It looks at conditions and driver demand, decides how much electrical current is warranted and sends it, properly conditioned, to the EV powerplant.

If the latter is a conventional brush DC motor, this conditioning is relatively straightforward, a controlled weakening of the DC-generated electrical field known as chopping; hence, a "chopper" control. Traditional choppers operated at 400 Hz or so, hence the classic streetcar whine

AC induction requires rather more complex conditioning. An inverter takes the battery's direct current, fools with it and turns it into a periodic wave, that is, into an alternating current the motor requires. PM DC motors, being AC-like, have even more complicated electronics albeit along similar lines.

The controller takes its 3-phase AC and varies phase, frequency and amplitude to get the motor operating at the desired speed in the appropriate direction. Remember, motors don't mind running either direction. Also, of which more momentarily, they can be driven by the wheels to act as generators.

As an example of controller operation, energy flow to an AC induction motor is routed by six solid-state switches, a schematic of which lurks in the opening montage. Technoids such as yourselves might enjoy deciphering which pairs of switches need to be closed to send current through the appropriate motor windings in either direction. You'll note, for example, that switches 3 and 6 send current through windings A and C.

Switching time is on the order of 10,000-20,000 Hz, a lot quicker than I did the exercise above and well beyond the range of human hearing. However, I suspect my husky's ears will perk up when an EV drives by. It's possible to save Kenwood's ears as well, but switching efficiencies fall off at super-high frequencies.

There's a strong synergy between advanced motor technology and that of power electronics. The latter is populated by the likes of MOSFETs (metal-oxide-silicon field-effect transistors), IGBTs (insulated gate bipolar transistors) and GTO-SCRs (gate-turn-off silicon-controlled rectifiers), the goal of each successive generation being more power transmitted through less silicon. It's a state of the art that changes monthly, but even now things are quite impressive. A controller handling 100 kW of power fits into a small suitcase.

And a good thing too, because efficient packaging of an EV is of critical concern. It's the usual game of light weight, optimal aerodynamics and reduced rolling resistance, combined with purely EV criteria of accelerating, braking, maneuvering, heating and cooling the vehicle, its powertrain and its occupants, all by electricity stored onboard.

For instance, long cables incur high resistance losses, so the battery pack, controller and motor need to be close to one another. This, however, complicates occupant packaging, optimal weight distribution and crashworthiness.

Indeed, this last criterion is especially challenging, what with none of lead, acid, cadmium, molten sodium, molten sulfur--or high voltage, for that matter--being among the environmentally friendly. Engineers are confident, though, that any viable EV will meet all the safety standards required of conventional cars, plus some others that are EV-specific: For instance, what happens when a careless EVer drives into a really deep puddle?

Another EV-specific challenge concerns what engineers call "hotel loads," all the comfort and convenience features of a modern automobile that require nuclear ones.

EVers also see their cars given use of dedicated car-pool commuter lanes on freeways. The range/performance trade-off will have to improved a great deal, however, just to get into these lanes.

Maintenance is another thorny issue. EVs don't need oil changes or tuneups.

But battery packs do not last the life of the EV. Replacement every two to three years will cost around $1000-$1500; the latter, worth a lot of oil and tuneups, you'll agree.

Initial cost is a problem too, despite waivers of registration fee, tax breaks and the like. In particular, automakers have all but said, "Batteries not included." That is, EV prices sans battery pack will likely be in line with those of comparable conventional vehicles.

Utility companies and battery makers may move into the leasing business. It would be sort of like owning your GTO, but not its small block. Recycling of battery packs is relatively straightforward, if lead-acid prevails. Otherwise a new infrastructure needs to be established, and quickly.

Europe and Japan have home-grown EV movements as well. Europeans think in terms of ring roads around cities, within which it would be EV-only. Such city centers tend to be devoid of freeways, and a couple of proposed European EVs probably reflect this in their pitiful acceleration. Parallel hybrids may make sense over there, what with minimal electric propulsion in the city and gasoline for the ring and beyond.

Japan has plenty of expressways in its cities, but they're rarely express. It has its environmentalists too, and the government has set a goal of having 200,000 EVs on the streets by the year 2000. Fleets get initial encouragement, followed by private vehicles later if economics so warrant.

An interesting quirk of Japan's home market is a relative paucity of garages and a less densely developed electrical infrastruture. For this reason, the Japanese have placed special emphasis on service-station quick charging. Indeed, Nissan has shown a Super Quick Charge system that can give a 40-percent lift to a NiCad battery pack in only 6 minutes or a full charge in 15. Evidently one helluva cord is required, but more to the point, there's excellent battery technology in dissipating the heat generated by this accelerated electrochemical activity. Lead-acid batteries respond almost as well, though long-term cycling of either remains an open question. As does the disadvantage of peak-usage charging during the day.

The rule is on the books. If an automaker sells 5000 or more cars a year in 2 percent of its 1998 sales must be Zero Emission Vehicles (or it must wheel-and-deal complex credits with those that sell more). The level goes up progressively to 10-percent ZEV by 2003. And, at this point, ZEV means EV.

Will anyone be ready?

Yes, and it's quite appropriate to raise the flag and salute As you've learned in reading this far, this technology is extremely multifaceted, and it's difficult--not to say pointless--to assess who's best. But, for once, I believe current domestic technology is second to none. For a while there, it was as though the Japanese thought the regulation wasn't going to stick (as, indeed, it may not).

But come 1998--and likely several years prior to this--I look forward to a healthy little niche of specialized EVs humming around. That's when I'll approach with the idea of a hybrid ultracapacitor feeding 100 hp to each of the four wheels of an enthusiast EV.

Until then, keep plugged in. Oops.

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Citation: 1993 v44 n6 p39(1)

Title: Electric. (First Drive)

Authors:

Subjects: Electric vehicles_Testing
Automobile industry_Product development

Companies: _Product development

Reference #:

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Abstract: Certain power companies will begin using electric in 1993. A prototype Ecostar, using a lead-acid battery instead of the production sodium-sulfur battery, is test driven. The handling is much like that of the European Escort van.

==

The first EV you're likely to see is the most transparent we've driven so far

It won't be until later this year that 80 of Ford's Ecostar electric vehicles enter real-world fleet service with the likes of and When they do appear, they'll probably be the first EVs that many folks see in actual use.

We've just had a brief drive, though, and can report that it goes a long way toward meeting goal of being "transparent." That is, the accelerates, brakes, steers and handles pretty much like the European Escort van it's based on - until it comes time for refueling.

I hasten to admit, however, that the example Ford offered us was not to final specification in a most crucial way: This prototype uses lead-acid batteries as opposed to the sodium-sulfur variety intended for actual production. As you may recall (see 1992), the Na-S battery offers potentially three times the range of its familiar-tech lead-acid competitor. And, sure enough, the Ecostar drives at our place were curtailed before all the interested parties had their chance at the wheel.

cites an Na-S range of 100 miles in driving akin to the EPA city cycle. A recharge takes five to six hours at 240 V/30 amps (the sort of line needed for an electric clothes dryer); a low-life 110 V/20 amp charge takes 18-20 hours.

We got maybe 25 miles total of motoring this time around, in admittedly spirited sampling. Each of us felt compelled to experience the 12-second 0-50-mph time. And at least two of us, and I, cruised around in search of impromptu drag races with unsuspecting econoboxes. It's sure fun to have peak torque at 0 rpm, not to say everywhere else in the rev range as well.

Everyone remarked on the eerie quietness of propulsion. Road noise became all the more noticeable, especially with the special low-rolling-resistance/high-pressure tires.

Yet there was no weirdness whatsoever in the operation of the accelerator or brake pedal. Each was a perfect mimic of its conventional counterpart, despite vastly different underlying functions. The accelerator, for instance, sends a signal to the system's controller, which converts the batteries' DC energy to 3-phase AC and decides just how much to provide the single motor driving the Ecostar's front wheels. It's a far cry indeed from a simple cable opening some mechanical butterfly valve.

The brake pedal deserves even more credit for its feeling of normalcy. For boost, there's an electrically operated vacuum pump (lacking engine vacuum, of course). And there's also regenerative braking, with the drive motor temporarily driven as a generator whenever braking is applied. But regen is carefully calibrated to provide just the retardation expected from compression braking of an internal-combustion engine.

It's an impressive first iteration of a real-world EV. I like Ford's idea of a practical van with 850-lb. payload, and there's rationality in leasing them to electric utilities and the like (albeit at $100,000/ 30 months!). I would suggest as well that governments of and other states promoting EVs take part in this evaluation process, rather than force the general public to play development engineer later on.

We wouldn't mind, though: We've already put in our bid for a long-term here at