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REVIEW OF STATUS OF COMPLIANCE
NOR-CAL 9 INCH LOWERED FLOOR FORD E250 OR E350
Document no. 030530

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June 01, 2003

In order for wheelchair users to drive or ride in personal use motor vehicles, the vehicle must be modified to accommodate the different requirements that are unique to this clientele. Such modifications may void some, or all, of the original compliance statements made by the original vehicle manufacturer (OEM). Furthermore, when the original vehicle is incomplete, the final stage manufacturer must ascertain that the completed vehicle meets the OEM and Federal Motor Vehicle Safety Standards (FMVSS) requirements and specifications. The modifier/alterer must therefore review the status of the vehicle's compliance and, if pertinent, demonstrate that the vehicle remains in compliance with all applicable (FMVSS). The review process can be conducted using OEM data such as the body builder guide and the incomplete vehicle document, as appropriate, and compliance can be demonstrated through many different methods such as testing and engineering analysis.

This document presents Nor-Cal's vehicle modification, the path it took to demonstrate its understanding and application of the CFR title 49 section 571 (Federal Motor Vehicle Safety Standards) and the specific data that supports its claim to compliance. All tests were conducted in a modified vehicle that was representative of current production vehicles.

1. VEHICLE MODIFICATIONS

The modified vehicle derives from a Ford Econoline E250/E350 that is completed and/or altered so as to increase the interior height and add features enabling wheelchair users to drive or ride in the vehicle. The following modifications are done to the original vehicle:

- Raise the vehicle body by 3 inches:
The body is raised by replacing the original body mounts and/or relocating the body mount supports higher up on the vehicle frame rails.
- Modify the fuel system:
The fuel tank is replaced and relocated aft of the rear axle. The existing aft of axle spare tire mounting structure is removed and replaced by cross members that supports the new fuel tank. The new metal fuel tank is manufactured by Transfer Flow Inc and has a usable capacity of 30 US gallons. The original vapor canister is relocated from inside the left rear frame section to the front of the fuel tank. The fuel filler lines/filler cap is relocated to the rear passenger side body panel. Fuel and vapor lines are extended and/or relocated to compensate for the new and relocated fuel tank and vapor canister. A metal shield is placed between the fuel tank and the differential. Drawings of the fuel tank as well as installation instructions are supplied by the tank manufacturer.
- Modify the vehicle frame structure:
The vehicle frame structure is modified by reducing its height, from a point in line with the front firewall to a point approximately 12 inches in front of the rear differential. The lowered frame as well as the transition areas between the unmodified and modified frame sections are reinforced to compensate for the loss of rigidity and to ensure that there is no deformation to the transition areas during a 30 mph frontal impact or a 50 mph 70% offset rear impact. All frame modifications are detailed in shop drawings.
- Lower the vehicle floor:
The original floor is removed, from the front firewall to a point approximately 10 inches in front of the rear wheel wells and from the left to the right inside limit of the rocker panels, and replaced by a new floor that is nine (9) inches lower than the original one. The floor modifications are detailed in shop drawings.
- Extend the front row seat bases:
Both front seat bases are extended so as to compensate for the lowered floor and to maintain the vehicle's original Seating Reference Point (SRP). The method of anchoring the extended seat bases to the lowered floor allows for quick and easy removal of the seats. This "quick release" type of seat bases provides the versatility to accommodate wheelchair drivers and front row

passengers or ambulant drivers and front row passengers as appropriate for the end user.

- Install a floor mounted seat belt anchor:
Both front row seating positions are equipped with floor mounted seat belt anchor systems and seat belt extension assemblies. This system ensures that, when the front row positions are occupied by a wheelchair user (when the seats are removed), a complete type II seat belt system is provided. Any additional seat belt hardware, if installed, meets the requirements of FMVSS 209. When the front row seats are removed, the seat belt warning sensor and the original occupant system protection sensors are bypassed by inserting an appropriate resistance.
- Install a rear row sofa bed - optional:
A three position sofa bed may be installed in the third row. The method of anchoring the sofa bed and the seat belt anchors are specified by the seat manufacturer. The seat belts for the third row seating positions consist in 2 type II belt systems for each outboard position and a type I belt system for the center occupant. The type II belts are anchored to the sides of the vehicle and to the floor (rearward of the sofa bed). The center lap belt is anchored to the vehicle floor behind the sofa bed. The seat belts are compliant to FMVSS and are properly labeled.
- Bumper relocation
The front and rear bumper brackets are modified so as to raise them and maintain the original height in relation to the vehicle body.
- Miscellaneous
Modify radiator bracket, install adaptive driving controls (optional), install a lift, steering column extension, tipping engine-transmission, install a trailer hitch, etc.

2. COMPLIANCE ISSUES

The modifications to the vehicle affect the original manufacturer's certification statement relative to some of the FMVSS requirements. A review of all FMVSS indicates that the modifications maintain, void or partially void prior certification data. Of the standards that are voided or partially voided, some require testing while others need simply to be analyzed to determine compliance. The following table (TABLE I - COMPLIANCE STATUS OF MODIFIED VEHICLE) lists the applicable standards and categorizes them as compliant as modified or compliance needs to be demonstrated. This classification simply addresses each relevant standard and does not explicitly imply that testing is required to demonstrate compliance. Some standards are listed because, although they are not required under the FMVSS, Nor-Cal wishes to meet the requirements of the specific standard (for example FMVSS 208 does not apply because of the unloaded weight of the vehicle but Nor-Cal

wishes to ensure an appropriate level of occupant safety). The different methods of demonstrating compliance and the existing documentation supporting compliance are addressed in the following section.

	Title (FMVSS)	Compliant as modified	Compliance needs to be demonstrated		Title (FMVSS)	Compliant as modified	Compliance needs to be demonstrated
101	Controls and Displays	X			201	Occupant Protection in Interior Impact	X
102	Transmission Shift Lever sequence, starter interlock, and transmission braking effect	X			202	Head Restraints	X
103	Windshield Defrosting and Defogging	X			204	Steering Column Rearward Displacement	X
104	Windshield Wiping and Washing System	X			205	Glazing Materials	X
106	Brake Hoses	X			206	Door Locks and Door Retention Components	X
108	Lamps, reflective devices, and associated equipment	X			207	Seating Systems	X
111	Rearview Mirrors	X			208	Occupant Crash Protection	X
113	Hood Latch System	X			209	Seat Belt Assemblies	X
114	Theft Prevention	X			210	Seat Belt Assembly Anchorages	X
116	Motor Vehicle Brake Fluids	X			212	Windshield Mounting	X
118	Power-operated Windows, Partitions and Roof Panels	X			219	Windshield Zone Intrusion	X
119	New Pneumatic Tires for Vehicles other than Passenger Cars	X			225	Child Restraint Anchorage Systems	X
120	Tire Selection and Rims for Vehicles Other Than Passenger Cars	X			301	Fuel System Integrity	X
124	Accelerator Control Systems	X			302	Flammability	X
135	Passenger Car Brake Systems		X				

TABLE I
COMPLIANCE STATUS OF MODIFIED VEHICLE

3. COMPLIANCE PROGRAM

Of the FMVSS that require a demonstration of compliance, only a few require actual testing. A typical compliance program starts with the impact tests, followed by the static tests and other out-of-vehicle tests. Analysis is usually performed on a different vehicle or prior to the impact tests. Although we encourage full compliance, we do not feel that certain standards can be met without the equipment or vehicle manufacturer's support; FMVSS 225 and 201 (U). A limited compliance program provides a level of certification comparable to other vehicle modifiers and final stage manufacturers. We propose that the following course of action be undertaken.

STEP 1

With an unmodified vehicle, determine/measure the following specifications:

1. Vehicle weight: As received with all fluid levels topped-off (wheel weights, axle weights and total weight).
2. Center of gravity: Determine center of gravity.
3. Frame dimensions
4. Seating Reference points of the seating positions, referenced from a fixed point on the vehicle body.

STEP 2

1. Modify vehicle structure as per drawings, templates or other traceable means
2. Take pictures as you modify
3. Review all structural modifications, concentrating on welds, bolts, fuel system components and seat bases
4. Perform final quality control on structural modifications
5. Complete body modifications and all other additional components (seat bases, wheelchair tie-down, seat belts, etc).

STEP 3

1. Install interior finishing in the first row area
2. List source of all interior finishing items
3. Weight remaining interior finishing materials
4. Install lift and other non-readily detachable components (or install equivalent components of comparable weight and weight distribution)
5. Weigh vehicle (As modified with all fluid levels topped-off (wheel weights, axle weights and total weight)).
6. Determine new center of gravity – compare to OEM requirements
7. Validate or determine:
 - a. GVWR, GAWR and unloaded vehicle weight
 - b. FMVSS 135 by comparing new center of gravity with OEM specifications
 - c. Designated seating capacity and cargo capacity

STEP 4

1. Verify FMVSS 302 – either by testing or supplier data, for all materials within a ½ inch of occupant airspace
2. Determine compliance of door locks and latches, schedule testing if appropriate
3. Verify FMVSS 209 - seat belts, if seat belt extensions or modified seat belts are used
4. Verify compliance with FMVSS 225 – Child restraint anchorage systems if applicable

STEP 5

1. Verify FMVSS 201 requirements and compliance status, if applicable
2. Verify emissions compliance with fuel tank supplier

STEP 6

1. Submit vehicle to pre-test roll-over to validate the initial integrity of the fuel system.
2. Perform frontal impact (FMVSS 208 and 301) with FMVSS 204 (Steering column rearward displacement), FMVSS 212 and 219 (Windshield mounting and Windshield zone intrusion) evaluations.
3. Perform rear impact (FMVSS 301) on the filler neck side of the vehicle.
4. Perform side impact (FMVSS 301) on the fuel line side of the vehicle.
5. Perform seat and seat belt anchorage tests (FMVSS 207 and 210)
6. Perform seat belt anchorage tests on wheelchair occupant restraint system
7. Perform wheelchair tie-down test – not related to FMVSS requirements.

STEP 7

1. Compile all certification data, including details of modifications and certification requirements.

4. DEMONSTRATION OF COMPLIANCE

Demonstration of compliance was undertaken by analysis/calculation, by direct testing or by third party (OEM statements). Ford Motor Co. provides a certain level of design criteria that allows for pass-through certification. Table II indicates methods of demonstrating compliance for each of the applicable standards as well as supporting documentation available for consulting.

FMVSS CMVSS	Description	Consequences of modifications	Method of demonstrating compliance
135	Passenger Car Brake Systems	Change to the original centre of gravity	Pass through certification with Ford approved location of center of gravity. Nor-Cal supporting documentation available at offices.
201	Occupant Protection in Interior Impact	Changes to interior finishing materials	RVIA and NMEDA submitted requests for exemption to the NHTSA. Decision pending.
204	Steering Control Rearward Displacement	Original steering column is extended to compensate for the body raise	Compliance demonstrated by observation of the steering column rearward displacement during a 30 mph frontal impact. Refer to MGA test center statement dated May 30, 2003
207	Seating Systems	Front row seat bases and third row seats are modified or replaced with aftermarket products	Compliance demonstrated by in vehicle testing of front row seating positions. Refer to MGA report no. CO3C3-002.1
208	Occupant Crash Protection	Seat base modifications and structural modifications	Compliance demonstrated by testing (compliance is not mandatory for vehicles with an unloaded vehicle weight above 5,500 pounds or a Gross Vehicle Weight Rating over 8,500 pounds). Refer to MGA file no.CO3C3-002
209	Seat Belt Assemblies	Addition of aftermarket rear row seat belts and front row seat belt extensions (labeling and strength)	Testing or manufacturer's compliance documentation and labeling is available at Nor-Cal offices.
210	Seat Belt Assembly Anchorages	Refer to 207 + wheelchair occupant seat belt must be tested	Compliance demonstrated by in vehicle testing of front row seating positions. Refer to MGA report no. CO3C3-002.1
212	Windshield Mounting	Structural modifications behind the vehicle crush zone	Compliance demonstrated by information (NOTE 1) test (frontal impact at 30 mph). Refer to MGA test center statement dated May 30, 2003
219	Windshield Zone Intrusion	Identical to 212	Identical to 212 – refer to 212

225	Child Restraint Anchorage Systems	Aftermarket third row sofa-bed type seat and any optional second row seats without child restraint systems.	FMVSS requirements come into effect September 2003. RVIA and NMEDA submitted requests for exemption to the NHTSA. Decision pending.
301	Fuel System Integrity	Replacement and relocation of fuel tank and routing of lines.	Compliance demonstrated by testing. Refer to MGA file no.CO3C3-002. Pass through from an E250 to an E350 is discussed at the end of this section.
302	Flammability	All materials within ½ inch of occupant air space must meet 302 requirements	Test results or supplier compliance data on file at Nor-Cal offices.
403 and 404	Platform lifts PROPOSED RULE	Addition of a wheelchair lifting device.	Upon announcement of the final rule and effective date, supplier information, installation as per the manufacturer's instructions and meeting other regulatory requirements (lighting, etc.) will demonstrate compliance.
Other	Evaporative Emissions	Fuel tank and line replacement and possibly the relocation of the canister.	Compliance demonstrated by the fuel tank manufacturer (Transfer Flow Inc.).
<p>Table II DEMONSTRATION OF COMPLIANCE</p>			

(NOTE 1)

Although the tests should be conducted as stand alone tests, it is reasonable to assume that the modifications did not affect the original vehicle crush zones and an information test is therefore acceptable to demonstrate that the vehicle is still within OEM specifications. Had there been any sign or issue of concern, a stand alone test would have had to be conducted.

4.1 BASE VEHICLES – COMPARISON (E250 – E350)

A review of the specifications of the E250 and 350 platforms indicates differences between the two chassis. The following data was obtained from the Ford Body Builder (2003):

PROPERTIES	E250	E350
Wheelbase	138 in	138 in
GVWR	7,900 pounds	9,500 pounds
Maximum unloaded vehicle weight	6,900 pounds	7,900 pounds
Minimum payload	1,000 pounds	1,600 pounds
Published base curb weight	5286 pounds	5483 pounds
Maximum payload ^(note 2)	2,614 pounds	4,017 pounds
Frame dimensions	6.16 X 3.18 X 0.181 in	7.69 X 3.18 X 0.212 in

(Note 2)

This maximum payload is calculated by subtracting the published curb weight from the GVWR.

The differences between the two vehicles must be reviewed in parallel with the FMVSS requirements. The major differences between the two vehicle platforms are the frame structure, the load carrying capacity and the test weight ^(Note 3). The FMVSS 208 and 301 ^(Note 3) are dynamic crash tests whereby a change to a vehicle frame assembly will cause variations to the vehicle crush and post impact speed (rebound). Differences in suspension may also change the vehicle’s reaction to an impact load. It is reasonable to assume that a heavier frame will decrease crush to the vehicle (crush less than a lighter frame) but this will result in increased deceleration to the frame and body of the vehicle. A difference in deceleration will affect occupant safety ^(Note 4) as well as transfer increased loads to the vehicle assemblies such as fuel tank mounting brackets, seat bases, wheelchair lifts, etc. The test weight is another design limit that would have to be applied to both the E250 and E350. The test weight sets the upper weight limit of the vehicle and neither vehicle must exceed this maximum value or any test results (208, 301) will no longer apply. The useful test weight ^(Note 5) of an E350 would be the base curb weight plus the additional weight of the modification (the weight of the modification must include all non-readily detachable components, including the wheelchair lift). This weight value would be 5483 pounds plus the weight of the modifications. This weight cannot exceed the maximum unloaded vehicle weight of the E250 without voiding compliance of the E250 to other standards that are related to the weight of the vehicle.

Considering that the FMVSS 208 does not apply to an E350, it is reasonable to assume that a more rigid frame would react as well as a less rigid frame, in regards to the FMVSS 301. The maximum unloaded weight of the E250, used to determine the test weight for the FMVSS

301 compliance test, is therefore the maximum allowable weight of the lowered floor E350 IF both vehicles are to use the same test data and modifications are identical.

(Note 3)

The test weight is a limiting factor in regards to vehicle modifications and continued compliance.

(Note 4)

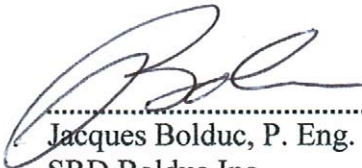
The FMVSS 208 is not required for vehicles with a GVWR over 8,500 pounds or an unloaded vehicle weight greater than 5,500 pounds. The 208 is essentially the same type of frontal impact test as the FMVSS 301.

(Note 5)

For the purpose of simplifying the terminology, we will use the term “test weight” as meaning the maximum weight of the vehicle as modified, without exceeding the allowable maximum unloaded vehicle weight. The actual definition of “test weight” is the weight of the vehicle, as received by the test center, plus two 150 pound passengers (dummies) plus 300 pounds of cargo or the actual cargo carrying capacity, whichever is the lesser. Many modifiers impose an “as delivered” weight equal to the maximum unloaded vehicle weight.

5. CONCLUSION

The Nor-Cal 9 inch lowered floor, as described in this document, has been subjected to a close review of Federal motor Vehicle Safety Standards. Vehicle specifications and modifications are properly documented and supported by adequate drawings, bills of materials and vehicle characteristics (delivery specifications, weights and weight distribution, work process, etc.). The conclusion is that, with the exception of pending requests for exemption, the vehicle is compliant to the stated Federal Motor Vehicle Safety Standards.


....., June 02, 2003
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