Adaptive Mobility

Mobility – Qualified Vehicle Modifier
Unique Guidelines and Requirements

INTRODUCTION

Ford Motor Company has developed guidelines for final stage manufacturers or vehicle alterers that modify the Ford light truck chassis. These guidelines are intended to help builders achieve greater levels of customer satisfaction and product acceptance through the manufacture of high quality vehicles. These guidelines should be used in conjunction with the Ford Truck Quality Program (FTQP) Common Guidelines, the Ford Truck Body Builders Layout Book, and the Incomplete Vehicle Manual. Double Boxed Items are Minimum Requirements.

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A. **SCOPE OF THIS MANUAL** *(Also See Common Section of Guidelines)*

This manual provides guidelines for final stage manufacturers building on Ford incomplete vehicles and vehicle alterers modifying Ford complete vehicle products. It also includes an introduction to process controls, quality controls, customer support, and management practices recommended by Ford. Ford recommends that manufacturers who build on Ford truck products obtain a copy of the *Ford Truck Quality Program (FTQP)*, available through the Body Builders Advisory Service. The *Ford Truck Quality Program (FTQP)* is designed to help final stage manufacturers evaluate their abilities to implement manufacturing controls and identify ways to improve the quality of the end product.

This manual is a supplement to, not a substitute for, the *Incomplete Vehicle Manual (IVM)* or the Ford *Truck Body Builders Layout Book* and *NMEDA GUIDELINES*. Final stage manufacturers or vehicle alterers must exercise sound engineering judgement in the execution of vehicle modifications and remain fully responsible for meeting all applicable federal and state rules and regulations.

B. **WARRANTY POLICY**

Warranty requirements are presented in the Common Section of the Ford Truck Quality Program Guidelines.

C. **THE MOBILITY QUALITY PROGRAM (MQP) ASSESSMENT - WHAT TO EXPECT**

Participation in the Ford MQP is voluntary and restricted to mobility vehicle modifiers. A MQP participant that undergoes *a change in ownership, location, or significant management must notify Ford Modified Vehicle Engineering of these changes*. The MQP status does not automatically apply after any such change. Under the MQP, the final stage manufacturer/vehicle alterer is responsible for the completed vehicle, even if some portion is sub-contracted to intermediate stage builders or alterers. Participants are expected to implement the guidelines in this manual, and any published revisions, to maintain program participation.

**Minimum Requirements**

Important elements of the design and manufacturing process are Double Boxed throughout this manual. These elements are judged to be basic *Minimum Requirements* that must be met (a rating of *YES* on rating sheet) by any modifier.

**Engineering Assessment Intent & Focus:**

The assessment intends to gauge the ability of the Ford Modifier to produce a consistent quality level, throughout the product line, through control over the engineering, fabrication, and vehicle delivery processes. *It is important to recognize that the engineering assessment primarily reflects the ability of the builder, and not the quality of any specific product.* The assessment will review the builder's overall approach to process control, quality control, engineering, and manufacturing, and it will identify areas where changes should be considered to better meet the program goals.

**Builder Steps Toward Program Application:**

To arrange for a MQP Assessment, the following steps should be taken:

1. Review this *FTQP, MQP* and *NMEDA Guidelines*.
2. Perform a self-assessment by evaluating your operations using the FTQP Self-Assessment Form listed in Appendix VIII.
3. If the Requirements are met, return a copy of the Self-Assessment Form (Appendix VIII) addressed to "FTQP" at the address on the form.
4. Once the FTQP Section has received the Self-Assessment Form, you will be contacted to schedule a visit at a mutually convenient time. For the visit to be scheduled, there must be assurance that Ford vehicles will be available for review. Vehicle reviews of all basic types and models of Ford based vehicles offered by your company are essential.
5. An on-site visit is conducted by the FTQP Assessment Team using this guidebook and the
How The FTQP Assessment Works:
The FTQP assessment visit provides the opportunity for the MQP Assessment Engineer to observe the builder's processes, quality, and manufacturing controls. A typical on-site assessment may take one or two business days and will contain the following sequenced elements:

- An initial office meeting to gather general information about the modifier's company. Personnel representing Engineering, Manufacturing, Quality, and Sales typically participate.
- A review of the complete modification process, from the receipt of the Ford chassis through the completed vehicle final inspection, including inspections of representative vehicles built on Ford chassis. Other products may also be included in the review.
- A vehicle test drive may also be conducted at the FTQP Engineer's discretion.
- The Ford assessment engineer will complete the Engineering Assessment.
- Ford and builder personnel will reconvene to discuss the assessment. Senior Management is expected to attend the closing meeting.

A preliminary assessment report is reviewed and provided with the builder.

Approach To Improving Quality:
Meeting the Requirements as detailed in this MQP Guide Book is a prerequisite to full participation in the QVM Program. However, satisfying these Requirements alone will not guarantee quality products. Those companies constantly striving to obtain the highest levels of quality and customer satisfaction will find that they are meeting these Criteria and this will assist them in becoming participants of the QVM Program.

D. ELEMENTS OF AN EFFECTIVE QUALITY PLAN (Also See Common Section of Guidelines)

The key elements of an effective Quality Plan used for this evaluation are Management Commitment, Employee Involvement, Engineering, Process Control, Quality Control, Completed Vehicle Sign-off, Customer Support, and Response to Quality Concerns. This section evaluates the manufacturer's ability to implement those key elements of an overall Quality Plan that works daily to ensure continual improvement.

M-D0100 MANAGEMENT COMMITMENT (Also See Common Section of Guidelines)
This section evaluates management's commitment to promoting high levels of safety, quality, reliability, and customer satisfaction. The eagerness of employees to become active in developing process and quality control innovation on the shop floor is vital to continuous quality improvement. But enthusiasm can be lost without Management's willingness to devote resources for tools, materials, or training.

- Management must have written Quality and Process Control Plans.

A Quality Plan should articulate an ideological vision of quality commitment and be published to all employees. The plan should include quality indicators to measure performance to establish targets. (Refer to Appendix IX.)

An organized approach is needed to control quality in the aftermarket modification process. Writing a plan promotes communication and a common understanding among all people and helps demonstrate commitment. Commitment from the top management of the company to the production worker is required for success. Management should be willing to devote resources to promote high levels of quality, safety, reliability and customer satisfaction. Additionally, management must be personally involved and lead the company in its efforts to promote continuous quality improvement by adopting applicable process and quality control recommendations included in this guide.

M-D0102 Management is encouraged to support and become members in their industry trade associations.

M-D0103 All builders must be registered with NMEDA, NHTSA, and Transport Canada if vehicles are sold in the Canadian market.
M-D0300  ENGINEERING

M-D0301 Sound engineering skills are essential to the development of quality products and manufacturing operations. If your company does not contain a formal engineering function, an alternate source of engineering support and expertise must be employed (i.e., an engineering consulting firm, a professional engineer, or a local university). The individual(s) assuming the engineering role must be responsible for coordinating all the process and quality control issues and product design requirements. One individual must be responsible for mandated compliance requirement (both C/FMVSS, federal and state requirements). Engineering analysis should be conducted at least once each model year and whenever the builder or the chassis OEM make product revisions that may have an affect on product sign-off. Refer to the applicable year Incomplete Vehicle Manual for a summary of pertinent FMVSS/CMVSS requirements. Sales literature should not include any options that have not been engineered.

There must be engineering drawings and written direction, understandable to production, generated to describe the assembly and critical processes.

M-D0302 Where applicable, testing must be performed to qualify designs for compliance with government regulations.

M-D0303 An electrical load analysis must be performed per industry specifications which considers all likely vehicle duty cycle experiences. The results of the analysis should be documented and remain on file. An electrical analysis includes, but is not limited to key-off battery drain for each completed model.

M-D0304 Center of gravity calculations for completed units offered in the current model year must be conducted to determine whether they are within Ford’s C/FMVSS 105 compliance representations. Refer to the Incomplete Vehicle Manual.

M-D0305 Engineering must adopt and utilize a formal change control sign-off system.

M-D0400  PROCESS CONTROL (Also See Common Section of Guidelines)

M-D0401 To help alert employees to all critical elements within a manufacturing process, a special symbol must be utilized to designate critical elements. The symbol is then included on all applicable process control materials.

M-D0402 An in-process sign-off sheet (or traveler), which includes specific, clear, pass or fail criteria, including all critical operations, is required. This sign-off sheet must remain with the vehicle throughout the assembly operation and include signature entries, for both the operator and the inspector, for all critical operations. The sign-off sheet should be filed with the vehicle's records for use later in problem solving investigations.

M-D0403 A formal change control process must be incorporated with a Change Control Form for identifying and documenting the change. The change control form should include a description of the change, the date it is effective, the first affected unit production number, a reason for the change, and a place for signature approvals from engineering, production, quality control, purchasing and management. The change form can usually be initiated by anyone but all activities must sign off before the change is incorporated into production. Engineering sign-off must include an assessment for compliance with government regulations and engineering drawing requirements. Refer to appendix VII for an example of a change control form.
Other items not directly related to safety, but which are especially important to the customer's perception of quality, including performance, reliability, and durability, may also need additional control. These items may get a different symbol, differentiating them from "critical" items, usually meaning a lesser level of control is accepted. However, given the customer's high level of quality awareness today, it is highly recommended that the manufacturer elevate as many of these items to "critical" as necessary.

QUALITY CONTROL AND RESPONSE TO QUALITY CONCERNS (Also See Common Section of Guidelines)

There must be a formalized system to document and track the progress of a concern. Documentation should include concern definition, problem resolution, action planning, verification, and effective dates.

Root-cause problem solving methods must be adopted by both the service network and the final stage manufacturer. (Refer to Appendix XI.)

There must be a follow-up procedure to measure any change in customer satisfaction after the incorporation of corrective actions due to customer concerns.

Engineering should be able to demonstrate examples of new designs that have been incorporated or are under study to improve the product as a response to quality concerns.

Production should be similarly able to demonstrate process improvements.

COMPLETED VEHICLE SIGN-OFF

Verify that the front wheel toe and steering wheel clear vision alignment on the completed unit agrees with the specifications in the appropriate year Ford Truck Shop Manual.

FRONT WHEEL TOE-SET ALIGNMENT POLICY:
It is the responsibility of the Final Stage Manufacturer (or After Market Equipment Installer) to reset front wheel toe and steering wheel clear vision, if necessary, to the chassis manufacturer's specification after completing the build (or installing aftermarket equipment). THIS "INITIAL TOE SET", IN PREPARATION FOR DELIVERY TO THE CUSTOMER, IS NOT A WARRANTABLE EXPENSE.

DESIGN and MANUFACTURING GUIDELINES - GENERAL CHASSIS

PROVIDE FOR UNDERBODY LONGITUDINAL AND LATERAL AIR FLOW AROUND THE CHASSIS.
Adequate clearance should be maintained between the top of the OEM frame side rails and/or the bottom of the body floor. Pay particular attention to heat resistance and shielding when considering any non-Ford material for a particular heat environment.

UNDERBODY HEAT SHIELDS ARE REQUIRED ON THE COMPLETED VEHICLE.
- Required Shielding: Shields must extend from above the frame rail to a minimum of 20 inches inboard to at least 4 inches beyond the exhaust inside edge. Longitudinally, the shielding must cover from 4 inches forward of the Ford OEM body floor rear edge rearward to the exhaust outlet.
- Material Specification: A minimum of 18 gauge Aluminized or Galvanized Steel.
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- Attachment and Clearance:
  > Preferred Attachment: All underbody heat shielding should be attached to the vehicle body and maintain an air gap of 1/4 inch to 3/4 inch between the heat shield and the floor underbody.
  > Optional Attachment: Attach the underbody heat shielding directly on top of the OEM frame side rail or crossmembers.
  > All heat shields added must provide a minimum clearance of 3/4 inch to all moving components.

M-E0103  FLOOR CONSTRUCTION

Floor modifications must satisfy C/FMVSS requirements.
Modifications must have a pathway-of-compliance ie. NMEDA 2004 E-Series lowered floor.

Proper floor construction and material usage is CRITICAL to overall vehicle heat management. All materials must meet C/FMVSS 302, Flammability of Interior Materials. If the OEM floor is modified the modifier assumes responsibility for his modification. The recommendations below meet minimum specifications for flooring and provide guidelines for heat management when used in conjunction with proper heat shielding.

- Floor covering: Typical automotive carpets, vinyl, or rubber floor coverings are acceptable. Carpeting must not restrict full throttle, parking brake, or service brake pedal travel (for the full master cylinder stroke). Floor coverings must not extend under the Ford engine cover seal or interfere with E-Series engine cover mounting hardware.
- Plywood Floor Top: If wood is used in your vehicle floor, special attention should be given to the quality and integrity of the wood materials chosen. Some factors to consider are thermal conductivity, water vapor and gas permeability, acoustical and electrical properties, and moisture resistance.
- Metal Skin Bottom: Bottom surfaces of the floor, within 24 inches of any exhaust component, must be protected with a minimum skin of aluminized or galvanized steel.
- Molded Expanded Polystyrene (Bead Board) Insulation: Consider thickness and the ASTM specifications for water absorption, flammability, and thermal conductivity in your material selection.

Restraint Control Module (RCM) relocation must satisfy C/FMVSS requirements.

M-E0400  STEERING AND SUSPENSION (Also See Common Section of Guidelines)

M-E0401  Steering modifications must adhere to C/FMVSS and NMEDA guidelines.

M-E0402  Drilling, cutting, or welding of any OEM steering or suspension component, including mounting brackets, is not recommended. Any modification to the steering box and steering linkage is prohibited. Modifications to the steering input shaft may be allowed on a case by case basis. Contact Ford Motor Company QVM Section. Any welding of the frame within 4 inches of the steering gear, or within 4 inches of any rivet attaching a suspension mounting bracket, is unacceptable.

M-E0403  Static body leans must not be greater than 3/4 inch. This is the side-to-side difference between the heights of the body side wheel house openings. Spacers between the springs and axles can be added to help balance any lean. The total spacer thickness should not exceed 3/8 inch and must not adversely affect driveline operating angles, QVM Bulletin-14. Using a tapered spacer may help control driveline angles. The body builder is encouraged to avoid as much side-to-side weight imbalance as possible by balancing floor plans in the original body design, with due consideration for the customer's plans for equipment placement.

M-E0404  Rubber jounce bumpers are required in combination with a dedicated metal jounce stop. Axles must contact the rubber before the metal stop.
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M-E0405  Any suspension component contact with the fuel system is unacceptable. Suspension components must clear the fuel tank(s) throughout their functional geometry, by 2 inches minimum.

M-E0406  All suspension components loosened, or removed and reinstalled, must be properly reassembled and torqued in accordance with the Ford Shop Manual.

M-E0407  FTQP Program 4 x 4 conversions are permitted only on models that Ford does not build with a 4 x 4 option. All C/FMVSS issues must be addressed, including C/FMVSS 105 (Hydraulic Brakes), C/FMVSS 106 (Brake Hoses), C/FMVSS 208 (Occupant Crash Protection), and C/FMVSS 301 (Fuel System Integrity).

M-E0500  BRAKES (Also See Common Section of Guidelines)

Brake system or line changes must follow the guidelines in QVM Bulletin Q-18, Guidelines for Modifying Ford Light Truck Wheelbases.

M-E0501  It is the modifiers responsibility to comply to C/FMVSS 105 if any changes to the OEM system are made. Testing may be required.

M-E0502  Splicing the parking brake cable is unacceptable. A new cable must be used. Follow QVM Bulletin Q-18.

M-E0503  Secure added service brake lines with clips using spacing similar to the original design. Avoid kinking or bending brake lines and clear all exhaust components by at least 4 inches.

M-E0504  The brake system must be fully functional when the vehicle is completed.

M-E0600  POWERTRAIN - ENGINE, TRANSMISSION, and AXLES (Also See Common Section of Guidelines)

M-E0601  Welding to an axle assembly is unacceptable. It can cause damage to wheel bearings, races, and seals.

M-E0700  FUEL SYSTEM (Also See Common Section of Guidelines)—Please refer to Ford Truck Body Builder Layout Book

- Fuel systems must comply with C/FMVSS safety standards and all applicable emissions & certification standards and regulations.
- Before working on fuel tanks or fuel systems, disconnect battery cables from the batteries.
- To replace the OEM fuel tank, a pathway of compliance, approved by Ford, must be used.
- Reinstallation of the fuel tank sender units always requires a new sender gasket and assurance of proper torque.
- Tanks removed for processing should be stored where protected and all openings of the removed tank and the disconnected fuel lines must be protected at all times. Dirt and dust can plug fuel filters or cause engine damage.
- Fuel tank clearance to body or frame components is 3/4 inch, minimum. All body mounting rubber components must be removed when determining if there is compliance to this dimension. This metal-to-metal condition simulates the rubber compressing or decomposing over time.
- Fuel tanks and fuel filler and vent lines must not be undercoated.
- No unfriendly surfaces are permitted near the fuel system, including during the build process.
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For example, fasteners for body mount brackets, seats, or sub floors; or new chassis components, such as air suspension valves that could lead to a possible puncture in a vehicle crash condition, must not point towards the fuel tank.

M-E0701 FUEL FILLER

- Modifications of fuel filler pipes or fuel filler necks, or welding to these components should be avoided.

- Fuel filler systems must comply with all applicable emissions standards and certification requirements.
- Fuel filler and vent hoses must not be exposed to sharp corners and should have a minimum of 1 inch clearance to the body and surrounding chassis components (except the frame). Shielding or abrasion protection must be provided to protect fuel filler hoses with less clearance to exposed edges or corners.
- If the fuel filler hoses or vent hoses are replaced, the new hose material must meet Ford Engineering Specifications.
- Hose clamps should be worm gear drive type, be installed inside of the normal exterior body surface plane, and be properly torqued.
- The fuel filler mounting at the body must not allow any fuel or vapor to enter the passenger or cargo area. Spillage, fuel overflow or kickback must be directed toward the ground.
- When painting the fuel filler area, the fuel filler tube must be masked off to avoid over spray into the tank and into the filler opening. The paint may contaminate the fuel supply and/or effect cap sealing.
- The fuel filler pipe must be sealed off from dust and dirt during the build process. Use the filler cap or a masking cover to prevent in-process contamination.
- Recognize that the rubber fuel filler hose can sag with age and provide sufficient suspension clearance or fuel filler hose support to preclude interference or sink traps.

M-E0800 EXHAUST SYSTEM (Also See Common Section of Guidelines)

- Exhaust system modifications must comply with all applicable emissions standards and certification requirements. System modifications may require recertification to federal and/or local noise standards.
- Any heat or grass shields attached to the OEM exhaust system must be left intact. Any exhaust component extensions should be similarly shielded.
- Exhaust pipes should not be routed near fuel tanks or under the fuel filler.
- The modified exhaust design should maintain the OEM hanger bracket design and spacing.
- Exhaust system revisions must consider the thermal expansion of materials to maintain design clearances. The exhaust outlet should not be directly under the fuel filler.
- If the exhaust pipe is lengthened, the extension must be located aft of the catalyst.

M-E0900 FRAME (Also See Common Section of Guidelines)

M-E0901 Welding, cutting, or drilling of the OEM frame rail flanges is not recommended but can be allowed on a case-by-case basis. Engineering analysis, including testing, is required for approval. (Contact Ford Motor Company QVM Section).
- When drilling holes in the frame side rail vertical web, follow the restrictions for hole sizes and edge distances outlined in the Truck Body Builders Layout Book. Protect the brakes, electrical and fuel system during frame drilling or welding.

M-E0902 GENERAL FRAME GUIDELINES

Frame modifications must meet the requirements in QVM Bulletin Q-18, Guidelines for Modifying Ford Light Truck Wheelbases.
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**M-E1000** BODY AND SEATING (Also See Common Section of Guidelines)

| M-E1001 | Body Modifications must meet all applicable C/FMVSS requirements. |
| M-E1002 | NMEDA guidelines present information that may assist in certification to C/FMVSS requirements. |
| M-E1003 | Any deviations from the *Incomplete Vehicle Manual* must be supported by engineering analysis, development prove-out, or testing to demonstrate equivalency to the OEM body design and compliance with the affected standards. |
| M-E1004 | The removal or alteration of under hood noise abatement components or the addition of hood louvers may require federal or local noise emission recertification. |
| M-E1005 | For mounting added components, the use of mounting pads or Butyl Sealer C9AZ-19554-B or equivalent between the body and the added components is recommended. Minimize the corrosive effect of mating dissimilar metals by the careful selection of materials. |
| M-E1006 | Running boards should be designed to attach only to the body. If equipment is attached to the body and braced to the frame side rail, chassis NVH is transmitted through the braces and into the body. Relative movement between the body and the frame may loosen the running board attachments and/or contribute to body fatigue and corrosion. |
| M-E1007 | Polycarbonate headlamp lenses have a film coating that must be protected. Do not apply harsh solvents or tape to them. |
| M-E1008 | Interior Modifications must meet all applicable C/FMVSS requirements. |
| M-E1009 | Controls, components, or panels should not be mounted in potential occupant impact protection zones; refer to the *Incomplete Vehicle Manual* for definition of these zones on the E-Series and consider similar areas on the Windstar. |
| M-E1010 | Overhead consoles should minimize contact points in the head swing areas. Refer to the *Incomplete Vehicle Manual* under Section 208 for E-Series recommendations. All overhead equipment must be secured so that it will not come loose in an accident. |
| M-E1011 | Added equipment should allow for the removal of the engine cover for service. |
| M-E1012 | The use of adhesives or rivets for securing carpet or other items to the engine cover is recommended. If screws are used, their installation should be considered a critical element in the manufacturing process to insure that they pose no threat to components in the engine compartment. Items attached to the engine cover should leave a 1/8 inch clearance to the instrument panel to preclude squeaks and rattles. |
| M-E1013 | If the floor covering is revised, assure that the carpet thickness is minimal under the accelerator pedal to allow full pedal travel. The carpet should not extend under the engine cover seal. |
| M-E1014 | Protect the fuel system components from damage during the build. Use floor templates to identify areas of the floor to be avoided to protect the fuel system and use drill stops when drilling through floor or frame rails. |
| M-E1015 | Verify that no bolts or screws are pointed toward the fuel tanks or lines. Any fastener projections in close proximity must be shielded to preclude penetration in a crash. Attempt to locate fastener protrusions within body sills and frame crossmembers. |
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M-E1016  C/FMVSS requirements for seating must be followed.

M-E1017  The seat controls and restraint system must be accessible and operate freely on the completed vehicle.

M-E1100  ELECTRICAL SYSTEMS (Also See Common Section of Guidelines).

M-E1101  WELDING

When welding is performed anywhere on the vehicle, the battery cables and PCM module must be disconnected.

M-E1102  Revisions, additions, and extensions to the Ford factory electrical system and information on all wiring and devices added by the converter should be noted in the converter's owner information manual. Electrical schematics should be included.

M-E1200  MATERIALS, GENERAL

M-E1201  Body sealer such as Liquid Butyl Sealer C9AZ-19554-B, or equivalent, is recommended. This sealer does not run, is fast drying, and remains semi-elastic. It can be used in areas such as the floor pan, wheel house, dash panel, running board, door openings, and drip rails.

M-E1202  Interior components must meet C/FMVSS 302, Flammability of Interior Materials, specifications.

M-E1204  Chassis that are stored should be maintained in accordance with the new vehicle storage guidelines in the Safety and Emission Section of the Ford Body Builders Layout Book.