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Project: Szulc Krzyzanowski Fuso FG Frame and Camper Box Mounting - Vehicle Inspection and Recommendations

Requested by: Vehicle owner, Michel Szulc Krzyzanowski

Chassis: 2007 Mitsubishi Fuso FG 140

Scope: Inspection and review of frame damage and camper box mounting system. Test drive of unit to check for driving characteristics, specifically front end "wander."

Inspectors: Douglas Hackney, 2007 Fuso FG 140 expedition camper owner, and Ron Lucero, Kearney Mesa Truck Center service manager

Process: A visual inspection of the 2007 Szulc Krzyzanowski Fuso FG / Santek camper box unit was made at Kearney Mesa Truck Center on 10 April 2009 by Douglas Hackney and Ron Lucero. A test drive was conducted on local surface streets and a freeway. Test drive length was approximately 8 miles. Test drive roads were all paved.

Goals:

- Determine if front end steering "wander" was present or noticeable.
- Evaluate vehicle handling, ride, etc.
- Examine and evaluate vehicle suspension.
- Examine and evaluate camper box mounting system.
- Examine and evaluate chassis frame damage.
- Recommend vehicle suspension changes.
- Recommend camper box mounting system changes.
- Recommend chassis frame repairs/modifications.

Summary:

- The Szulc Krzyzanowski Fuso FG (SKF) camper box mounting system suffers from several design and implementation errors.
- The SKF camper box mounting system does not follow the guidelines, procedures and requirements of the Mitsubishi Fuso Body Builder's Guide.
- The SKF has suffered significant frame damage as a result of the camper box mounting system.
- The SKF would profit from changes/upgrades to the suspension.
- The SKF is suffering significant corrosion which will lead to premature component failure.
- No "wandering" was noted. Changes in the vehicle's handling between new and now are probably due to the bent frame, which changed the rear axle's relationship to the frame's longitudinal axis.

Frame Failures:

- Visible bend in the passenger side (LHD) frame rail just forward of the forward spring hanger for the rear axle.
- Possible bend in drivers side (LHD) frame rail (requires measurement).
- Bending in the flange at the forward camper box mount.
- Possible bending at the rear camper box mount (requires measurement).

Frame Failure Causes:

- Only two camper box load points on the frame, very widely longitudinally separated—widest longitudinal separation of any known Fuso FG camper box pivot mount system.
- Rear camper box mount is on the rear-most section of the frame, where section modulus (and corresponding strength) is less than half that of the strongest sections of the frame.
- Rear mount was welded onto the frame flanges, in direct violation of the Mitsubishi Fuso Body Builder's Guide.
- Front camper box mount is located near the most stressed portion of the frame: behind the cab and near the aft spring hangers for the front suspension.
- Front camper box mount applies its load on one isolated point, there is no distribution of the load over the length of the frame.
- Neither front nor rear camper box mount utilizes any type of taper to reduce or eliminate stress risers in the frame.
- No positive indexing of the front camper box mount to the frame rails, e.g., a longitudinal section with bolts into the web. U bolt attachments of the front camper box mount are incapable of withstanding fore/aft pitching forces.

Recommendations:

- Remove camper box for frame repairs.
- Carefully inspect bare frame for bends and cracks, especially around high stress points, e.g., front camper box mount, spring shackle mounts, aft of cab, rear camper box mount.
- Repair frame as necessary, e.g., straighten, weld cracks, repaint corrosion.
- Install frame reinforcements on step down as per Mitsubishi Fuso Body Builder's Guide.
- Sleeve entire frame.
- Alternative to sleeving entire frame is to replace frame section aft of the step down with a stronger frame section that utilizes a constant web height. Note: If a replacement frame section aft of the step down is used, sleeving of the frame forward of the step-down would still be required if the existing front camper box mounting location was retained.
- Warning: If the frame is straightened and only reinforced in a limited area, stresses will be concentrated in the next weakest and highest stressed portion of the frame leading to catastrophic frame failure (breakage). See failure of Hackney Fuso FG frame for an example.
- Re-engineer camper box mounting system to follow Mitsubishi Fuso Body Builder's Guide guidelines and requirements, specifically, spread the load at the mounting points to extended longitudinal sections of the frame and include tapers or fish-mouth cutouts on the mounts to limit or eliminate stress risers.
- If possible, spread camper box load onto multiple points along the length of the frame.
- Weigh each corner with vehicle fully wet and loaded.
- Procure custom spring packs for each corner based on "rolling wet" weights. Rear spring packs should carry full loaded weight—eliminate the overload springs. Eliminate air bags (not field repairable in developing countries).
- Rotate tires.
- Remove existing paint on corroding components and powder coat.
- Front tires should be inflated to maximum PSI or slightly over. Maximum road speed should be adjusted to stay within resulting and corresponding load range limit(s) of the front tire(s).
- Four wheel alignment after frame repairs and new spring packs.
- Heavy layer of undercoat to limit corrosion. Note: all existing corrosion must first be eliminated and repainted or powder coated (preferred).

Detail:

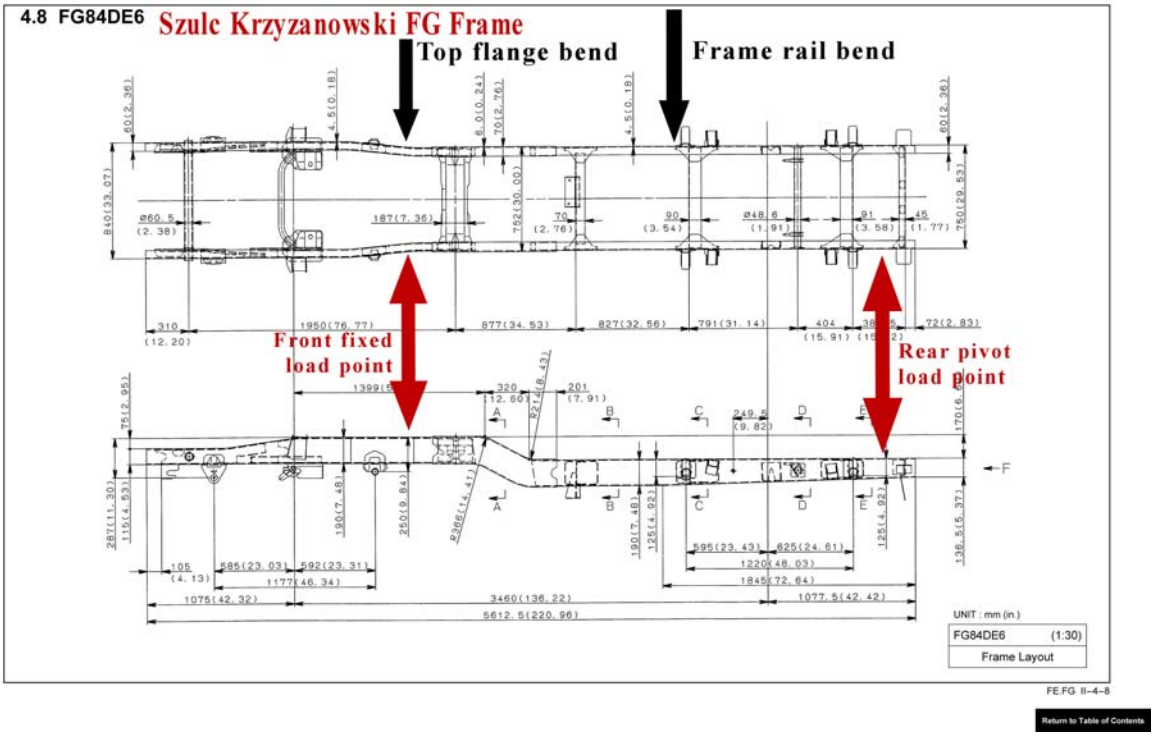
The SKF was built by Santek, an RV manufacturer that is no longer in business. The SKF was Santek's first attempt at building a camper box that utilized a pivot or camper box suspension system. Santek's original camper box front mount design was abandoned prior to completion of the unit. There have been multiple failures of the camper box pivot/suspension system requiring field repairs in Mexico.

The SKF is used primarily in Baja California, Mexico and spends extended periods parked on the beach, exposed to salt spray and salt air.

The SKF utilizes stock Fuso FG springs on the rear and modified Fuso FG springs (additional leaf) and helper air bags on the front.

The SKF is overweight on the front axle. The SKF is approximately 1,200 pounds / 544 kilos under GVW overall.

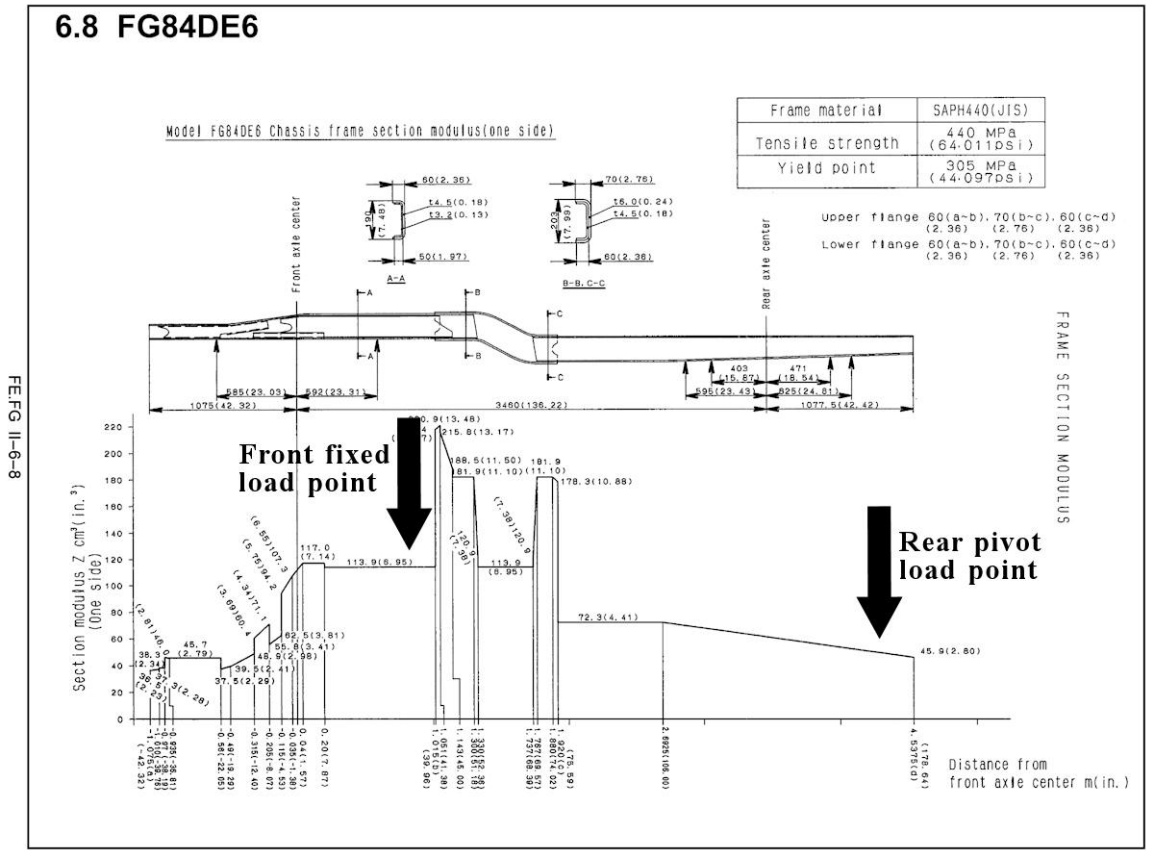
The SKF has experienced chassis frame failures as illustrated:



The front and rear load points for the camper box are too far apart, placing the entire load of the camper on two widely longitudinally separated parts of the frame. This led to constant flexing (bowing) of the frame. Over time, the frame became fatigued and bent. Unless major changes are made in this system, **catastrophic frame failure (cracking and breaking) is inevitable**.

In addition, the camper box mounts were not designed or constructed following the Mitsubishi Fuso Body Builder's Guides. The load points are not distributed on the frame and there is no taper or fish-mouth used in the mount design. Consequently, stress risers were introduced into the frame, leading to frame distortion at the mount points.

Frame section modulus with load points



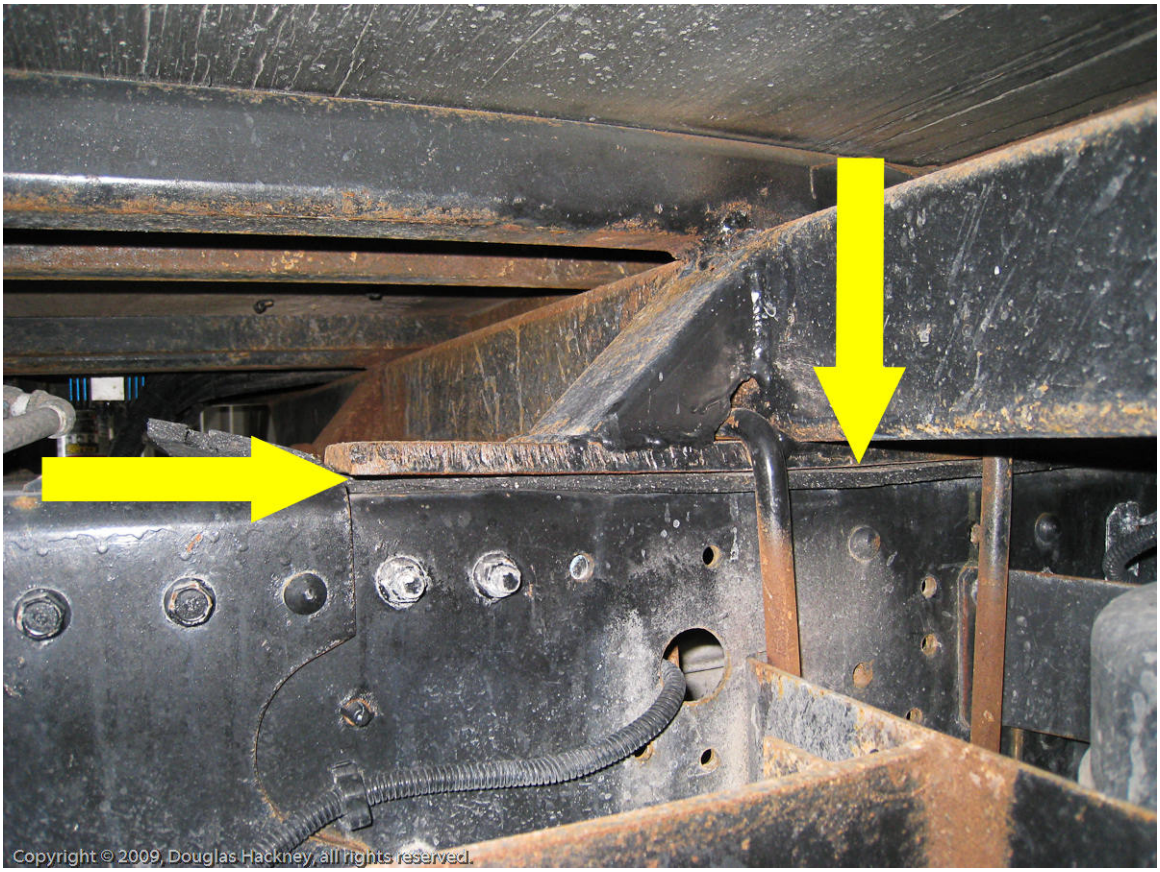
The rear camper box mount is on the tail end of the frame. The section modulus and resulting strength of that section of the frame is less than half that of the frame section location of the front mount.

One of the highest stress portions of a truck frame is the spring shackles. The SKF frame bent at the forward shackle mount of the rear axle.

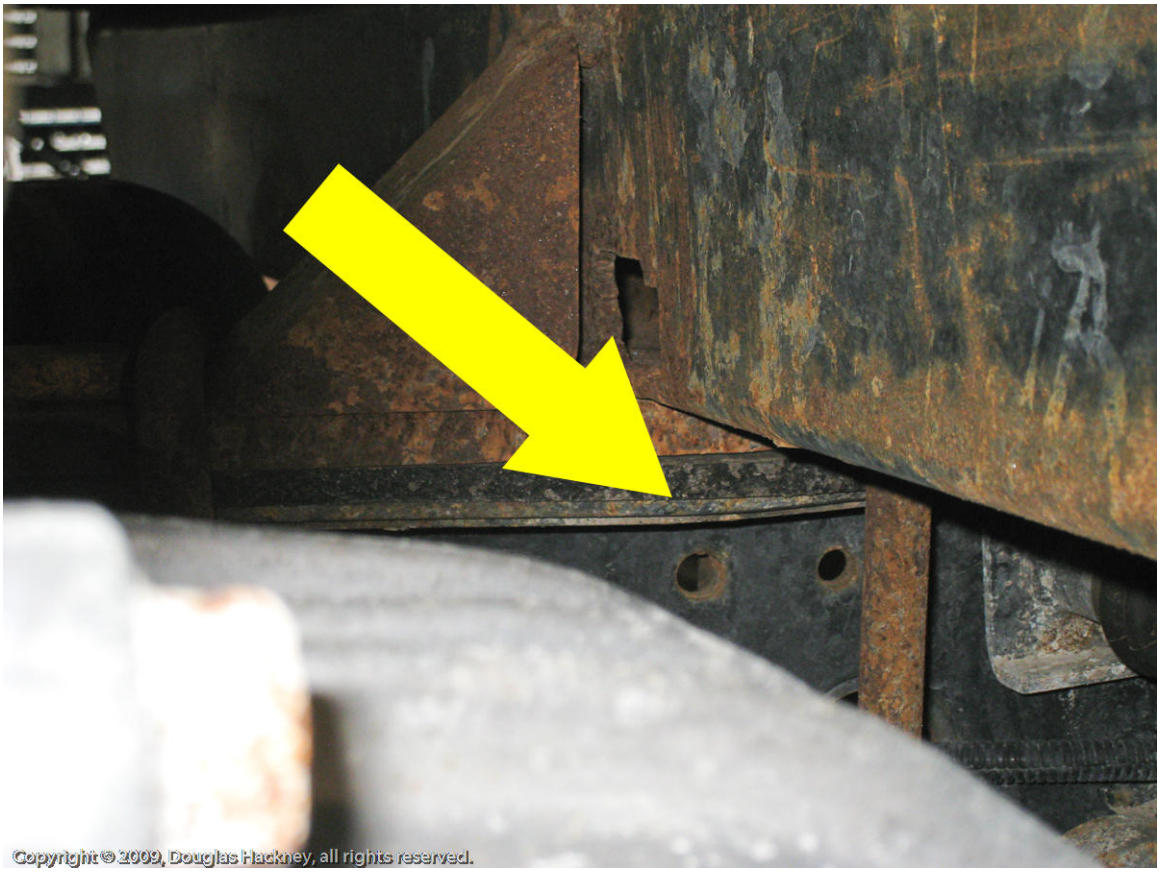
Typically, the highest stress point on a truck frame is behind the cab. The SKF front camper box mount is in this area, which also includes the aft spring shackle mount of the front axle.

The camper box mounting design and payload weight utilized by Santek for the SKF exceeded the design envelope of the Fuso FG frame.

Left arrow: Deflection of forward camper box mount plate.
Right arrow: Illustration of load forces leading to stress risers.



Arrow: Forward camper box mount, bend in frame flange.



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