

Overview:
 Current "strategies" for development of utility vehicle stability have changed over the past few years due the increased availability of rollover accident data and analyses. Previous strategies were partially driven by the Insurance Institute tests of the Jeep CJ7 in the early 80's which emphasized risk from rollovers caused by extrema (rate and magnitude) steering inputs in emergency maneuvers. Independent DOT, GM and Ford studies have confirmed that rollovers directly induced by extrema steering inputs are rare for any Utility vehicle (including the CJ7). The following quote from GM's recent SAE Paper (Reconstruction of Rollover Collisions, SAE 890857), summarizes current wisdom ... "A common pre-rollover maneuver is an off-road path by the car, followed by heavy steer correction back towards the road leading to a side slide, and, ultimately, a trip followed by the rollover". Based on this new information, the UN46 was developed using a handling philosophy notably different from the BII. A comparison of BII and UN46 handling strategies is summarized below:

Model	Response	Cornering Capacity	Body Roll
BII	"Quick" steering and moderate understeer for good response and minimal tire "squeal". Develop vehicle for high speed through lane change pylons.	Maximize for good accident avoidance capability and fast "lap times" on handling track.	Minimize for "flat" feel and high cornering confidence.
UN46	Reduce steering gain and increase understeer to slow steering response. This will increase driver feedback (more tire "squeal") and reduce sensitivity to driver over-correction (common with drivers "under the influence").	Not to exceed current BII levels. Limit cornering capacity with larger tires through suspension revisions and tire pressure reduction.	Increase body roll to reduce cornering confidence and thereby discourage aggressive driving.

Parametric Comparison:

Parameter	2 dr UN46		4 dr UN46		'89 BrII		S-Blaz(4x4)		Path/Fdr
	4x2	4x4	4x2	4x4	4x2	4x4	Std	Opt	
Avg. Track Width	58.1	58.3	58.1	58.3	56.9	56.9	55.8	55.8	55.6
C.G. Height (curb)	26.9	26.8	27.1	27.1	27.5	26.7	25.7	25.7	26.3
Stability Index	2.16	2.17	2.14	2.15	2.07	2.13	2.17	2.17	2.11
Versace Metric 1/	.349	.348	.336	.336	.3760	.3650	.3459	.3459	.3447
Roll Gain (%/g)	TBD	5.6	TBD	5.7	N/A	3.7	6.9(e)	N/A	9.0
U/steer @ .3g (%/g)	TBD	6.5	TBD	TBD	N/A	4.4	4.2	N/A	3.2
U/steer @ .6g (%/g)	TBD	TBD	TBD	TBD	N/A	19.8	24.6	N/A	9.8
Overall Str Ratio	19:1	19:1	19:1	19:1	19:1	19:1	20:1	20:1	20:1
Wheelbase	102.1	102.1	111.9	111.9	94.0	94.0	100.5	100.5	104.3
WB/Tan(20°/SR) 2/	463.0	463.0	507.5	507.5	426.3	426.3	479.8	479.8	497.9
Engine Disp.	4.0L	4.0L	4.0L	4.0L	2.9L	2.9L	2.8L	4.3L	2.9L
Horsepower	170	170	170	170	140	140	125	160	139
Curb Weight	3576	3791	3719	3907	3278	3373	3217	3267	3715
HP/Weight 3/	.048	.045	.046	.044	.043	.042	.039	.049	.037

- 1/ This a measure of stability that shows high correlation with actual FARS rollover data. Unlike the "Stability Index", this measure includes wheelbase effects (important for "directional stability") ... lower is "better".
- 2/ This is an analytical measure of steering gain. The smaller the value, the "quicker" is the perceived steering response.
- 3/ High power/weight is believed to promote aggressive driving.

due to inconsistencies with the computer analysis program ADAMS, the UN46 2 Dr 4x4 will be signed-off for rollover stability by actual "limit" testing at the Arizona Proving Grounds (April 18th to 29th). Testing will include an '89 S-10 Blazer with 4.3L engine along with a current production BII 4x4. The BII provides an essential "baseline" for UN46 Rollover Stability sign-off because our analysis of the BII FARS data indicates almost no propensity for rollover during "handling" maneuvers. Testing will begin at relatively low speed (40 mph) and steer angles (90 deg.) and gradually increase to 55 mph and 350 deg. to establish the limit "threshold". The UN46 must at least be equivalent to the BII in these maneuvers to be considered acceptable for production.

Track Handling (Non-limit Subjective):

The UN-46 2 door and 4 door models, both 4x2 and 4x4, exhibit track handling performance superior to the 1989 Bronco II models. Evaluations on the handling and serpentine courses demonstrate that the vehicle body roll induced during increasingly severe maneuvers provides ample feedback to the driver of impending limit conditions. Increased understeer during severe cornering reduces the lateral acceleration and enhances control. The UN-46 models are superior to the Bronco II for all available options, including tires currently released for the program. The UN-46 models have been rated superior to the Chevrolet S-10 Blazer and Nissan Pathfinder for overall subjective handling.

Tire Pressure Reduction:

Engineering has recommended use of tire pressures below maximum allowable inflation levels for all UN46 tires. As described previously, the reduced tire pressures increase understeer and reduce maximum cornering capacity (both "stabilizing" influences). This practice has been used routinely in heavy duty pick-up truck and car station wagon applications to assure adequate understeer under all loading conditions. Nissan (Pathfinder), Toyota, Chevrolet, and Dodge also reduce tire pressures for selected applications. While we cannot be sure of their reasons, similarities in vehicle loading suggest that maintaining a minimal level of understeer under rear-loaded conditions may be the compelling factor.

Summary:

Based on an analysis of FARS accident summaries and BII & Competitive handling characteristics, it is impossible to identify any type of vehicle "defect" that could explain the BII FARS performance. It is most likely that the handling strategy used during the development of the BII, which fully exploited the vehicles inherent quickness (due to its short wheelbase), encourages aggressive driving and makes the vehicle more sensitive to the large steering wheel "over-corrections" that seem to be part of most rollover scenarios. This sensitivity is aggravated by the fact the most operators in rollover accidents are either inexperienced drivers, under the influence of alcohol or both. The UN46, designed with the benefit of the FARS experience for all utility vehicles, has been intentionally developed to resolve these issues.

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