



### PROGRAM REPORT

Subject: 1983 $\frac{1}{2}$  Bronco II Handling Evaluation

#### Background

A Bronco II "J" turn handling evaluation was conducted at APG from 4/14/82 to 4/23/82 (attachment I details these results). Tests were conducted on the APG skid pad to determine the affect of pitman arm, wheel size, spring rates, tire type and size, variable ratio power steering gear, and track width variations on the Bronco II during the "J" turn handling maneuver. The test procedure consists of four combinations of right hand turn steering wheel angle/throttle inputs performed in sequence at each test speed until lift-off occurred or a top speed of 55 mph was achieved. The sequential inputs are a 360 degree steering wheel input (S.W.I.) coast throttle, a 540 degree S.W.I. coast throttle, a 360 degree S.W.I. power throttle, and a 540 degree S.W.I. power throttle. Attachment II details prior and current trip results.

Jeep CJ-5 tests were also conducted to determine the affect of wheel size, tire type and size, track width, and a constant ratio power steering gear variations on the Jeep CJ-5 during the "J" turn maneuver. The same test procedure described above was used. Attachment III details the trip results.

#### Overall Results To Date

##### Bronco II

- . A rear stabilizer is detrimental to handling in a release level configuration, with 6.0" and 7.0" wheels, or with a 2.0" track increase.
- . A front stabilizer bar is required to maximize handling.
- . A maximum toe steer/slow response length pitman arm improves vehicle handling.
- . The variable ratio steering gear evaluated does not improve handling.
- . Front and rear spring rates had no affect on handling during these tests.
- . Wheel width evaluated had no effect on handling.
- . Fourteen inch wheels significantly improve handling (10 mph lift-off speed increase).
- . A one inch track increase does not improve handling noticeably.
- . A two inch track increase has a minor affect on handling (5 mph lift-off speed increase).
- . At GVW, vehicle handling is significantly worse (10 mph lift-off speed decrease).
- . Tires significantly affect handling in this maneuver as follows with the P195 highway tire offering the best handling results:
  - P195 highway tires 50% worn decrease lift-off speed by 17+ mph.
  - P195 mud/snow tires decrease lift-off speed by 10+ mph.
  - P205 mud/snow tires decrease lift-off speed by 20+ mph.

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CONFIGURATION	OBJECTIVE	RESULTS
<u>Bronco II</u>		
1-1/8" front stab. bar 128X51 pitman arm 364 lb/in front springs 165 lb/in rear springs 15X5.5" wheels P205 G/Y M/S tires	Evaluate 128X51 p/arm with P205 M/S tires	Outrigger contact occurred at a 40 mph, 360° S.W.A. coast input. (The 128X51 pitman arm results in unacceptable vehicle turning diameter).
AA - 160X37 pitman arm P195 F/S Hwy. shaved tires	Evaluate worn highway tires with release lever p/arm	Outrigger contact occurred at a 38 mph, 360° S.W.A. coast input.
AB - P205 G/Y M/S tires	Evaluate M/S tires w/ release level p/arm	Outrigger contact occurred at a 35 mph, 360° S.W.A. coast input.
AD - Variable ratio P/S gear	Evaluate affect of variable ratio gear	Outrigger contact occurred at a 33 mph, 360° S.W.A. coast input
AE - 160X37 release level p/arm P195 G/Y M/S tires	Evaluate P195 M/S tires with release level p/arm	Outrigger contact occurred at a 45 mph, 360° S.W.A. coast input.
AF - 336 lb/in front springs 145 lb/in rear springs P205 G/Y M/S tires	Evaluate lower rate springs with M/S tires	Outrigger contact occurred at a 35 mph, 360° S.W.A. coast input.
AG - 15X6.0" wheels	Evaluate small track increase with 6.0" wheels	Outrigger contact occurred at a 35 mph, 360° S.W.A. coast input.
AI - 14X5.5" wheels P195/75R14 G/Y M/S tires	Evaluate lower C.G. with 14.0" wheels	Outrigger contact occurred at a 55 mph, 360° S.W.A. coast input.
AJ - 15X5.5" wheels P205 G/Y M/S tires 1.0" track increase	Evaluate 1.0" track increase.	Outrigger contact occurred at a 35 mph, 360° S.W.A. coast input.
AK - 2.0" track increase	Evaluate 2.0" track increase	Outrigger contact occurred at a 40 mph, 360° S.W.A. coast input.
AL - Vehicle at GVW at max. rear axle capacity	Evaluate handling at GVW simulating 2 rear seat passengers and luggage	Outrigger contact occurred at a 25 mph, 360° S.W.A. power input.
AM - Vehicle at curb P195 General M/S tires	Evaluate other released tires	Outrigger contact occurred at a 35 mph, 360° S.W.A. power input.
<u>JEEP CJ-5</u>		
JA - Jeep CJ-5 15X7.0" wheels L78X15 G/Y M/S tires	Evaluate 1982 Jeep w/ optional wheels & tires	Outrigger contact occurred at a 30 mph, 360° S.W.A. power input.
15X5.5" wheels G78X15 G/Y M/S tires	Evaluate base wheels & tires	Outrigger contact occurred at a 30 mph, 360° S.W.A. coast input.

Jeep CJ-5

- The lift-off speed is not affected by wheels/tires or variable vs. single ratio power steering gears.
- The lift-off speed decreases by 10 mph at GVW and is not affected by the type of power steering gear.

Conclusions

*"Release level" refers to current design int. and does not reflect final production level*

- The release level Bronco II is slightly better than the 1982 Jeep CJ-5 at curb and at GVW.
- A significant improvement in "J" turn handling can be achieved on the Bronco II by releasing fourteen inch wheels or increasing track width three to four inches.

Further Testing - Proposed

The following additional tests are planned for evaluation at APG the week of May 10th:

- 1980 level Jeep CJ-5
- Base Bronco II with tires from different manufacturers
- Retest of variable ratio steering gear in Bronco II to verify previous trip results.
- Lower rate axle pivot bushings.

DEPOSITION  
 EXHIBIT  
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 MUNLSON



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<u>CONFIGURATION</u>	<u>OBJECTIVE</u>	<u>RESULTS</u>
Vehicle at GW	Evaluate handling at GW simulating 2 rear seat passengers and luggage	Outrigger contact occurred at a 20 mph, 540° S.W.A. power input.
JD - Single ratio 1980 level P/S gear	Evaluate single ratio P/S gear at GW	Outrigger contact occurred at a 20 mph, 540° S.W.A. coast input.
JE - Vehicle at curb	Evaluate single ratio P/S gear at curb	Outrigger contact occurred at a 30 mph, 360° S.W.A. coast input.

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BRONCO-II ARG WINDY: LOWEYNER RESULTS

TEST	15 MPH	"	"	"	"	30 MPH	35 MPH	40 MPH	"	45 MPH	60 MPH	30 MPH	55+ MPH	30 MPH	55+ MPH	50 MPH	55+ MPH	"	"	"	"	33 MPH	40 MPH	35 MPH	40 MPH	35 MPH	40 MPH
1.50	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.40	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.30	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.90	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.80	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.70	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.60	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.50	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.40	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.30	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0.00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X



JEOP CJ-5 AIRB HANDLING MANEUVER RESULTS

	WHEELS		TIRES		STABILIZER		VEH WEIGHT		TREAD	
	15X70	15X55	275	275	310	310	CLB	CM	FRONT (IN)	REAR (IN)
JA 30 MPH (360° POWER)	X	X	X	X	X	X	X	X	51.25	52.36
JB 30 MPH (360° COAST)	X	X	X	X	X	X	X	X	52.17	50.0
JC 20 MPH (540° POWER)	X	X	X	X	X	X	X	X	"	"
JD 20 MPH (540° COAST)	X	X	X	X	X	X	X	X	"	"
JE 30 MPH (360° COAST)	X	X	X	X	X	X	X	X	"	"