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*A Supplement To*  
**AN EVALUATION OF THE SAFETY PERFORMANCE  
OF TRICYCLES AND MINIBIKES**

**Prepared For:**

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## FOREWORD

This document is a supplementary volume to the principal technical report, An Evaluation of the Safety Performance of Tricycles and Mini-bikes, Calspan Report No. ZN-5144-K-1 on the work performed under Contract No. FDA 72-91 for the Bureau of Product Safety, Food and Drug Administration. Most of the observations and evaluations given herein were made by the test rider, Mr. Douglas Milliken and the project engineers (authors) are pleased to give him this opportunity to present him appraisals of the test machines.

## Subjective Evaluations of Minibikes

To supplement the objective measurements of minbike performance, general comments on the operation of the test units were solicited from the rider who performed most of the experimental work. These comments, which are separated into (1) specific appraisals of the units and (2) opinions on minibike safety, are given in this appendix.

## Test Program Observations

### Braking

Charger (rear brake only: contracting band brake mounted on wheel) - Good brake, lockup does not require excessive force and brake is nicely progressive up to lockup.

Trail Flite (rear brake only: contracting band brake mounted on wheel) - Good brake, similar to Charger but less force required to get lockup - more leverage in handle. Before lockup it is annoying because the drum is off center, giving a pulsating braking action.

Toad (rear brake only: contracting band brake mounted on clutch) - Not as good as others; very low force required for lockup and hard to keep from locking because its force requirement is so low. However, it doesn't pulsate. Not good because there is no braking if the chain falls off.

Spoiler (rear brake only: disk brake with cam operated dual pad floating caliper) - Not a good brake, combines bad tendencies of Trail Flite and Toad. The force to lockup is moderate but before that it pulsates something fierce and when pulsating the hard braking force often locks up the rear wheel. From high speed, the pulsing is a high frequency and the wheel has little chance to lock but, at around 15 mph, the same lever force usually locks up the wheel. It should be noted that this brake mechanism was moderately degraded since the Spoiler was about two

years old. Also grabbing or pulsating may have been caused by the scored disk (sprocket) which is scraped when the chain falls off.

Scrambler (rear brake only: internal expanding drum brake) - Good brake, more progressive than other brakes. Bike is so stable under straight braking that the absence of tire squeal makes it difficult to tell when brake is locked up. Only fault is high force required to lock-up-might be hard for a 12-13 yr. old.

Mini Trail (front and rear brakes: both internal expanding drum brakes) - Front brake - High force levels made it almost impossible to lock front brake, only one front lock-up was made in 15 or so tries. This is good because a younger rider wouldn't be able to lock the front wheel at all, (note on front wheel lock-up, once wheel is locked, control is extremely difficult, especially when rear is rolling). No data was collected on two wheel lock-up for two reasons: 1. Extra weight transfer to front increases force level beyond my normal capability. 2. I'm chicken!! Rear brake - Quite progressive, hard to compare sensitivity between foot and hand brakes, lock-up did not require excessive force. Both brakes - Used in the range short of lock-up, both brakes at once were the most usable of the bunch.

#### Speed Control and Accelerating

Five bikes have Tecumseh engines with basically the same throttle set-up. Differences occur in the cable and twist-grip assembly.

Charger, Trail Flite, Scrambler and Spoiler - Good throttles; speed control good on all except Trail Flite which had a high engagement RPM on its clutch, making steady low speeds difficult to maintain.

Toad - Throttle sticky, will not return by itself. From experience, this is typical of cheap throttles; notchy action makes speed control difficult.

Mini Trail - Most precise because hooks directly to butterfly; however it doesn't return immediately on release.

Mini Trail and Scrambler have a tendency to do wheelies on rapid acceleration due to the torque multiplication available at low speeds and also sudden clutch engagement.

#### Handling

Spoiler and Scrambler - Very similar and very good, round profile tires permit large bank angles and nice feel to steering. The Spoiler has a lighter feel to its steering due in part to less castor; unfortunately the Spoiler didn't go as fast as the Scrambler. So high speed (30 mph) handling differences were not noted. The Scrambler felt solid up to very high bank angles and on occasion lost adhesion at the front. Through the slalom the Scrambler felt the best of the group. The Spoiler first lost adhesion in the slalom at the rear but not a disconcerting amount (rather, a nice assist in getting around the corners).

Mini Trail - Could be as good or better than first two in slalom except for suspension problems. I explain them this

way: The bike pitches a lot (relative to the first two) and the rear springs have a lower frequency than the front. The pitching may be due to the high seating position coupled with the short wheel base.

Trail Flite - The Trail Flite is the nicest feeling of the three bikes w/out rear suspension. This is perhaps due to its round crosssection tires. Perhaps where it loses out is in control positioning. The handle bars are too far forward and the foot pegs are too far back for best maneuvering. Its one peculiarity is the funny twitch it gives on entering a turn, which is slightly disturbing. It also was harder to get all the way over between slalom turns.

Charger and Toad - Both of these bikes have square cornered tires and when leaned over, the corner of the tire is all that is working. This limits the usable bank angle and makes these two feel marginal at high bank angles. Physical accommodations again were a problem. The Charger's handle bars were too high and back and the Toad foot pegs were unusable by me. On the plus side, the Chargers front suspension worked with no fuss and certainly didn't hurt its time. The Toad, with its short wheel base and low ground clearance would have felt much better if it fit me better and didn't have the disconcerting habit of catching the kickstand and dumping me on my knee (on the opposite side, the frame tube grounded just in front of the rear tire).

Note: All bikes, except Mini Trail, grounded something at high

bank angles. The part grounded on four bikes was the foot pegs and, as mentioned above, the kickstand and frame on the Toad.

### Bump Jumping

Mini Trail - Wanted to pitch over when sitting and when standing. To get a nice landing, it was necessary to really jerk up on the handle bars (standing position). The foot starter on the right side is in such a position as to catch your ankle on landing (see note under Scrambler about undamped rear strings).

Scrambler - Extreme pitch over when in seated position; un-damped springs catapult rider over handlebars with resultant loss of control. Perhaps the worst of all the test units from this stand point. Standing up produced good landings with a small amount of rider input.

Spoiler - In between Mini Trail and Scrambler when in seated position (see note under Scrambler about undamped rear springs); was easiest to get a good landing when standing up, probably due to best standing position of all bikes (for some one of my height). The springs on all three bikes which had rear suspensions did not have progressive bump stops. This proved to be a real headache-maker on all but the very slowest jumps. I feel the development of a progressive bump stop would greatly increase the comfort when landing.

Charger - No rear suspension made for a harder but more controlable landing when seated. Making a faster run standing up broke off the right foot peg, which is one of the things you

really count on when in a standing position. This really hurt too, when my foot hit the ground.

Trail Flite - Basically the same behavior as the charger but the foot pegs are farther back than most, which makes standing up quite difficult. The front "suspension" probably moved for the first time ever when I landed on the front wheel. It doesn't do much good under normal circumstances.

Toad - Short wheel base put the rear wheel down shortly after the front when in seated position. After finding a place to put my feet when standing up, I found that it flew quite well, i.e., front wheel up.

## General Impressions and Opinions Regarding Mini-Bike Safety

### Brakes

1. Total force level for rear wheel lock-up should not be greater than an 8-10 year old can exert unless the bike is large enough so that some one of this age can't ride it. Perhaps outer limits should be arrived at for brake force because too little force is not the best either.

2. It is nice to have a certain amount of progressive braking available before lock-up. I think that the torque applied to the brake (dependent on wheel size) affects this. (Smaller wheel, poorer brake, in general).

3. In general, all rear brakes should be mounted on the rear wheel; this leaves you with brakes when the chain falls off.

4. External contracting types work fine under dry conditions but their efficiency drops almost to zero when wet. This type, because of lack of shielding, might also perform poorly under dusty conditions.

5. Front brakes should be set up like the Mini Trail's (i.e., almost impossible to lock, on pavement.)

### Tires

1. In general, tires with round profiles feel better than those with squared corners; however, when run at low pressure (light load - small child) the difference is not great. This suggests that the smaller size bikes can get away with square tires.

2. There is no reason why the manufacturer couldn't label tire pressures on the bikes (as the Mini Trail has).

3. In terms of use off level areas (so-called trail riding) a tire under 12" in diameter or so is pretty worthless; this does not say however that smaller tires are not OK for use on lawns or driveways.

### Cornering

1. Under cornering conditions on high coefficient pavement (hardest cornering situation) no parts of the frame or kickstand should touch the ground. The foot pegs can touch if they are hinged to go up and back (most are).

2. The tires all break loose at such high bank angles that under ordinary conditions no tire problems should be encountered with regard to cornering on pavement.

3. Riding position affects your ability to corner quickly; in general, the more forward riding position was more easily adjusted to with the exception of the Trail Flite, which places your body weight on your arms too much. For optimum controllability your hands shouldn't have to support body weight. The situation is similar to that in a car where the use of the steering wheel as a hand hold lessens its effectiveness as a control device.

4. For those bikes designed for trail use, placement of the foot pegs to allow standing up is very important; again, most of your weight should be on your feet, not on your hands and arms as this lessens controllability.

5. It seems that the minibike manufacturers could learn a lot about seating position, handle bar location, and foot peg location from the motorcycle fraternity.

#### Steering

1. Due mostly to its short wheel base, the minibike has "quick" steering. This is what catches most people out on their first ride. For this reason, a new rider should work-up to higher speeds gradually.

2. The amount of centering action desired depends a great deal on the riding conditions. Too much or too little makes control difficult.

#### Construction

1. Frame construction at present is perfectly adequate with the exception of poor quality control on welding; it appears that the general welding test consists of "if it holds it together, it is fine". I have seen some examples of really terrible welding on minibikes.

2. On bikes with rear suspensions the swing arm should be mounted in such a way that it cannot flex in its mounts and it must be strong enough, itself, so that no flex is apparent. One of these problems was present in the Spoiler rear suspension and was definitely annoying.

3. Foot pegs should be strong enough to hold the entire weight of a heavy rider upon landing from a height of several feet, with an adequate safety factor of 2-3. This is really im-

portant because the only way to jump safely is to stand up on the foot pegs, which puts all of your weight on them on landing. There is no reason why foot pegs like the Charger's (which broke off) should be used.

4. Attempts should be made to eliminate the sticky throttle. The two causes of this that could be remedied by the manufacturer are (1) too much paint under throttle and (2) hand grip is pushed over a part of the handle bar which is not straight. Obviously, a sticky throttle caused by excess dirt is the owner's responsibility.

#### Suspension

1. Suspensions made the ride over rough surfaces much more pleasant. However, rear springs without dampers tend to catapult the rider over the handle bars when hitting bumps with the rider seated.

2. None of the bikes tested had a progressive bump stop. An abrupt change in handling occurs when you change from sprung suspension to metal-on-metal.

#### Transmissions

1. Transmissions like the one on the Mini Trail should incorporate some kind of clutch slippage so that unexpected wheelies are not so easy to get. The ability to wheelie should remain for the experienced rider to exercise (just so it doesn't jump when you put it into gear from idle.)

2. High engagement RPM's on centrifugal clutches should

be avoided because of the jerk they give on engagement.

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