1953 - 1954 Corvette: Technical Article: Summary Report on Changes to Achieve Improvement in Corvette Handling and Ride

Summary Report on Changes to Achieve Improvement in Corvette Handling and Ride

Below is a Chevrolet Inter-Organizational Letter dated March 29th, 1954 by Zora Arkus-Duntov addressing Maurice Olley's concerns about the Corvette's ride and handling peculiarities. The Corvette test car #856 mentioned in Zora's letter was the second car built under the Project Open Work Order #19000 which was in between the two 1953 Corvettes that were specifically built for the GM Motorama.

INTER-ORGANIZATION LETTERS ONLY

CHEVROLET

Mr. Maurice Olley	ADDRESS	Research & Deve
Mr. Z. Arkus-Duntov	ADDRESS	Research & Deve
_ SUMMARY REPORT ON CHANGES TO ACHIEVE IMPROVEMENT IN CORVETTE HANDLING AND RIDE _	DATE	March 29, 1954

The handling and ride peculiarities of the Corvette were as follows. At high lateral acceleration:

a. Oversteer
b. At still higher acceleration, tail lurch
c. Improper roll timing - roll recover to slow in respect to path recovery
d. Axle tramp leading to skids on turns with irregular surface
e. Harsh and choppy ride
f. Sensitivity to crosswind and excessive wheel fight at high speed for car of this caracter and size

Mr. Olley's instructions were to get rid of tramp and wander promoting rear spring slope, and inconsistent front and rear roll steer of some 2.75% oversteer in front and 14.2% understeer in rear.

After all changes have been made, Items a, b and c were totally eliminated. Items d, e and particularly f, considerably improved. The suspension specificatons of the improved Corvette #856 are as follows:

1. Front roll steer = zero
2. Rear roll steer = 5% understeer
3. 2 ^{o} positive caster in front
4. Spring of .62 - negative camber
5. Shackle angle of 65%

Physical changes affected:

I. Under shimmying of central steering arm by .250"
II. Raising front eyes of rear spring by 1.73"
III. Differently cambered spring of .62" negative camber
IV. .5" shims on front spring bracket displacing whole axle and assembly backward to obtain desired spring/shackle relationship
V. Wedges for realignment of rear axle drive pinion to compensate for diffrent spring camber
VI. 2 ^{o} wedges between the frame and front crossmember to provide desired caster with gain in anti-dive

To evaluate the improvements, the changes will be incorporated in a production 1953 or 1954 Corvette.

Physical changes planned on the production Corvette are as follows:

1. Under shimmying central steering arm for zero roll steer.

2. New rear spring bracket.
3. 2 ^{o} shims between the frame and front crossmember.
4. 51.5" long leaf spring assembly (.5" longer than present design to provide desired shackle angle of 65 ^{o} in "flat" position) of .5 negative camber (.158 negative present production design).

The changes were arrived at by the following process.

Analytical investigation in roll couple distribution using Mr. Olley's method described on May 15, 1953 showed that disproportionate share of roll couple is carried on the rear wheels, particularly considering the ratios of roll couple percentage to weight percentage.

Analysis was carried on the basis of Technical Center Report No. 127-1 which did not show change in rear suspension rate due probably to a narrow range in which the test was carried out. A brief test at Research & Development Garage showed that the suspension rate increases progressively with deflection. This, or course, aggravated the disproportion in roll couple distribution still further. Analysis showed that a stabilizer of some 7/8" will bring the roll couple distribution into the desired range. A stabilizer of .843 disameter was made and the first test showed that the car handled perfectly.

The car would not oversteer, lurch or go into a skid. Contrary, increasing the speed, the car would go into drift remaining under perfect control; that is, responding to the steering wheel in the same fashion as below drifting speed. The car felt and was vastly superior on all parts of the ride road and on the super. All bends were taken with one motion of the steering wheel, without correction either way. As could be expected, the car showed some sluggishness in response to the steering wheel under less violent style of driving and a pleasant decrease in steering angle in all conditions.

Shake was increased considerably. However, the incidentals were immaterial, since the purpose of this test was to check the correctness of diagnosis and an establishment of a base line as to interrelation between front and rear roll stiffness. The calculated roll angle showed a decrease from 3.55 ^{o} to 2.01 ^{o} at .5g of lateral force and the next step was to bring the roll angle to a former value by decreasing the overall roll stiffness but maintaining the relationship by simultaneous decrease of the roll stiffnesses front and rear. This step was carried unrelated but simultaneously with planned reduction of the rear spring slope.

One set of the new springs were made to provide correct standing height with higher front eye location. With such a camber, the spring/shackle relationship provided lower increase of ride rate with deflection. In conjunction with this spring, a 3/4" diameter stabilizer proved successful. The results were not as good as in the first case, but indicated that both the ride and handling could be obtained by following the same path.

Rear suspension was further softened by repositioning the spring in relation to the shackle and production stabilizer of 11/16 diameter was fitted. Tests showed that under high lateral accelration, the handling was perfect, the ride improved and the efforts were directed toward the improvement of handling on straight running in conjuction with changing of roll steer characteristic of the car.

Raising up the front spring eye of the rear spring even one division (3/4" on Car 856) confirmed the statements of Messrs. Caswell and Petersen than the car handles best with the spring in the highly slanted position. I could add that it handled on straights <u>only</u> in that position. Nothing else was expected since it was assumed that the car arrived at this unusually high rear understeer not without a good reason. Obviously, the car relied for linear stability on the caster effect of the rear understeer, and the front oversteer was necessary to achieve desired characteristic of transition.

An analysis showed that in response to external disturbance acting in the plane of the front wheels, the angular acceleration of the Corvette will be 42% higher and the restoring aligning torque 33% lower as compared to the Chevrolet sedan. Assuming that the steering effort required on the passenger car will be admissible on the Corvette, there was a margin to introduce the additional restoring torque on the front wheels by means of a caster. A caster angle which would provide the restoring torque to make up the difference between the self-aligning torques of the passenger car and the Corvette was calculated. Taking the difference of steering ratios into account, the calculated caster angle was 1.25%. Tapered shims of 2 ^{o} were made and mounted between the frame rails and cross member. It was thought that for the car covering a wide range of speeds, the least of the roll steer would be the better, and the front roll steer was set at zero. To this front end setting, the smallest understeer in rear was determined experimentally.

With the spring slope determined, the car showed total absence of wheel fight, and an inherent straight running tendency with little or no response to cross-wind. The final position of the front eye of the rear springs was adjusted to provide a neutral transition without over or understeer.

The improvement in ride will be better materialized when the shock absorbers are adpated to the new characteristics which is scheduled as soon as the changes are incorporated into the production Corvette. A production Corvette should be available for evaluation in the week starting April 1st - possibly before.

Z. Arkus-Duntov

ZAD:hs