

FRONT END ALIGNMENT

CONTENTS

Subject	Page No.
DESCRIPTION AND OPERATION:	
Front Wheel Alignment	3C-22
DIAGNOSIS: (Not Applicable)	
MAINTENANCE AND ADJUSTMENTS:	
Inspection Before Checking Front Wheel Alignment	3C-22
Adjusting Caster	3C-23
Adjusting Camber	3C-25
Adjusting Toe-In	3C-25
King Pin Inclination	3C-26
MAJOR REPAIR: (Not Applicable)	
SPECIFICATIONS:	
Wheel Alignment Specifications	3C-26

DESCRIPTION AND OPERATION

FRONT WHEEL ALIGNMENT

Wheel alignment is the mechanics of adjusting the position of the front wheels in order to attain the least steering effort with a minimal amount of tire wear.

Correct alignment of the chassis is essential to proper alignment of front and rear wheels. Briefly, the essentials are that the frame must be square in plain view within specified limits, that the top and bottom surfaces of the front cross member must be parallel fore and aft, and that the upper and lower control arm must be at correct location in respect to shafts and the front cross member. All bushings, ball joints and bolts must be of proper torque and in usable condition.

Wheel and tire balance has an important effect on steering and tire wear. If wheels and tires are out of balance, "shimmy" or "tramp" may develop or tires may wear unevenly and give the erroneous impression that the wheels are not in proper alignment. For this reason, the wheel and tire assemblies should be known to **be** in proper balance before assuming that wheels are out of alignment.

Close limits on caster, front wheel camber, and theoretical king pin inclination are beneficial to car

handling, but require only reasonable accuracy to provide normal tire life. With the type of front suspension used, the toe-in adjustment is much more important than caster and camber are as far as tire wear is concerned.

Caster and camber adjustments need not be considered unless visual inspection shows these settings to be out, or unless the car gives poor handling on the road. In the majority of cases, services consisting of inflating tires to specified pressure and interchanging tires at recommended intervals, balancing all wheels and tires, adjusting steering gear and setting toe-in correctly will provide more improvement in car handling and tire wear than will other front end alignment adjustments.

The correct use of accurate front end alignment equipment is essential to determine whether front suspension parts have been damaged by shock or accident, and to obtain correct alignment settings after new parts have been installed.

MAINTENANCE AND ADJUSTMENTS

Inspection Before Checking Front Wheel Alignment

Before making any adjustment affecting caster, camber, toe-in, theoretical king pin inclination, or **steer-**

ing geometry, the following checks and inspections must be made to insure correctness of alignment equipment readings and alignment adjustments.

1. The front tires should have approximately the same wear and all tires must be inflated to specified pressures (see Wheel and Tire Specifications • Section 3G).
2. Check front wheel bearings for looseness and adjust if necessary (see Front Suspension Adjustments • Section 3A).
3. Check for run-out of wheels and tires, (see Section 3G).
4. Check wheels and tires for balance and correct if out-of-balance (See Section 3G).
5. Check for looseness at ball joints and tie rod ends; if found excessive, it must be corrected before alignment readings will have any value.
6. Check shock absorber action and correct if necessary. Consideration must be given the optional equipment on the car, undercoating, dirt, etc.
7. It is advisable to check the condition and accuracy of any equipment being used to check front end alignment and to make certain that instructions of the manufacturer are thoroughly understood.

ADJUSTING CASTER (GT)

CAUTION: *Front suspension fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

To change caster, three washers are available • one with a .12" thickness, one that is .36" thick, and one .24" thick. **To increase** caster place one of the thin washers at the front of the control arm shaft and one of the thick washers at the rear. **To decrease** caster place one thick washer at the front of the control arm shaft and one thin washer at the rear.

1. Position jack below front suspension cross member and raise front end of car.
2. Place jack stands below front frame side members and remove front wheel on side which caster is to be adjusted.
3. Install front spring compressor J-21689 and compress spring. See Figure 3C-2.

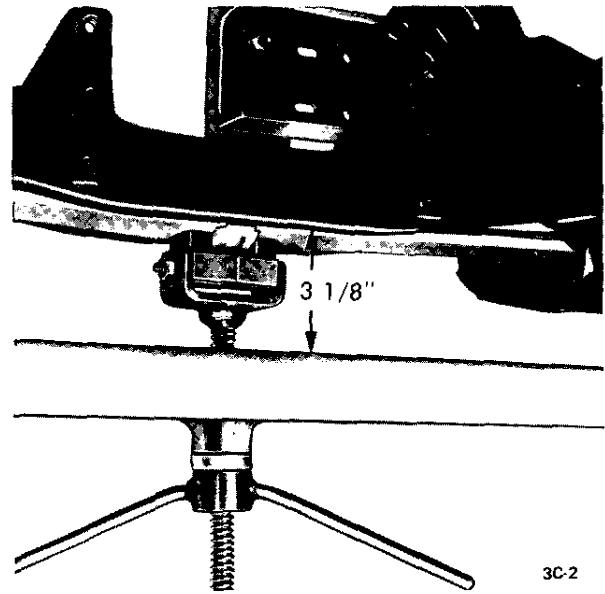
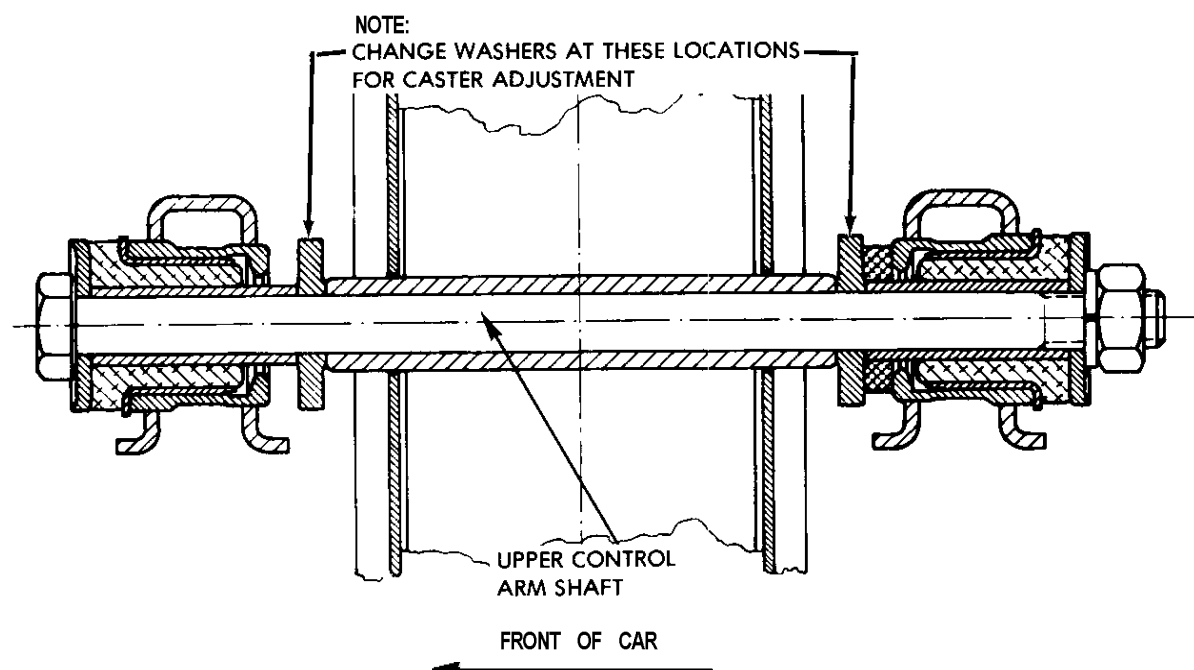


Figure 3C-2 Spring Compressor J-2 1689 Installed

4. Remove upper control arm shaft,
5. Remove upper control arm from shock absorber support, being careful not to lose toothed washers.
6. Adjust caster by installing selective toothed washers on both sides of control arm shaft, between control arm and shock absorber support. Never use more than one washer at any one location. The total thickness, front and rear washer, must equal .48". There are only two possible caster changes that can be made.
7. Using a drift to align holes, replace control arm shaft in the direction as shown in Figure 3C-3. Torque hex nut to 33 lb.ft. Make certain that crown of both plate washers shows outward.
8. Remove spring compressor, and install front wheel and torque wheel nuts to 72 ft. lbs.
9. Recheck caster.

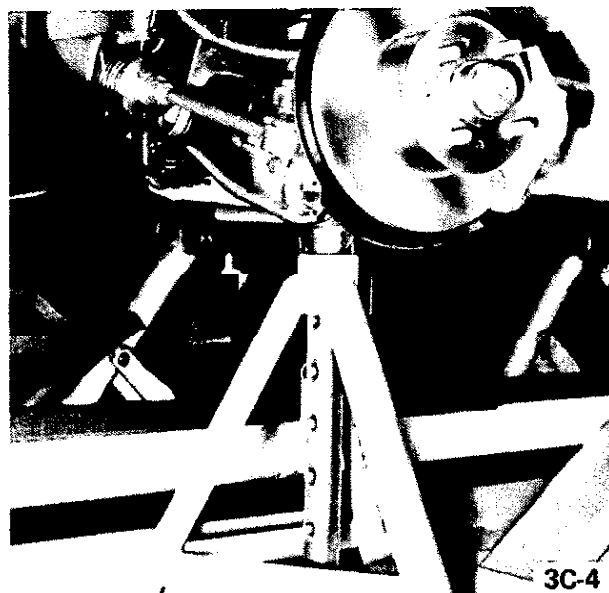
ADJUSTING CASTER (OPEL 1900. MANTA)

1. Jack up vehicle and remove front wheel on the side on which caster is to be adjusted.
2. Support vehicle below both lower control arms. See Figure 3C-4.
3. Unscrew hex nut from upper control arm shaft and pull out shaft.
4. Adjust caster by replacing washers (A) (front) and



3C-3

Figure 3C-3 Upper Control Arm Shaft and Bushings



3C-4

Figure 3C-4 Supporting Vehicle at Both Lower Control Arms

(B) (rear) between upper control arm and shock absorber support. See Figure 3C-5.

5. One .24" thick washer each is installed in production on each car side. Consequently, only two adjustments are possible by adding washers of different thickness.

6. One .12" in front and one .36" in the rear (caster increase of 1 degree) or one .36" in front and one .12" in the rear (caster decrease of 1 degree). Never add

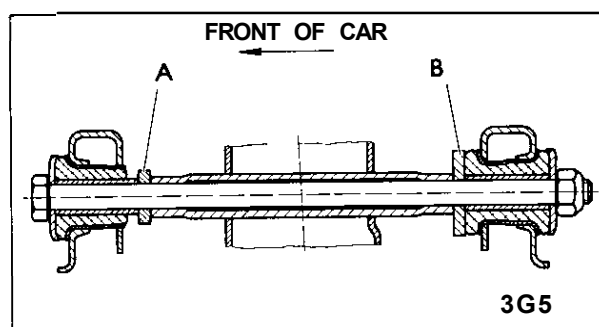


Figure 3C-5 Caster Adjustment Washer Location · Opel 1900 · Manta

several washers in one place. The washers B installed in production have a larger outer diameter than the washer A. For service, the Parts and Accessories Department supplies only larger washers with an outer diameter of 1.57".

7. Insert control arm shaft from front towards the rear into upper control arm and shock absorber support. Observe that the crown of both plate washers shows inwards. See Figure 3C-5.

8. Torque hex nut of control arm shaft to 40 ft.lbs. Always use new self-locking nut.

9. Torque wheel nuts to 75 ft.lbs.

10. Recheck caster setting.

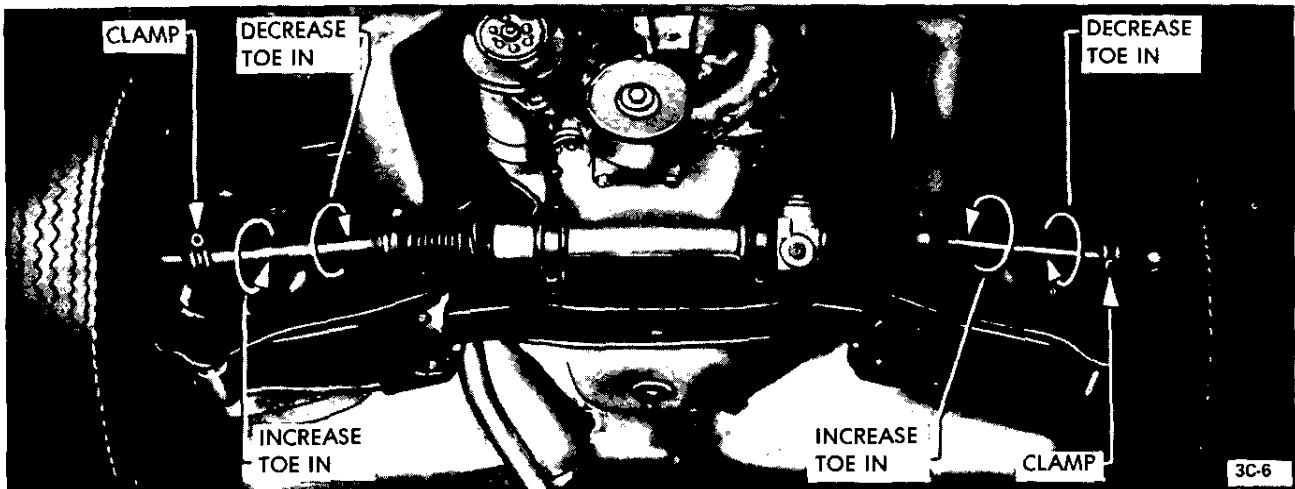


Figure 3C-6 Adjusting Toe-In (GT)

ADJUSTING CAMBER

Camber is adjusted by turning the upper ball joint flange 180 degrees. This means that only two possible camber adjustments can be made. At the factory **camber** is set at the smallest possible positive camber setting for GT and smallest possible negative camber for Opel 1900 • Manta. Rotating the flange will make **camber** more positive on GT and more negative on Opel 1900 • Manta.

1. Raise front end of car using wood block on jack to prevent damage to front cross member.
2. Support car below lower control arm and remove front wheel on side to be adjusted.
3. Remove ball joint from upper control arm and front steering knuckle.
4. Lift upper control arm and turn the ball joint flange through 180 degrees.
5. First tighten both ball joint attaching bolts on upper control arm and then the ball stud castle nut. Torque to 29 ft. lbs. on GT and 44 ft.lbs. on Opel 1900 • Manta. Install new cotter pin.
6. Install front wheel and torque wheel nuts to 72 lb.ft. on GT and 75 lb.ft. on Opel 1900 • Manta.
7. Recheck camber.

ADJUSTING TOE-IN (GT)

Toe-in is adjusted by rotating the tie rod sleeves. Refer to Figure 3C-6.

1. Recheck caster and camber before proceeding with toe-in adjustment. If correct, adjust toe-in.

2. Set wormshaft and ball nut to steering gear high point by turning steering wheel half way from one stop to the other, noticing the following:

- (a) With the steering wheel hub button removed, the "marking" on the steering shaft end should be in a horizontal position.
- (b) The steering wheel spokes should also be in a centered position.

3. Remove wire clamps on left and right tie rod and push back bellows.
4. Loosen clamp bolts and tie rods. See Figure 3C-4.
5. The toe-in should be $1/32'' - 1/8''$.

When adjusting toe-in, never grip tie rod on inner ball stud joint. To avoid ball stud resting against inside of hole in tie rod outer end, center outer end of each tie rod to the ball stud.

6. Pull bellows over tie rods and attach with wire clamps. The bellows must not be twisted and wire ends must show towards steering gear adjusting screw opening.
7. Torque clamp bolts to 12 lb.ft.
8. After toe-in adjustment, turn steering wheel several times completely towards the left and right to determine whether bellows are properly attached to the tie rods and steering gear housing.

ADJUSTING TOE-IN (OPEL 1900. MANTA)

The adjustment of the toe-in has always to be carried out on both tie rods.

1. Loosen lock nut of left and right tie rod and slacken back nut.

2. Remove hose clamp for rubber bellows attachment from respective axial joint and adjust toe-in by turning axial joint. When doing this, observe that the rubber bellows, having a tight seat on the joint, is not twisted. If necessary, lubricate seat of bellows and hold back bellows when turning. See Figure 3C-7.

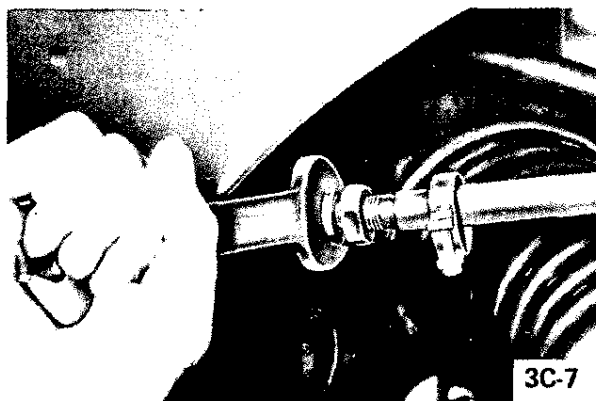


Figure 3C-7 Adjusting Toe-In Opel 1900 Manta

3. Toe-in should be $1/8'' \pm 3/16''$.

4. Torque lock nut of left and right tie rod to 47 ft.lbs.

5. Attach respective rubber bellows with hose clamp, making sure that clamp bolt points towards the front. The rubber bellows must not be twisted, i.e.,

the individual grooves of bellows must be in vertical position.

6. After adjustment, turn steering several times to the left and right to determine if a proper attachment of both rubber bellows to the steering gear housing is warranted.

CHECKING THEORETICAL KING PIN INCLINATION

When checking theoretical king pin inclination, car must be on a level surface, both transversely and fore and aft, must have trim heights within limits, and must be at curb load.

With camber known to be within specified limits, theoretical king pin inclination should check to 8.5 degrees for Opel 1900 • Manta, and 6 degrees for GT.

If camber is incorrect beyond limits of adjustment and theoretical king pin inclination is correct, or nearly so, a bent steering knuckle is indicated.

There is no adjustment for theoretical king pin inclination as this factor depends on the accuracy of the front suspension parts. Distorted parts should be replaced with new parts.

The practice of heating and bending front suspension parts to correct errors must be avoided as this may produce soft spots in the metal in which fatigue and breakage may develop in service.

Specifications

FRONT END ALIGNMENT

MODEL	CASTER °	CAMBER °	TOE-IN		OUTER WHEEL WHEN WHEEL AT 20 °
			MIN..	MAX.	INNER
1900	3 1/2 - 6 1/2	-1 ± 1/2	1/8 - 3/16		19 1/4
GT	3 ± 1	1 ± 1/2	1/32 - 1/8		18 1/2

* Permissible deviation from left to right wheel • maximum 1''.