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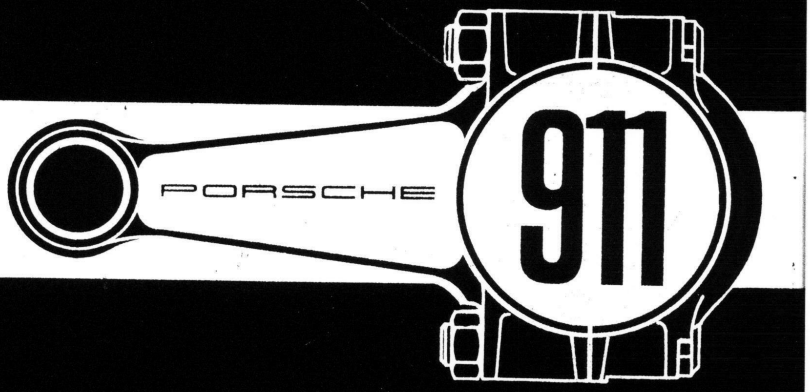
WORKSHOP MANUAL
MANUEL DE RÉPARATION



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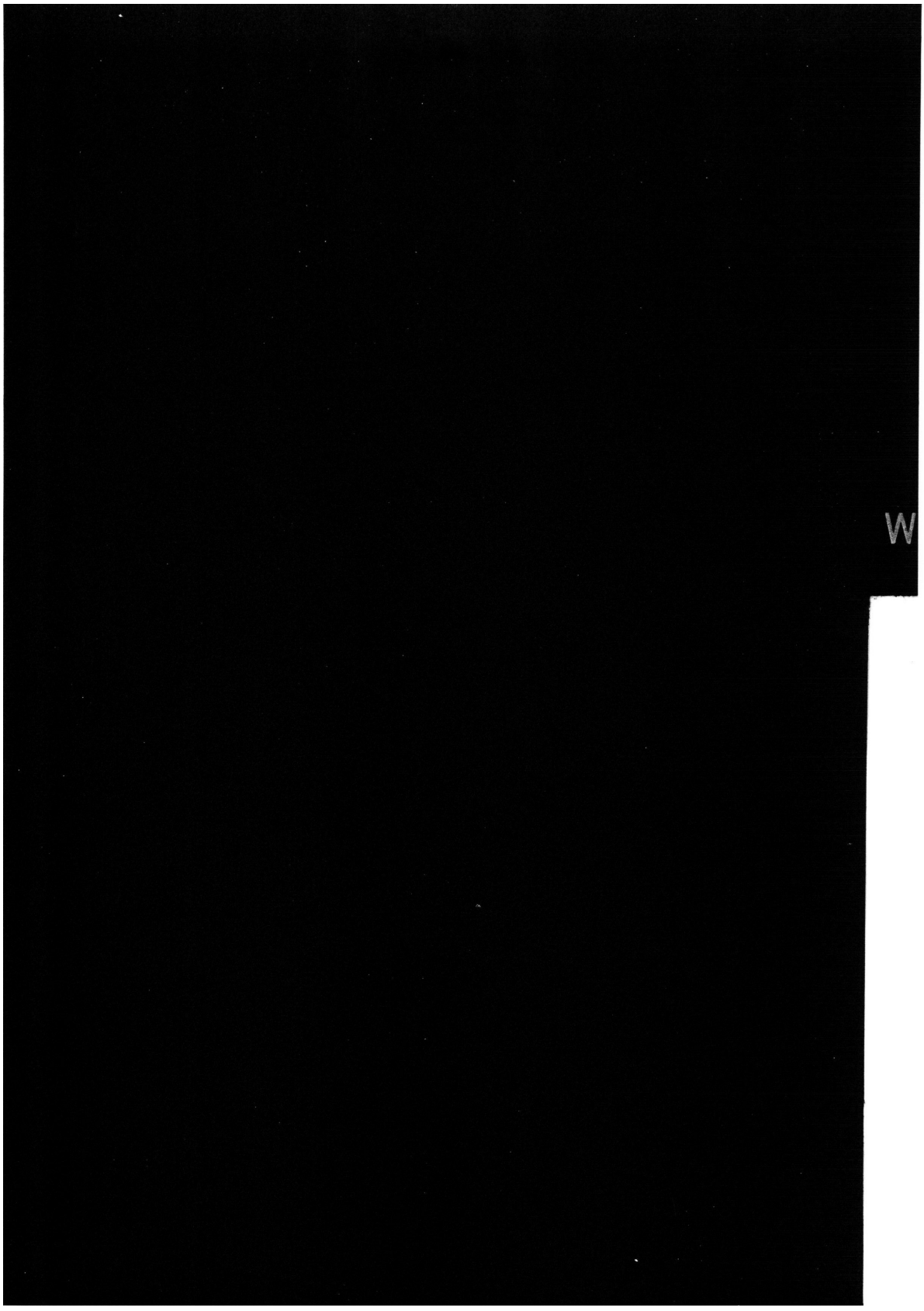
VOLUME

I


W

SECTION INDEX

Group W -- Wheel Alignment

General:

The roadholding and cornering qualities of the car are greatly influenced by wheel alignment and vehicle height adjustment. Considerable deviations from established specifications in reference to vehicle height, tracking, camber, caster, and cornering angle differential will have a negative effect upon the good road-holding and also result in abnormally high tire wear.

Outlined below are procedures for checking the wheel alignment and adjusting the front and rear wheels to proper standards.

Successful accomplishment of the work is contingent upon the following factors:

1. Empty weight of the vehicle must meet specifications spelled out in DIN 70020, i.e., the car must be road-ready including a full fuel tank and a spare wheel on board.

2. All moving components of steering and suspension must have proper mechanical clearance.

3. Wheel rims may not have a lateral or vertical runout exceeding the permissible tolerances.

4. Tires must be properly inflated and not show traces of unequal wear.

Toe-in

In toe-in condition, the distance between the horizontal wheel centers is smaller in front of the wheels and larger at rear.

Wheel camber and rolling resistance of the front wheels cause each wheel to have a tendency to run outward from the direction of travel. To counteract this outward force, it is necessary to establish a toe-in value of such proportion as to prevent a toe-out condition at speed taking into account at the outward forces and mechanical clearance existing in the steering components.

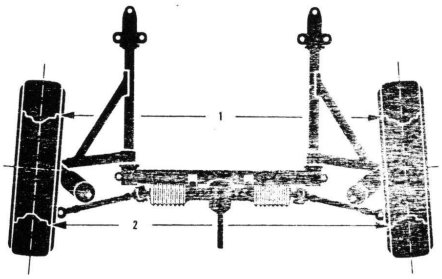


Fig. 1

Value 1 is smaller than Value 2

Cornering Angle Differential

The front wheels track in parallel. That is, the steering trapeze formed by the front axle and steering components is so designed that no significant angular difference is created between the right and left wheels; any existing cornering angle differential will be the sum of the toe-in value plus the mechanical clearance in the steering components. Contrary to the customarily applied tracking angle geometry, the parallel-tracking layout has a tendency to toe-in.

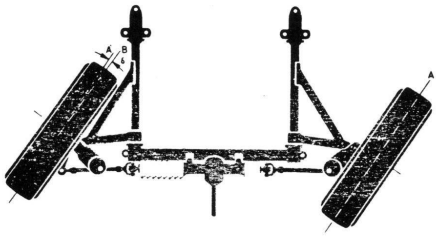


Fig. 2

A' = Parallel to A
B = Wheel plane
δ = Angle differential

Camber and Steering Axis Inclination

Camber is the angular difference between the wheel plane and the vertical plane with the root established at the wheel's point of contact with the ground.

Steering axis inclination is the angular difference between the center line of the suspension strut and the vertical plane.

The angular values of camber and steering axis inclination are calculated to place the point of contact of the tire and the center line of the suspension strut at the most favorable point where the rolling radius values of the cornering wheel are kept as small as possible yet, at the same time, road shock transfer to the steering components is at its minimum.

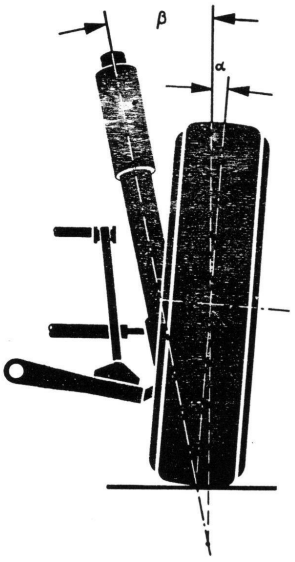


Fig. 3

a = Camber angle
ß = Steering axis inclination

Caster

Front wheel caster is created by positioning the upper part of the suspension strut to the rear of the wheel center so that the center line of the suspension strut meets the ground ahead of the wheel's point of contact. Consequently, a pulling force is exerted upon the moving wheel causing it to maintain a forward direction of travel.

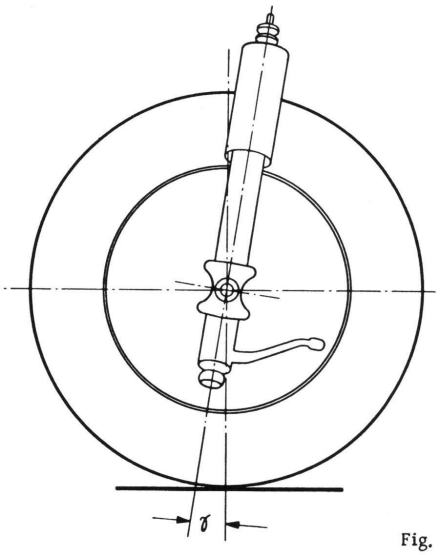


Fig. 4

γ = Caster

General:

An exact height adjustment will provide the necessary basis for the accomplishment of a wheel alignment check.

Note!

Prior to proceeding with the adjustment work, prepare car according to DIN requirements, i. e., road-ready including a full fuel tank and a spare wheel on board.
Check tire pressure.
Drive the car onto the alignment ramp or level floor. The vehicle must remain on its wheels.

Front Axle Height Adjustment

1. Mark dead center on dust covers of front wheel hubs.

2. Depress front of car several times, by pushing down on the bumper horns and allowing the body to come up by itself on the rebound, to set the suspension at proper attitude.

3. Measure the vertical distance between the front wheel center and a level part of the ramp or level floor (see dimension "a" in Fig. 5).

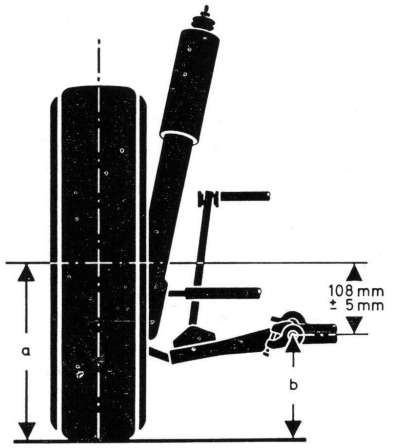


Fig. 5

4. Value "a" minus 108 mm (4,25 in) equals value "b". A height marker adjusted to value "b" can be effectively used for taking measurements at the torsion bar center.

5. Remove torsion bar dust cover at the adjusting lever to gain access to the torsion bar centering mark which should be used as a reference point.

6. Loosen or tighten the torsion bar adjusting screw until value b is obtained at the torsion bar center.

7. Depress front of car, allowing it to come up by itself, and recheck height of both sides for value b, correct if necessary.

Note!

Even though a $\pm$ 5 mm deviation is permissible for value b on either side, difference in height between right and left sides must not be more than 5 mm.

Example:

Value a = 315 mm
- 108 mm

Value b = 207 mm $\pm$ 5 mm (= 202 to 212 mm)

Based on the above example where value b measures 207 mm with permissible deviations anywhere between 202 and 212 mm, the following adjustment possibilities become evident:
If value b on left side is 202 mm (= 207 minus 5), then value b on right side can be 202 to 207 mm (up to $\pm$ 5 mm difference).
If value b on left side is 207 mm (= 207 $\pm$ 0), then value b on right side can be 202 to 212 mm (up to $\pm$ 5 mm difference).
If value b on left side is 212 mm (= 207 plus 5), then value b on right side can be 212 to 207 mm (up to - 5 mm difference).

Rear Axle Height Adjustment

1. Depress rear of car several times by pushing down on the bumper horns and allowing the body to come up by itself on the rebound to set suspension at proper attitude.

2. Measure the vertical distance between the rear wheel center and a level part of the alignment ramp or a level floor (see dimension "a" in Fig. 6)

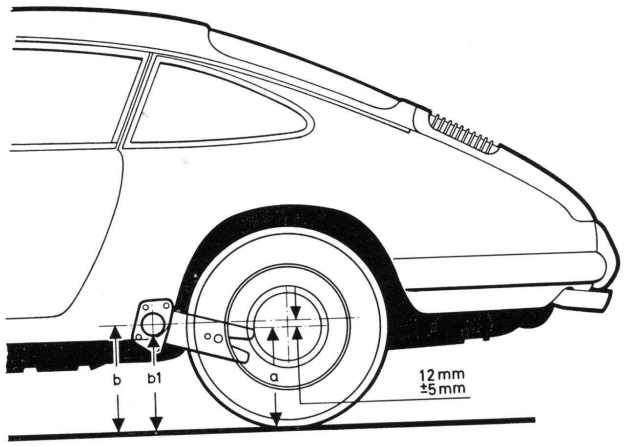


Fig. 6

3. Value "a" plus 12 mm equals value "b"; however, value "b" cannot be measured since the torsion bar is off center due to mounting in a rubber bushing.

4. Value "b" less bushing-cover radius (1/2 diameter) equals value "b1".

5. Measure height of vehicle (value "b1") with the help of a height marker or similar device. The actual value b1 should not differ from the calculated value b1 (pts 3 and 4, above) by more than $\pm$ 5 mm; in addition, the height difference between the right and left side should not be more than 8 mm.

Example:

Value a = 315 mm
\+ 12 mm

Value b = 327 mm

Value b = 327 mm
\- Bushing-cover radius = 30 mm

Value b1 = 297 mm

Permissible tolerance for Value b1:

If value b1 on left side is 292 mm (297 minus 5), then value b1 on right side can be 292 to 300 mm (up to + 8 mm difference).
If value b1 on left side is 302 mm (297 minus 5), then value b1 on right side can be 294 to 302 mm (up to - 8 mm difference).

6. If proper suspension adjustment values cannot be achieved, proceed as follows:

   a) Check height adjustment of front suspension and correct if necessary.

   b) Check rear torsion bar adjustment and correct if necessary.

General:

A wheel alignment device is necessary for checking the wheel alignment. Since a great variety of such devices is available on the market today, involving various measuring techniques, the actual wheel aligning procedure has been omitted and this outline confined to information dealing with adjustments and permissible tolerances.

Front Wheel Alignment

2 Wh Adjusting Toe-in

Note:

Toe-in must be adjusted with the steering mechanism in its midmost position since otherwise the wheel turning angle will not be same on both sides resulting in unequal turning circle.

1. Turn steering wheel to lock, applying slight pressure to feel the stop in steering box.

2. Holding the steering wheel against the stop, note the position of the lower spoke in the steering wheel in relation to the switch panel this will be dimension "a". Mark this spoke with chalk as shown in Fig. 7.

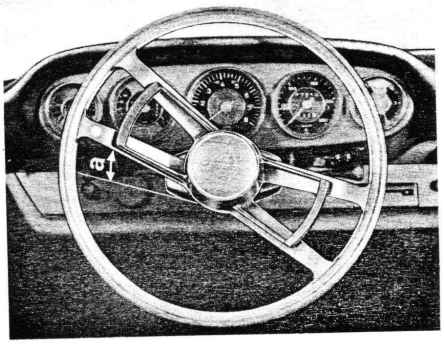


Fig. 7

3. Turn the steering wheel in opposite direction to lock, and note dimension "a" at the unmarked lower spoke (see Fig. 8).

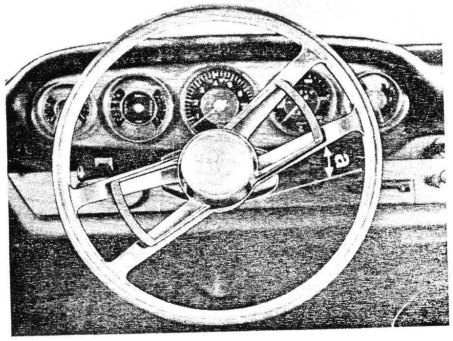


Fig. 8

4. If dimension "a" differs on one side from that on the other, the steering wheel will have to be removed and appropriately reset.

5. Set the steering wheel to its midmost position. With the aid of an optical wheel alignment device, adjust the left and right tie rods to bring each road wheel to a 20' toe-in (wheels should be pressed with a preload of 15 kp or 33 lbs).

Note!

Vehicle weight must be at the DIN dry weight standard, i.e., a full fuel tank plus spare wheel and tools on board.

Cornering Angle Differential

Cornering angle differential exceeding the specifications cannot be eliminated through tie rod adjustment. Deviations falling within limits indicated on the measurement data card are tolerable; excessive error will most likely be due to deformed steering arms, tie rods, or steering knuckle at the suspension strut.

ADJUSTING CASTER AND CAMBER

Special tools: P 291 Allen Wrench

Note:

Caster and camber cannot be adjusted on vehicles up to chassis serial number 302.694, as well as on Chassis Nr. 302.736 and 302.805. Should vehicles in the above categories show error in excess of limits shown on the vehicle measurement data card, it will be necessary to check the suspension components as well as the suspension strut supporting points for possible deformations or wear.

Adjusting Camber

1. Pull back enough front compartment carpeting to facilitate access to the three retaining screws of the strut-position adjustment.

2. Remove sealing compound from the pressure plates and the movable dish ring (scrape off and clean with a tar solvent).

3. Mark position of the single-hole and two-hole plates, loosen retaining screws with Special Tool P 291.

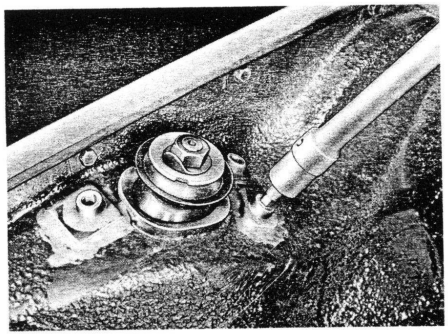


Fig. 9

4. Reset movable dish ring together with suspension strut end across the direction of travel to obtain the desired camber adjustment; resetting the dish ring by 1 mm equals a 6' change in suspension strut attitude.

Note!

Resetting the dish ring along the direction of travel (forward or back) affects the caster adjustment.

5. Tighten the retaining screws with Special Tool P 291 (torque to 4.7 mkp).

6. Reseal surfaces around the pressure plates and dish ring with non-hardening sealer (i.g., National-Kleber 670) and refasten carpet with appropriate adhesive.

Adjusting Caster

Proceed according to instructions dealing with camber adjustment.

Caution!

Reset dish ring and suspension strut in longitudinal direction (forward or back in direction of travel); transverse resetting will affect the camber adjustment.

Note

When using optical alignment devices which have no provision for taking direct readings of caster values (such as the Exacta equipment), caster angle can be determined from the overall camber differential taken at 20° left turn and 20° right turn and multiplied by 1.5.

Example:

Left wheel

Caster at 20° left turn = + 3°
Caster at right turn = - 2° (on right wheel 20° turn adjusted)

Overall camber angle differential = 5°

Total camber angle differential of 5° x 1.5 = 7.5° caster.

General:

Rear wheel camber and tracking can be adjusted by means of built-in eccenters. However, a mandatory prerequisite for obtaining permissible camber values at the rear wheels is proper adjustment of the torsion bars. The camber adjusting eccenter allows smaller camber corrections than is possible to achieve through the torsion bar adjustment.

Adjusting Camber and Tracking

1. Loosen retaining-bolt nuts and eccenter-bolt nuts at the rear axle flange (see Fig. 10).

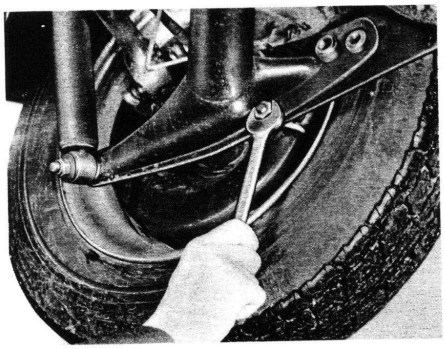


Fig. 10

2. Turn tracking and camber eccenters so that the required adjustment values are obtained on the optical alignment device.

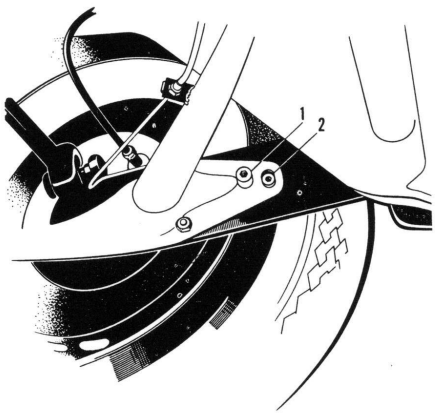


Fig. 11

1 = Camber eccenter
2 = Tracking eccenter

Caution!

When installing the eccenters or when adjusting camber and tracking, note the following:

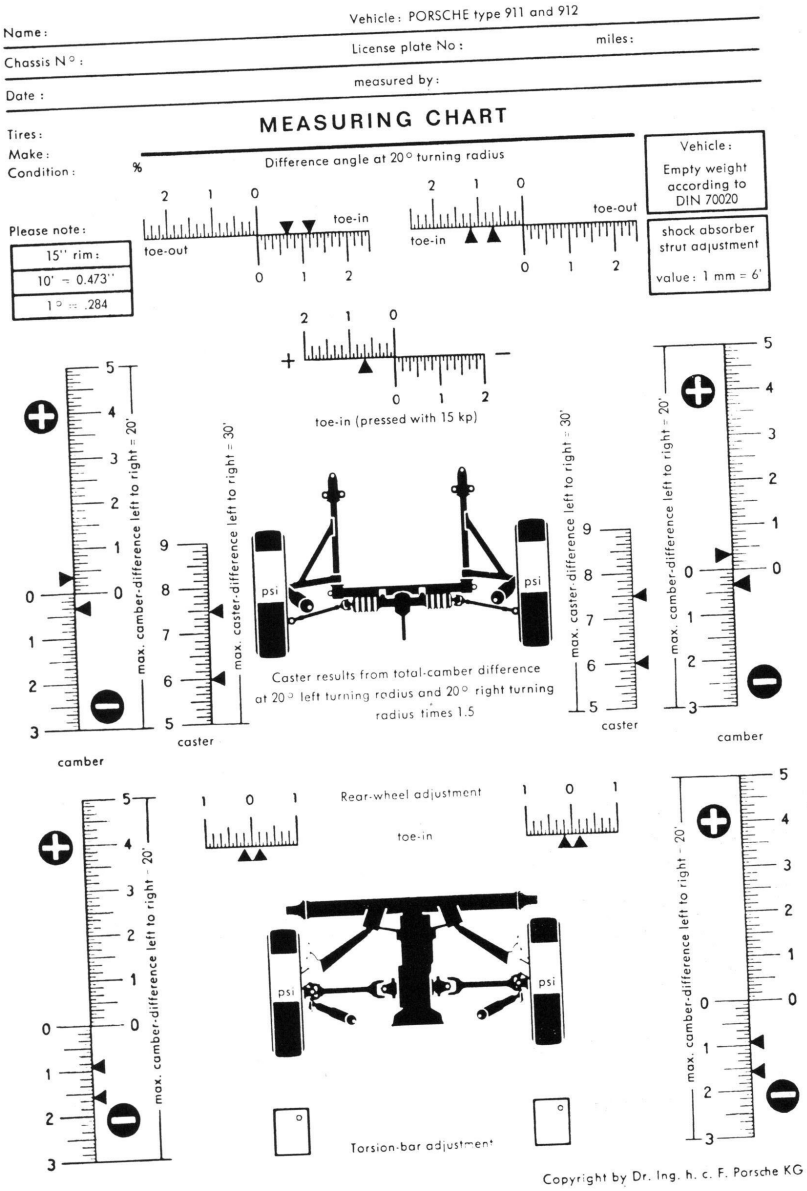
a) It is possible that subsequent to adjustments requiring considerable tracking angle changes, the position of the camber eccenter happens to be in the extreme right or left end of the oblong cavity in the radius arm; in such cases the eccenter should be turned around by 180° to preclude possible binding.

b) The camber eccenter must always point down at time of installation to preclude binding when camber and tracking angle adjustments are made.

3. Tighten eccenter retaining nuts.

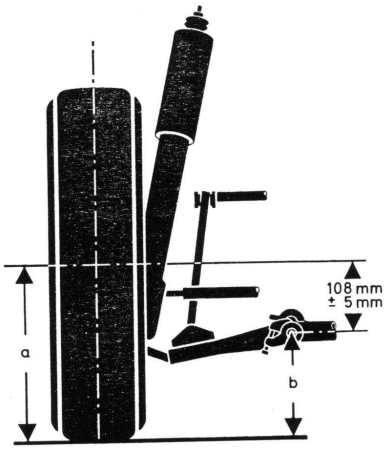
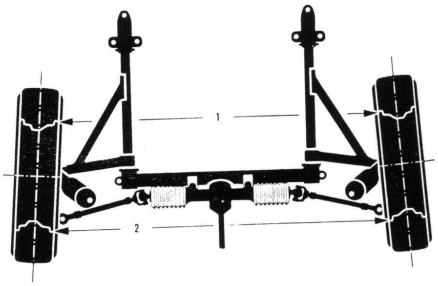
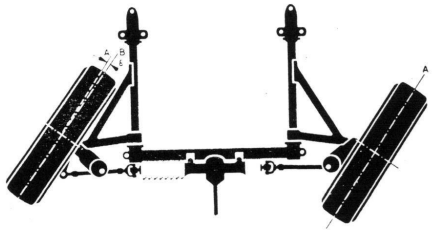
General:

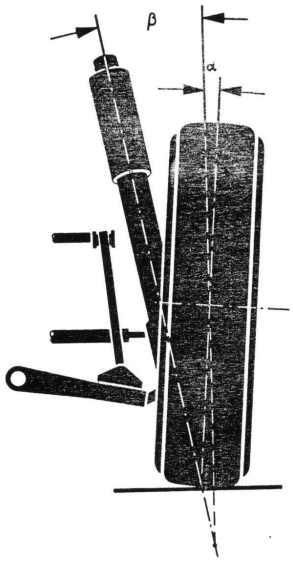
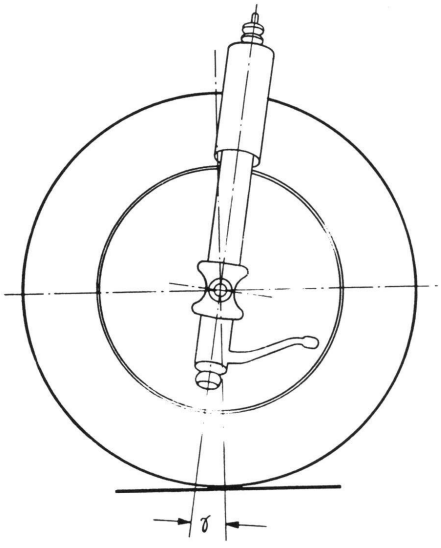
The permissible adjustment values have been indicated on this measurement data card by way of small triangles to provide a concisely compiled reference data for quick evaluations of measurements made on wheel alignment measuring devices.

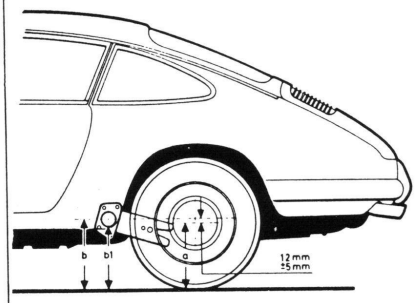


TOLERANCES AND ADJUSTMENT SPECIFICATIONS

(Type 911 vehicle in no-load condition, Empty Weight = DIN 70020)

Item	Nominal Value and Tolerances	Maximum Deviation left to right	
Front Axle Height adjustment: Rear center of front axle torsion bar lower than front wheel center	108 mm (4.25 in.) ± 5 mm (.2 in.)	5 mm (.2 in.)	
Toe-in (pressed, preload 15 kp or 33 lbs) Total left plus right wheel Value 1 is smaller than value 2	+ 40' From model '68 on 0°	none	
Angle differential in 20° turn (with toe-in bias) A' = Parallel to A δ = Angle differential	40' to 1° 10' From model '68 on 0° to 30'	Corrections possible only through replacement of steering arms	

Item	Nominal Value and Tolerances	Maximum Deviation left to right	
Front wheel camber (in straight-ahead road wheel attitude) a = Camber angle	0 ± 20'	20'	
Caster γ = Caster	6° 45' ± 45' From model 70 on 6° 5' ± 15'	30'	

Item	Nominal Value and Tolerances	Max. Deviation - left to right -	
Rear Axle			
Height adjustment:			
Center of transverse carrier above rear wheel center	12 mm ±5 mm	8 mm	
Radius arm adjustment:			
Type 911 and 911 S Coupe and Targa	36°	-	
Type 912	33°	-	
From 68-model on:			
Type 911 (all)	39°	-	
Torsion bar diameter	22 mm		
Type 912	36°	-	
Torsion bar diameter	22 mm		
From 69-model on:			
Type 911 (all)	36° 30' to 37°	-	
Torsion bar diameter	23 mm		
Type 912	33° 30' to 34°	-	
Torsion bar diameter	23 mm		
Toe-in, per wheel	0° ± 10'	-	
Camber			
Type 912 and 911 (all)	-55' to 1° 35'	20'	
From 68-model on:			
Type 912 and 911 (all)	-30' to 1° 10'	20'	

SUPPLEMENTS

GROUP **W**

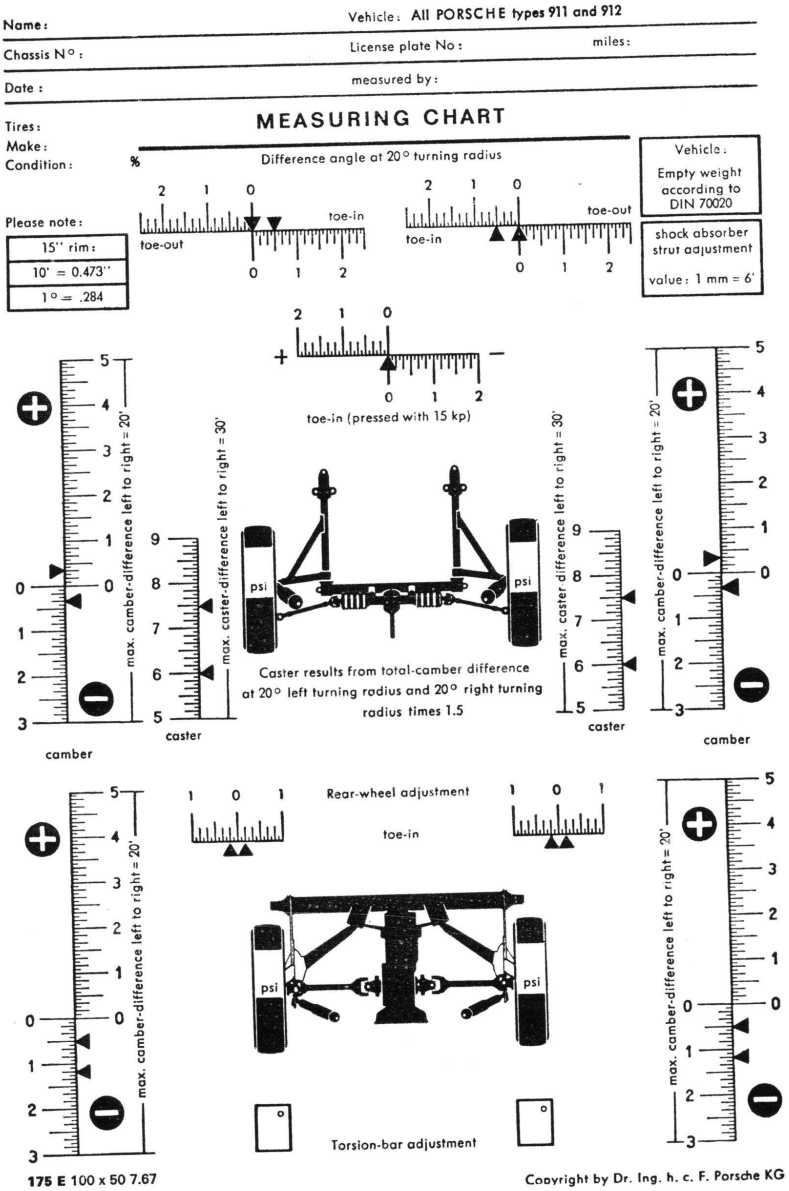
WHEEL ALIGNMENT

WHEEL ALIGNMENT DATA CARD

(From 1968 models on)

General

The new wheel alignment data, effective with the 1968 models, may also be applied to earlier versions of Type 911 and 912 vehicles for better directional stability and a more even rear tire wear.



MEASURING WHEEL ALIGNMENT ON CARS WITH SELF-LEVELING HYDROPNEUMATIC SUSPENSION STRUTS

Special tool: P 301b Measuring pin

General

Before wheel alignment values can be checked or adjusted the front axle of cars with self-leveling hydropneumatic spring struts must first be brought to the correct height.

1. Insert the measuring pins of special tool P 301b through the hollow of the sub-frame until they make contact with the left and right wishbones. Attach the measuring pins with a small quantity of grease.

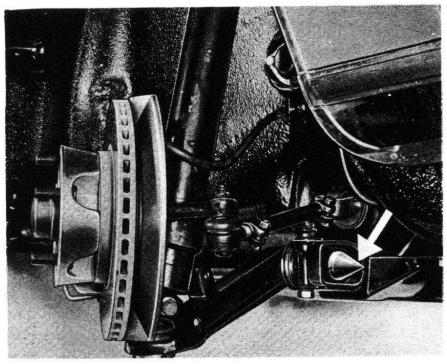


Fig. 1

2. Lift the car at the front center with a car jack until the correct height of 108 mm (4.252") is reached (see page W 4).

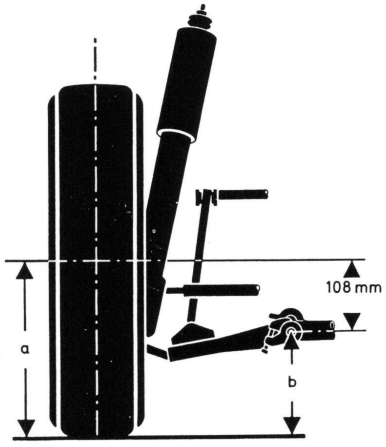


Fig. 2

Warning:
If a hydraulic car jack is used, make sure that the jack does not sink while measuring is taking place.

3. Carry out the normal wheel alignment check and adjustment procedure.
Warning:
Use the wheel alignment values supplied for 68 models.

SAMPLE OF DATA MEASURING CHART

(from Model 70 on)

General

The caster values of the front axle were changed from Model 70 on. The new data card shows the values up to and including Model 69 and from Model 70 on, so that the data card applies again for all Porsche Models 911 and 912.