SCI

ROAD TEST:

The Citroen DS 19

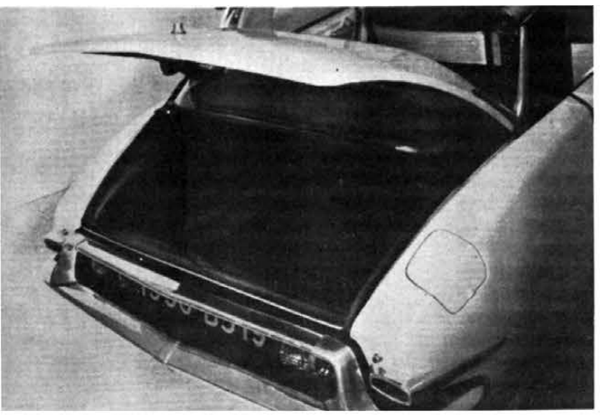
Allen type nut holds driving wheels on hexagonal drive-key. Remove with a specially supplied wrench.

Road clearance of the DS 19 adjusts from within driver's compartment. Here car sits at 13 inches.

From thirteen inches above the road, car is lowered to normal driving stance.

By exhausting the hydraulic fluid from suspension cylinders, Citroën is placed just 3 inches above road.

The Citroën seemingly distorts itself in a sharp bend. Only excessive force broke tires from pavement.



With the spare wheel conveniently carried in the front, and the fuel tank rectangular in shape and pushed well forward, the trunk space becomes unusually deep.

THE mere explosion of a bomb would have caused far less excitement at the late 1955 Paris Automobile Show than the introduction of an entirely new two liter Citroën with hydro-pneumatic independent suspension front and back, plus brakes, steering, clutch and gearshift operating on the same hydraulic system. Motorists actually fought to get their names given delivery priority and today, the new Citroën DS 19 is virtually a black-market item with used cars bringing more than the new price of 930,000 francs.

Now to attempt an analysis of one of the most complex creations ever to be offered the motorist—at a very reasonable $3,285 delivered in New York, anywhere in the U. S., or France.

The very efficiently streamlined four-door body is monoshell on a box beam frame. It has light gauge steel door panels and fenders, aluminum hood and trunk lid, and a plastic top supplied already painted or transparent. The car's suspension is hydro-pneumatic with a self-leveling load device front and rear, operating in any one of three car body height positions. Front and rear brake pressures are equalized according to load on rear axles—giving an entirely new concept in brake efficiency, and front brakes are inboard disc type with "automatic" take-up on the friction material, opposed-clamps type shoes in each unit. Rear brakes are of the outboard, conventional drum type. The 75 hp engine is conventional, four cylinders in-line, having two coils and two contact breakers instead of a distributor, and a twin-throat Weber carburetor which rations gas intake by keeping the secondary throat closed until the primary throat is fully opened.

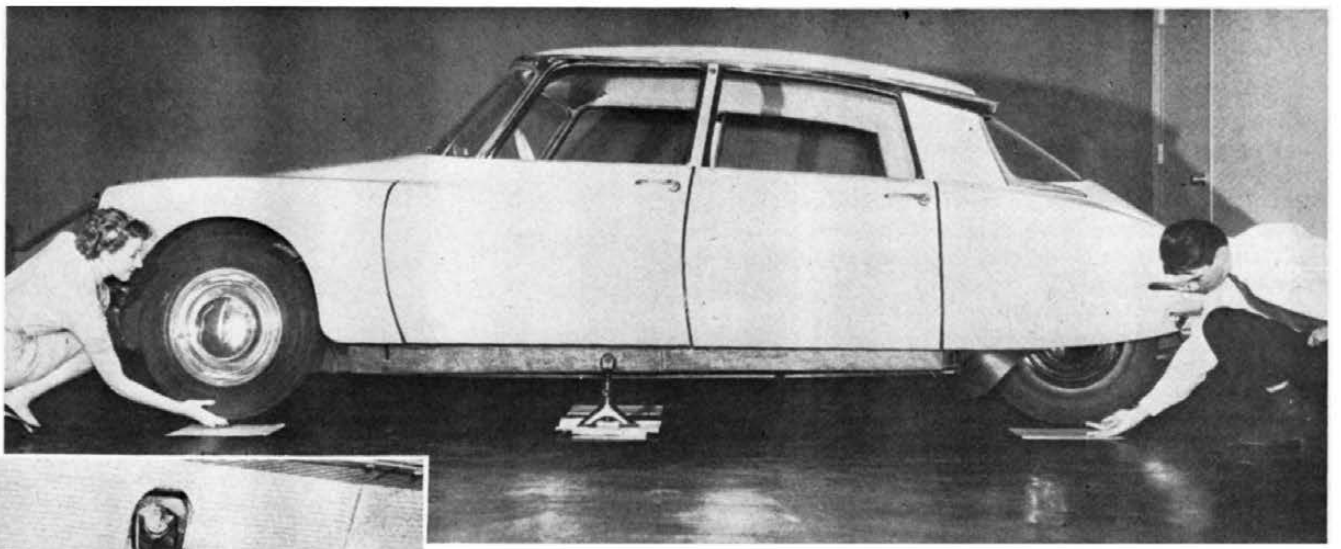
The four-speed forward shift is basically conventional, but its operation is by hydraulic means and features clutchless control through a lever extending from the dash panel directly in front of the steering wheel. Steering is the full-time power type—having three turns lock to lock, and a single spoke, 15½ inch diameter wheel. Drive is—need we say?—FW.

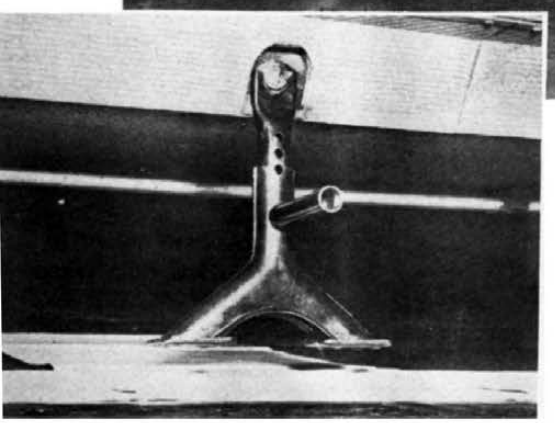
The car has a 123 inch wheelbase, front track of 59 inches, rear—51 inches, and weighs 2,475 pounds with one gallon of gas, tool-kit and spare wheel. All this just about sums up the car until we briefly outline the car's very *different* handling and performance. With the dash-located switch key turned to the right, the engine fires smoothly after a few seconds' coaxing with the shift lever moved from neutral to far left to engage starting motor. Returning the shift lever to neutral, it is then pushed dead ahead (to within a half inch from the horizontal line speedometer face) for low gear selection. Here, Citroën recommends that the car be held at standstill by placing the right foot lightly on the 1½ inch diameter, 1½ inch high, main brake "button". Upon brake release, the car will move slowly and smoothly away. Then the gas treadle is employed for normal pickup. If a faster take-off is desired, omitting the brake and footing the gas treadle instantly upon gear selection will obtain it. But, unless the driver feeds gas very smoothly, a short, wheelspinning surge will disturb everyone concerned, and perhaps induce a series of take-off bucks.

Once rolling, second gear is selected by pulling the shift lever directly back, through neutral, towards the steering wheel. If the gas foot is not slightly backed off upon moving the lever, the engine will rev up anywhere from slightly to fiercely—depending on the urge applied, and second gear engagement will be another surge ahead. Third and fourth gears are found by moving the lever to right center, then to full right. The cross-dash engagement positions are nicely marked—"2-3-4"— and can be distinctly "felt" upon entering or leaving. Reverse is found by moving the lever ahead to low gear position, then full right. Here, much gas foot care must be taken to avoid a sudden backwards jump.

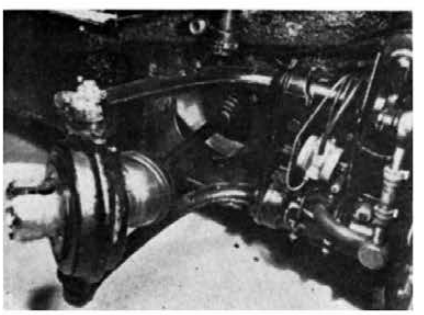
The engagement of gears can be hurried by backing completely off the gas, then tromping down hard. Otherwise, a wait of anywhere from one to three or more seconds is encountered, depending on the adjustment of the entire shift unit's timing. Three of the four cars tested were found to have at least a two second lag with one suffering a full five seconds before making up its mind to engage. This car could, however, be made to shift as quickly as those in "good" order by the quick, hard gas tromp technique . . . at the inconvenience of a jump ahead.

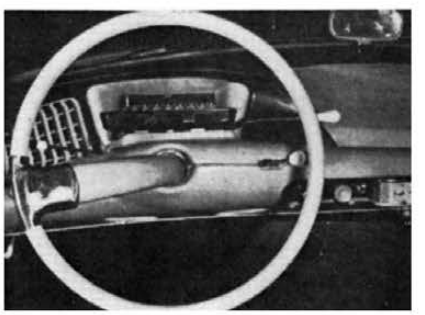
Shift down can be done very nicely by revving the engine a bit as the lever is moved to the left. But, if the driver moves the lever to the left without applying gas, he may wait for anything up to a minute before downshift engagement occurs. This seems to be part of the car's over-all safety





ABOVE: Car is raised fore and aft by placing jack in center slot. BELOW: Jack in slot before lowering body.





LEFT: Front suspension and drive of the Citroën. Articulating arms are set well back of drive shafts in roller mounts. RIGHT: One-spoked wheel & dash panel.

design, as sudden engagement of a front wheel drive to full engine brake can cause front wheels to lose traction—a very unpleasant occurance under certain cornering conditions.

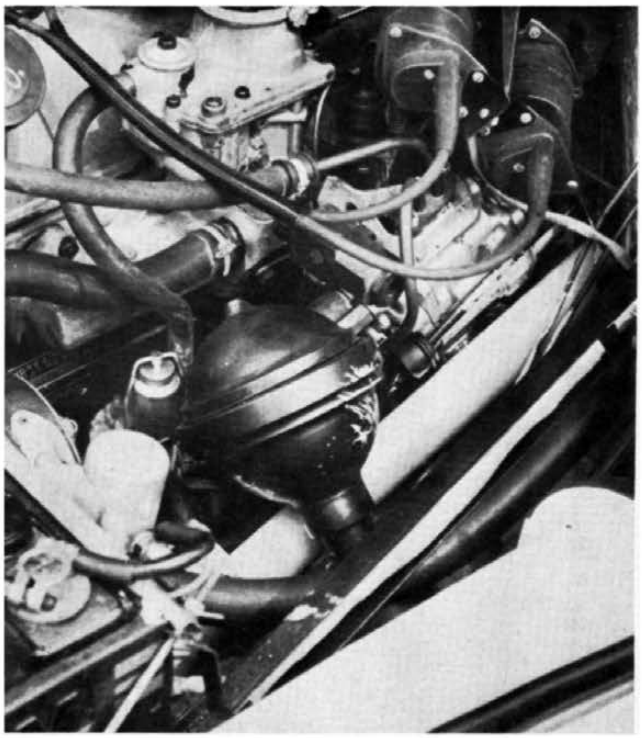
Right here, it becomes apparent that the new Citroëns require a very individual gear change technique. It's not difficult to learn and can be most enjoyable, once mastered. The advantages of a well-ratioed, four-speed box requiring no clutching become very evident upon fast touring through busy terrain.

Steering sensations are completely individual, as the response is about as fast as, say the Mercedes 300 SL, and the full time power system is devoid of any lag or soft feeling. More unusual, the system is such that a straight line will be "held" by the car during hands-off periods—even though slight bumps are encountered. However, the control is not dead in the usual power steering sense due to the unit's remarkable quickness. The over-all effect is one of great safety, for drivers relatively unfamiliar with sports-car fast steering can direct the car without the usual human overcontrol awkwardness. There is a direct hookup to the pinion should the power unit fail to operate and steering may be continued instantly by manual control, although a test of this feature showed considerable heaviness of feel at lower speeds.

Suspension characteristics are certainly the most outstanding encountered. The complete damping out of high frequency wheel movement, instantaneous yet graduated checking of rebound, and the system's ability to rapidly compensate car height to varying axle loads, all combine to make a riding comfort and safety that must be experienced to be comprehended. The car may be literally hurled through rough downhill corners by unskilled hands and remain comfortably safe. Attempts to make the back wheels break away were unsuccessful in almost all instances during the fastest cross country tests. Once the rear does break, it does so evenly and regains traction faster than conventional IRS on cars such as the Mercedes 190 SL— if such performance can be estimated.

For those who have experienced front wheel drive car steering to date, the Citroën is superior to even the finest Millers in over-all ability to hold a set curve under severe braking by either engine or power brake. Even when the independent mechanical foot (parking) brake operating front wheels only, is applied sharply in a bend, the front wheels hold traction in remarkable fashion. It is possible to brutally force the car that the front wheels slide out in plowing manner, but few Citroën owners will ever find this point, even on wet roads. Should such a skid occur, it is unwise to attempt brakes, as sharply applied power will most efficiently aid recovery. There is a French legend that should a Citroën be accidentally driven off a mountain bend into thin air, the driver needs only sufficient power at front wheels to bring him safely back to the road. After five days of testing the DS 19, this tale does not appear too far-fetched.

The car may be raised from a highway running height with ground clearance of seven inches, to one of two rough terrain running heights permitting 11 inch or 13 inch clear-



Pneumatic sphere has rubber diaphragm separating fluid, lower half, from inert gas, upper half. Two valves in the unit control hydraulic pressure in damping fashion and act as shock absorbers.

ance. A five-inch hand lever, painted white, located left of the parking brake pedal, alongside the driver's lower leg, controls running heights, plus a full-down position allowing only three inch ground clearance. This lowest position is obtained by exhausting the hydraulic fluid from the suspension pistons, and is intended to be used in conjunction with the car's unique jacking system. (The car is power raised to full height, adjustable stand is secured to stud recessed in bodywork under front door, then car is "lowered" with the result that the "jacked" side stays up.)

The braking theory employed by Citroën removes this car from any category other than Grand Prix cars. And its superiority goes even further in that brake efficiency remains constant under all duty as there is no fade. Load on the rear axle governs brake force between front and rear wheels, and separate accumulators on separate piping actuate front and rear brakes independently; each unit being able to stop the car under any circumstances. The brakes are so powerful that full application will cause a front wheel (usually left) to lock and drag at speeds up to fifty-five mph. However, the foot pressure required to cause wheel lock is relatively high, and the most amazing short stops can be achieved without panic pressure on the brake button.

The important thing for the driver new to DS 19's is to practice "finding the brake button." It is not that the smallness of the control makes it difficult to locate, but that the height is somewhat lower than the gas pedal—and a full four inches below most standard brake pedals. "Pawing the air"

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CITROEN DS 19

PERFORMANCE

TEST CONDITIONS:

Number aboard	two
Top position	sedan
Temperature	70° at sea level.

TOP SPEED:

Two-way average	90 mph.
Fastest one-way run	94 mph.

ACCELERATION:

From zero to	Seconds
30 mph	5
40 mph	8.5
50 mph	12.7
60 mph	16.2
70 mph	25.9
80 mph	34
90 mph	52
Standing ¼ mile	21
Speed at end of quarter	67 mph.

SPEED RANGES IN GEARS:

I	0 to 25 mph
II	6 to 52 mph
III	12 to 75 mph
IV	18 to 90 mph

SPEEDOMETER CORRECTION:

Indicated	Actual
30	30
40	41
50	50
60	61
70	71
80	80
90	89

FUEL CONSUMPTION:

Average driving (under 60 mph) . . 28

BRAKING EFFICIENCY:

(10 successive emergency stops from 60 mph, just short of locking wheels): no fade.

SPECIFICATIONS

POWER UNIT:

Type	In-line four; water cooled.
Valve Arrangement	60° OHV hemispherical.
Bore & Stroke (Engl. & Met.)	3.07 x 3.94 ins.; 78 x 100 cm.
Bore/Stroke Ratio	.78 to 1
Displacement (Engl. & Met.)	116.5 cu. ins.; 1911 cc.
Compression Ratio	7.5 to 1
Carburetion by	Weber dual barrel Type 24/30
Max. bhp @ rpm	75 at 4500
Max. torque @ rpm	101 lbs./ft. @ 3500
Idle Speed	550 rpm

DRIVE TRAIN:

Transmission ratios (overall)	I	13.79 to 1
	II	6.96
	III	4.77
	IV	3.31
	Reverse	14.82
Final drive ratio (test car)		3.88/1

CHASSIS:

Wheelbase	
Front Tread	59 ins.
Rear Tread	51¼ ins.
Suspension, front	Independent-hydro-pneumatic
Suspension, rear	Independent-hydro-pneumatic
Shock absorbers	Citroen suspension unit.
Steering type	Rack and pinion.
Steering wheel turns L to L	3
Turning diameter	36 ft. 1 in.
Brake type	Front inboard disc; Rear drum.
Brake lining area	161.82 sq. ins.
Wheel studs, circle diam.	Center lock nut.
Tire size	165 mm x 400 mm.

GENERAL:

Length	189 ins.
Width	70½ ins.
Height	58 ins.
Weight, test car	2500 lbs.
Weight distribution, F/R	66⅔/33½
Weight distribution, F/R, with driver and one passenger	68/32
Fuel capacity	17 gallons.

RATING FACTORS:

Bhp per cu. in.	0.686
Torque (lb-ft) per cu. in.	.87
Pounds per bhp, test car	33.3
Piston speed @ max bhp	2955 fpm

DS-19

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when seeking the brake can be downright dangerous under emergency conditions, and after 300 miles one may be still a bit conscious of the "lost brake" feeling. As the button provides full brake with a mere half inch of travel, the driver requires considerable practice to obtain a nicety of control. Once accomplished, the button proves remarkably sensitive, permitting the most delicate use of brake force. And it's quick enough to permit precision "tapping" on slick surfaces.

Driving in snow poses a standard FWD problem—to use chains or mush through, trusting to traction from the Michelin 165 x 400 "X" low pressure tires with steel mesh cord construction. In questioning drivers who have made ski trips on snow covered European mountain roads, it is found that Citroën cars without chains or snow tires have gotten through where rear wheel-drive cars equipped with chains have not. The accepted procedure with Citroëns encountering difficulty in traction is to have two passengers ride the front end fenders for added ballast.

Returning to the engineering aspect of the Citroën DS 19, the four cylinder engine is rubber mounted, has no metal contact to body parts, and displacement is 116.5 cubic inches with 3.07 inch bore and 3.94 inch stroke. The cylinder head is aluminum, combustion chamber hemispherical, with large diameter valves inclined 60 degrees. A spark advance "octane selector" is kept at full advance with U. S. fuels, the compression ratio being a gentle 7.5 to 1. Developed bhp is factory-rated 75 at 4500 (R.C.A. rated 15.08 hp) and maximum torque is 101 pounds-feet at 3500 rpm. Carburetion is by compound dual throat Weber type 24/30 DCLC, in which the secondary barrel opens only after primary is wide open. This secondary feed definitely roughs up the engines extreme smoothness of first throat operation and cannot be tuned out, as is the case with many hemispherical chamber designs under full load. It does, however, provide much needed power under load conditions in all gears. The roughness is noticeable only to critical drivers and passengers say they do not feel it.

The carburetor tune *must* be made with an electric (shop) tachometer's aid. The entire synchronization of the power clutch and shift depends upon

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proper idle speed (550 rpm) for declutching, with engagement at 700 rpm —no more, no less. One half a turn of carburetor jets without an exact compensating of shift unit timing can cause anything from limping home to taking trains. The intake manifold is water heated, the oil pan is an aluminum casting, the shrouded fan has nylon blades (that merely sting fingers at idle!), and the low pressure cooling system uses anti-freeze (glycol) at 15 degrees below zero protection *all year around*. (Car comes with anti-freeze.)

Next comes the main attraction—a seven cylinder swashtype pump, belt-driven off the engine's right front (behind transmission) on an adjustable mount. Drawing Lockheed hydraulic fluid #55 from a tank reservoir located ahead the radiator to the right, this unit pumps at high pressure into a main accumulator below the reservoir. This accumulator has a spherical section containing fluid at constant pressure, with metering valves. It feeds four suspension accumulators, two brake units, the power steering unit, and the shift unit, each then exhausting into the main reservoir in endless cycle (or until some particle of dirt finds its way into the lines and jams one of the many needle-fine valves.)

The suspension units look like large shock absorbers with an accumulator sphere on one end. Roughly, that's what they are, with pistons linked to articulating arms on which the independent action wheels are end mounted. The piston head moves varied amounts of fluid against a rubber diaphragm in the sphere's center, which compresses an inert gas sealed in the upper half of the sphere. The gas is the "spring". The fluid is pressure fed in graded quantities, according to car load, front and back. Two valves in the unit control hydraulic pressure in damping fashion, acting as "shock absorbers". These valves can cause hydraulic squeals ranging from gentle yipes to prolonged howls—should certain high frequency vibrations occur due to thinned oil on hot days or any extreme heat condition. Some cars have come through with howls that required valve closing springs of different rate fitted to effect a cure. This condition can occur on other valve units throughout the cars, and seems somewhat produced by fate, as one vehicle will have one squeal condition and the next be entirely different. All DS 19 cars squeal slightly at times when very hot.

Power operation of the rack and pinion type steering is by means of a hydraulic cylinder with piston lined by rod to the rack. Fluid is admitted at one or the other end of the cylinder in ratio to manual effort on the steering wheel, with control valves located under the car's battery. With power on, there is no contact between steering shaft end and rack. With power off, a striking plate that normally operates valve action travels slightly further and hits the valve body to achieve direct mechanical action to pinion on rack. (With FWD, this action is more than a handful for Lady pilots). There is a simple screw-set mechanism on the "straight line steering" spring loaded cam device located near the foot of the steering column. Handily located, this unit upon normal wear can cause a definite right or left side steering pull (that will make many "experts" swear that the entire steering is out of line!) The unit provides a centering point that no other power steering boasts, thus achieving a good impression of real steering "feel".

The single dry disc clutch is actuated by an hydraulic cylinder. A valve either admits fluid from a main accumulator for clutch disengagement, or releases it for engagement under action of a return spring. A twin stage control is utilized, with a separate pressure pump actuating the clutch for car start and then caused to bypass its power in continuous cycle when engine exceeds 700 rpm. The second stage shifts gears when rpm exceeds 700, and features a two-valve control for either rapid or slow, smooth

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shift dependent on urge at gas treadle. The larger valve quickly evacuates the fluid in the clutch cylinder. The smaller valve delays clutch re-engagement.

The shift lever system activates individual hydraulic cylinders at the gear boxes selector fork ends, with pistons linked to the forks fully engaging each gear. It is evidently not an entirely foolproof gear change method, as one car in the Citroën shop was suffering an expensive ailment caused by inept clutch handling. At no time during tests, however, did the clutch perform poorly other than to lag.

An over-all look at the DS 19 service requirements tells that no ordinary shop can attempt even small adjustments to the hydraulic system unless under supervision of factory-trained staff, or upon consulting and comprehending an exhaustive shop manual, which, at the moment, is in preparation. It would be very wise for owners to obtain this manual when it becomes available and work from it personally, or while supervising a patient mechanic preferably from aircraft shops where the work principle of neatness—required for hydraulic repair —is deeply drilled into every involuntary movement. General accessibility is not bad as first glance indicates, and as both front fenders are held on by a bolt front and back, removal opens up the works for action quickly and adequately. The rear fenders are removed for wheel change with one bolt (nice plated) protruding through rearmost contour. All wires are color coded, all nuts, bolts, metric. The present French battery should not be allowed to discharge completely, as it usually fails to recharge thereupon.

The park brakes serve two purposes, being linked by cable to the front disc shoes, and also to a dog cam that will, when required, take up the disc friction plates (shaped as a top-sawed-off keystone and merely dropped into slots when replaced.) This "automatic" brake adjustment is very ingenious, being the key to public-operated disc systems, and can cause the owner temporary alarm by occasionally creating brake smell upon initial set. Upon foot depressing, the brake locks in ratchet, is released upon pulling an under-dash button at door line. Hence, it is not the ideal second brake, but does most safely check the car at average speeds. Parking in gear is possible, but requires use of the remote, under dash, manual clutch control, hence the foot brake "gets used."

Seats are designed for ideal posture, have nylon jersey on foam rubber upholstery with support by very light, entwined coil springs set every three inches. Just how long this type construction will hold up without sag is something we don't know . . . but while it lasts, it is most luxurious.

The no-draft ventilation as designed by Citroën eliminates side vane windows by means of defusers on the extreme sides of the instrument panel. These vents have adjustable openings leading to intakes under the fenders above the front wheel suspension. (At night, headlight illumination may be seen through these plastic lattices.) Vents serve in winter for heating from a water unit, with control by large knob on the engine wall under panel center. Heating efficiency is such that the DS 19, when subject to minus 25 degree centigrade in Sweden, provided interior heat of plus 18 degrees. Just above the heat knob, under the dash, is a pull knob that provides manual control for window wipers. These wipers drop below the hoods trailing edge when not in use, and are most efficient on regular automatic electric action.

The instruments consists of gas gauge, and ammeter below the speedometer. Speedometer may read kilometers or mph, depending on the date of import. There is no oil pressure or water temperature gauge – no one knows why. Warning lamps include a center red oblong to tell if brake pressure lowers (then you still have up to 70 stops reserve if the leak is not major), very dim, green blinker arrows seen best after dark, and a bright-lights red spot.

Economy tests showed 22 mpg under hard driving, 28 mpg average cross country, 33 mpg at economy speeds (34 mph in 2nd, 50 mph in 3rd, 68 mph in top). Wide-out racing gave 14 mpg on a four mile test.

Brake tests included successive stops from 50 mph, with no fade or loss of retard measurable. Brakes were applied full at 90 mph on an eleven percent downgrade, start was instantly made, obtaining a speed of 68 mph on the same grade, followed by full brake to stop—with no fade. Brakes on one car chattered slightly, due to the single screw holding disc plate being slightly loose.

Top speed was precision timed at 90 mph on one car,, read 94 mph on another car tailed by Corvette with accurate speedometer. Acceleration rates varied widely due to shift unit's inconsistent performance on most cars. The best (specially tuned by Citroën for test) reading by corrected speedometer was seven seconds to 37 mph, 12 to 50 mph, 16 to 62 mph, 24 to 68 mph, 30 to 75 mph. Speedometer error was very small in all cars, averaging two mph fast through the range.

Without a doubt, the Citroen DS 19 is the current be-all and end-all of automotive gadgetry, but above and beyond that, it is an enthusist's car . . . that is if the enthusiast is not so simonpure that he can't stomach having oil do his work for him. —*Ben West*