
MAZDA

Pay Raise:

MAZDA ROTARY

The '77 shows a 62 percent improvement in fuel economy, plus performance . . .

PV4 TEST

How about a 62-percent raise in pay? Or, wouldn't it be great to manufacture a mini pickup whose fuel economy has improved by 62 percent since 1974—without apparent sacrifice in overall performance? The manufacturer is Toyo Kogyo; the mini pickup is the rotary-engined Mazda; and the improvement in fuel economy is the aforementioned 62 percent. The Mazda rotary mini's performance remains, simply put, brilliant!

General Motors has, by-and-large, abandoned its Wankel rotary engine development program for two stated reasons: (1) rotary powerplants are generators of atmospheric pollutants and pose difficult emissions control problems, and (2) rotary engines are gas guzzlers. Toyo Kogyo, to the contrary, has continued to develop the Wankel engine for Mazda cars and trucks to the point at which its exhaust emissions are under control and at which the rotary powerplant clearly demonstrates true fuel economy.

Those are facts proven in comparison of test results gathered by **PICKUP, VAN & 4WD** test crews for Mazda rotary pickups evaluated in 1974, 1975 and 1977. Facts are one thing; subjective driver impressions are another.

The Mazda rotary mini pickup remains a pure joy to drive.

But, before examining the 1977 Mazda rotary pickup, here's a capsule review of the Wankel powerplant's history, and how it works. In the early 1950s, German engineer, Felix Wankel, analyzed the possibilities of rotary piston engines, then discovered the fundamental principle that makes Wankels workable. The principle is one of rotating an equilateral triangle inside a similarly shaped housing, in which three variable-volume chambers could be formed to satisfy the intake, compression, power and exhaust phases of the conventional 4-cycle (Otto) piston engine. Subsequently, an NSU engineer, Dr. Walter Froede, refined Wankel's design and simplified both motion and construction of the engine. In addition to GM, NSU, holder of the Wankel patent, at one time or another licensed such diverse firms as Curtiss-Wright and Nissan to develop and build Wankel engines. Citroen, Mercedes and Rolls-Royce also have made attempts at Wankel development. Between 20 and 30 license agreements were made early-on in the rotary engine's career, but Mazda (Toyo Kogyo) survives as the sole producer of automotive rotary engines. NSU continues to produce Wankels for industrial purposes.

Here's a follow-through on the Wankel engine's cyclic progression: In the rotary, an equilateral triangular member with curved sides orbits about an eccentric on a shaft in a stationary housing. The inner, or working surface of the housing is in the shape of an epitrochoid (a fat, open figure-8). The epitrochoidal shape is defined by a point on the radius of a circle which rolls around the outside of the base circle. The point which defines the shape, however, is not the circumference of the rolling circle. The difference in circle centers, as they "rotate," provides the eccentric or "crank throw" for the Wankel's crankshaft. In operation, as a rotor side passes the intake port in the housing, it begins to draw in a fuel/air mixture. As the rotor continues around, the mixture is compressed as the side of the rotor draws closer to the interior of the epitrochoidal chamber's working surface and effective combustion chamber volume decreases. The compressed mixture is fired by a timed spark and power producing expansion takes place, driving the rotor around. Exhaust occurs through a port as decreasing chamber volume expels burned gasses. The interior gearing on the triangular piston and outside of the crankshaft is a 1:3 ratio, meaning that the rotor orbits once for every three revolutions of the shaft. The central gear is stationary and anchored to the side cover of the housing. The internal ring gear is part of the rotor. Hence, when referring to the Wankel engine's speed, the reference is actually to crankshaft speed.

The current Mazda rotary engine is a double-rotor design, considerably refined from initial production Wankels of either German or Japanese manufacture. The twin rotors in double epitrochoidal chambers displace 80 cu in. (40 cu in., times two). Original Wankels employed direct fuel injection and single spark plug ignition. The present-day ▷

ROTARY

Mazda unit uses dual ignition—two spark plugs per rotor—and a single 4-barrel carburetor. The dual ignition system produces a longer, cleaner burn than does a single-plug ignition system. In the Mazda rotary, the leading plug fires when the rotor is effectively 5 degrees past top dead center and the trailing plug fires when the rotor is about 20 degrees past top dead center.

The Mazda rotary engine is rated as developing 110 bhp (net) at 6000 rpm and producing 117 lb-ft (net) of torque at 3500 rpm.

The rotary engine is in a special Mazda mini-pickup chassis, a variant of the Mazda B1600 (PV4, Oct., '75), and the Toyo Kogyo-produced Courier that is built for U.S. distribution by Ford Motor Co. The Mazda rotary chassis features a wider stance, with both front and rear track almost 6 in. greater than that of the standard '77 Ford Courier.

The Mazda rotary chassis is assembled with a ladder frame, front suspension comprised of upper and lower A-arms with coil springs and tubular shock absorbers, and rear suspension made up of longitudinal leaf springs and tube shocks, the Mazda/Courier design of long standing.

The '77 Mazda rotary-powered mini offers a Gross Vehicle Weight Rating (GVWR) of 4210 lb.

Vacuum-boosted disc brakes, 10 in. in diameter at the front, and 10.24 x 1.77-in. drum brakes at the rear, and variable-ratio steering are standard.

The vehicle supplied to **PICKUP, VAN & 4WD** for evaluation was fitted with a set of Bridgestone Skyway Deluxe 7.35 x 14 tires, with four polyester plies and one nylon ply in the tread, and four polyester cord plies in the sidewalls. The tires' maximum load capacity is rated at 1450 lb per tire at 36 psi inflation pressure.

As mini pickups go, the Mazda rotary exterior reflects the cab and bed design of the '76 Ford Courier, with integral fender flares to accommodate the increased front and rear tread width. And as mini pickups go, the Mazda rotary's interior reflects perhaps the most thoughtful instrument layout and tasteful appointments among the light-duty imports now available.

On the instrument panel to the driver's left is a combination speedometer and trip odometer. Fuel and coolant temperature gauges are to the right. In the center, just above the steering column is a tachometer redlined at 7000 rpm. (The tach is coupled to a warning horn that blasts when engine rpm exceed seven grand.) A manual choke is to the left, with trip odo reset just above and to the right. AM radio and heater/defroster controls are to the right, at the center of the panel.

Textured vinyl upholstery, color-coordinated buckskin tan in the orange and white-striped test vehicle, covered the standard bench seat. Woodgrain inserts here and there set off the tans and blacks of door and dash panels.

The Mazda rotary pickup looks fine, but it performs even better than it looks.

In the test unit the dual-ignition "double-bucket" rotary powerplant was coupled to a 5-speed overdrive manual transmission and 3.90:1 final drive gearing in an "open" axle.

Test crew drivers, the ones who're graying at the temples, and who don't move as quickly as they used to, can recall the light, fast British sports cars of the 1950s, and the Detroit muscle cars of the 1960s. The rotary piston truck of the 1970s, to these drivers, was a combination of sports and muscle.

The sports aspect was reflected in the Mazda's general high-speed handling quality on pavement; the muscle was reflected in the instant throttle response and brisk acceleration generated by the smooth, high-winding rotary engine.

In first gear, 6000 rpm gets 32 mph; a shift up to second and a blip of the throttle, again to 6000, gets 52 mph; third gear and 5500 rpm delivers 77 mph; 4500 in fourth produces 87 mph; and the Mazda rotary driver can look at 90 on his speedo at 4000 rpm in fifth gear. No amount of writing can explain the power surge of the rotary engine in conjunction with the crisp, fully-synched shifts of the 5-speed manual gearbox. One word will suffice: Superb!

On freeways, with troopers on patrol, the rotary Mazda idles along easily in fifth, producing the legal 55 mph at 2500 rpm. But, on paved, curvacious back-country two-laners, away from the watchful eye of the traffic policeman, the Mazda rotary tends to get out of hand. Wow! Sports car time again! The rhythm of the curves, upshift-downshift, stab-the-throttle, is like the old days. (One driver wished he could put the top down.) The Bridgestones' bite on asphalt gave the small truck a sure-footed feel, a kind of assurance that things wouldn't come all that loose, even though things were pressed to the edge of adhesion. The entertainment index of the Mazda rotary is, to say the least, *high*—breathtaking, even!

Touring paved rural roads provided several pleasant days for test crew personnel. One excursion onto semi-desert dirt roads changed all that, however. The tall-geared Mazda, with its street-treaded tires and its open differential, on its initial venture into drywash sand, buried itself to the frame rails. The situation revealed (1) that the Mazda rotary in standard form is definitely *not* an off-pavement vehicle, and (2) that the nifty scissors jack supplied with the truck is a lifesaver in a stuck-in-sand predicament. Once unstuck, the rotary Mazda thereafter was kept on pavement during its evaluation period.

Back at the dragstrip for some serious testing, the rotary Mazda achieved 0–60-mph acceleration in 10.4 sec, and traversed the standing-start quarter-mile in 18.1 sec at 76 mph. In panic braking tests, 38 lb of pedal pressure brought the vehicle to a halt in a rather lengthy 185 ft, as the right rear drum brake locked quite easily, which required pedal modulation to keep the line of deceleration more or less straight. In six stops at a deceleration rate of 1/2 g, the Mazda's brakes demonstrated 63 percent fade.

As the accompanying table shows, acceleration and braking figures recorded for the '77 rotary pickup, are very close to those tallied for a pair of 1974 Mazda rotary vehicles with 4-speed manual transmissions and a similar unit with a 3-speed automatic tested in 1975. The similarities disappear, however, when the eye reaches the city/freeway and off-road fuel mileage columns in the table.

Using precision electronic fuel-flow equipment, the test '77 Mazda rotary with 5-speed overdrive transmission and 3.90 final drive gearing, delivered an outstanding 26.3 mpg in the city/freeway test cycle and 17.1 mpg in off-pavement operation.

The least miserly '74 truck delivered only 16.3 mpg in the city/freeway cycle, and a flat 13 mpg off-road. This figure was 4 to 7 mpg less than contemporary piston-engined imported mini-pickup trucks. Staff drivers, in 1974, assessed the rotary-engined mini from Mazda as a highly acceptable performer, but a loser in terms of fuel economy as compared with other mini trucks of that particular model year.

Since 1974, Toyo Kogyo engineers have improved things. The 1975 unit, with 3-speed automatic and 4.375:1 final drive gearing, delivered 19.7 mpg in the city/freeway cycle and 13.7 mpg in off-pavement running. The 1975 Mazda rotary was almost in the mini truck ballpark in terms of fuel economy, but not quite. Test crewmen were inclined to think that the '75 version of the twin-rotor engine was the ultimate in terms of rotary engine fuel economy.

Then came the '77 model. In the driving necessary to gain the subjective feel of the vehicle, test crew drivers discovered they were reaching for their gasoline credit cards less frequently than with past rotary pickups. Only when the engine was put to the fuel flow test over the standard city/freeway course did the dramatic improvement in fuel economy become apparent. The increase from 16.3 to 26.3 mpg, 1974 to 1977, is truly amazing, in consideration of the facts that (1) acceleration in the quarter-mile is only off 0.4 sec and 2 mph, (2) 0–60-mph acceleration is 0.4 sec quicker, and (3) all this is achieved with a taller axle ratio and a 5-speed overdrive transmission.

Mazda displayed tasteful buckskin vinyl upholstery, woodgrained panel.

The '77 rotary's fuel consumption at 26.3 mpg might be compared with some other mini pickups, those with piston engines. Here's a listing: 1976 Ford Courier with 110-cu-in. engine and 5-speed gearbox, 27.5 mpg; 1976 Datsun Li'l Hustler with 119-cu-in. engine and 4-speed gearbox, 23.8 mpg; 1976 Toyota SR-5 with 5-speed gearbox, 24.0 mpg; 1977 Ford Courier with 140-cu-in. Pinto engine and 5-speed gearbox, 26.6 mpg; 1977 Ford Courier with 140-cu-in. Pinto engine and 3-speed automatic, 22.8 mpg; 1977 Datsun King Cab with 119-cu-in. engine and 5-speed gearbox, 24.1 mpg; and 1977 Toyota SR-5 with 134-cu-in. engine and 5-speed gearbox, 26.2 mpg. All of the above only goes to prove that the Mazda rotary engine *is* in the mini-pickup fuel economy ballpark, and thus is more competitive than ever in the imported pickup marketplace.

In this fuel economy ballpark, the rotary-engined Mazda is quicker and faster than any of the piston-engined competition.

That increase in fuel economy from 16.3 mpg to 26.3 mpg, 1974 to 1977, is an improvement of almost 62 percent, which for Mazda pickup owners who buy gasoline is almost as good as a raise in pay. And Mazda engineers and sales people must be grinning from ear to ear because of that pickup, the fuel economy of which has improved by 62 percent since 1974—without apparent sacrifice in overall performance. •

REVIEWING THE ROTARIES

And perusal of the percentage payoff . . .

Model Year Mazda Rotary	Transmission	Axle Ratio	Engine Rpm In Top Gear @ 55 mph	Vehicle Weight, lb	Acceleration 0–60 mph, sec	Acceleration Standing-Start Quarter-Mile, sec @ mph	Stopping Distance From 60 mph, ft	Percent Brake Fade In Six 1/2-g Stops From 60 mph	Fuel Mileage, mpg City/Freeway	Fuel Mileage, mpg Off-Road	Fuel Tank Capacity, U.S. gal.	Range, Miles City/Freeway	Range, Miles Off-Road
1974	4-M	4.625:1	3300	2870	10.8	17.7 @ 78	150	25%	16.4	13.1	20.8	341	272
1974	4-M	4.625:1	3500	2800	11.0	17.9 @ 77	165	87%	16.3	13.0	20.8	339	250
1975	3-A	4.375:1	3100	2830	10.6	17.7 @ 79	159	61%	19.7	13.7	21.1	416	289
1977	5-M	3.900:1	2500	2800	10.4	18.1 @ 76	185	63%	26.3	17.1	21.2	558	360

MAZDA ROTARY SPECIFICATIONS AND PERFORMANCE

PRICES

Basic list, West Coast POE	
RX-4 rotary pickup w/5 spd	$4445
RX-4 rotary pickup w/auto	$4715
Standard Equipment	rotary engine, 5-spd manual transmission, power front disc brakes, tinted glass, chrome front bumper, full nylon carpeting, double-latched tailgate, simulated-woodgrained instrument panel, heavy-duty heater, cigarette lighter, trip odometer, tachometer, glove compartment, 2-spd wiper/washers, 7.35 x 14C tires

GENERAL

Curb weight, lb (test model)	2800
Weight distribution, %, front/rear	53/47
GVWR (test model)	4210
Optional GVWRs	none
Wheelbase, in.	107
Track, front/rear	57/56
Overall length	176
Overall height	61
Overall width	67
Overhang, front/rear	25.5/41.2
Approach angle, degrees	33
Departure angle, degrees	20
Ground clearances (test model):	
Front axle	8.0
Rear axle	7.2
Oil pan	12.4
Fuel tank	9.5
Exhaust system (lowest point)	7.2 @ catalytic converter shield
Fuel tank capacity (U.S. gal.)	21.2
Auxiliary	none

ACCOMMODATION

Standard seats	full-width bench
Optional seats	none
Headroom, in.	33.4
Accelerator pedal to seatback, max	42.5
Steering wheel to seatback, max	17.7
Seat to ground	44.6
Floor to ground	15.4
Unobstructed load space (length x width x height)	75.3 x 43.0 x 15.6
Tailgate (width x height)	55.7 x 15.7

INSTRUMENTATION

Instruments	speedometer, odometer, trip odometer, tachometer, fuel gauge, water temp
Warning lights	oil pressure, low coolant indicator, alternator, hazard warning, exhaust system overheat indicator, parking brake
Optional	none

ENGINES

Standard	80-cu-in. rotary
Bore x stroke	twin 40-cu-in. rotors
Compression ratio	9.2:1
Net horsepower @ rpm	110 @ 6000
Net torque @ rpm, lb-ft	120 @ 4000
Type fuel required	unleaded
Optional	none

DRIVETRAIN

Standard transmission	5-spd manual
Clutch dia., in.	7.9
Transmission ratios: 5th	0.86:1
4th	1.00:1
3rd	1.46:1
2nd	2.26:1
1st	3.68:1
Synchromesh	all forward gears
Optional	3-spd automatic, $270
Transmission ratios: 3rd	1.00:1
2nd	1.46:1
1st	2.46:1
Rear axle type	Semi-floating hypoid
Final drive ratios	3.90:1
Overdrive	none
Limited slip differential	none

CHASSIS & BODY

Body/frame	ladder-type frame with separate steel body
Brakes (std)	front, 10-in. dia. disc; rear, 10.2-in. drums
Brake swept area, sq in.	303
Swept area/ton (max load)	148
Power brakes	std
Steering type (std)	recirculating ball
Steering ratio	20.2:1
Power steering	none
Turning circle, ft	38.2
Wheel size (std)	14 x 6.0
Optional wheel sizes	none
Tire size (std)	7.35 x 14C
Optional tire sizes	none

SUSPENSION

Front suspension	independent A-arms with coil springs and tube shocks
Front axle capacity, lb	1790
Optional	none
Rear suspension	semi-elliptic leaf springs on live axle and tube shocks
Rear axle capacity, lb	2630
Optional	none
Additional suspension options	none

TEST MODEL

RX-4 rotary pickup with standard equipment, AM radio ($69), step bumper ($60), stripe trim package ($35.90), large side mirrors ($33.50). West Coast list price ... $4574, plus $95 freight, not including taxes or license fees

ACCELERATION

Time to speed, sec:	
0–30 mph	3.5
0–45 mph	6.3
0–60 mph	10.4
0–70 mph	14.9
Standing start, ¼-mile, sec.	18.1
Speed at end, mph	76

SPEED IN GEARS

High range, 5th (4000 rpm)	90
4th (4500 rpm)	87
3rd (5500 rpm)	77
2nd (6000 rpm)	52
1st (6000 rpm)	32
Engine rpm @ 55 mph	2500

BRAKE TESTS

Pedal pressure required for ½-g deceleration rate from 60 mph, lb	38
Stopping distance from 60 mph, ft	185*
Fade: Percent increase in pedal pressure for 6 stops from 60 mph	63
Overall brake rating	good

*Right rear brake locked easily and required pedal modulation to stay straight

INTERIOR NOISE

Idle in neutral, dbA	53.5
Maximum during acceleration	76.0
At steady 60 mph cruising speed	76.5

OFF PAVEMENT

Hillclimbing ability	very good
Maneuverability	excellent
Turnaround capability	excellent
Driver visibility	excellent
Handling	excellent
Ride	very good

ON PAVEMENT

Handling	excellent
Ride	good
Driver comfort	very good
Engine response	excellent

FUEL CONSUMPTION

City/freeway driving,* mpg	26.3
Off pavement	17.1
Range, city/freeway driving, miles	558
Range, off pavement	363

*80 percent freeway, 20 percent city