

LS 400: THE LEXUS STORY



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LS 400:

THE

LEXUS

STORY



Eiji Toyoda



Shoichiro Toyoda

Dear Lexus owner:

In our language we have a saying for the occasion when a daughter is given away in marriage: "Here's our cherished child—please take good care of her."

That's just how we feel about the Lexus LS 400. This beautiful motorcar is, indeed, "our cherished child" and, just like a family with a cherished child, we have dedicated ourselves to it. In this finest of Lexus automobiles we have invested all our engineering and design resources; all the know-how we have gained in 54 years of making automobiles; the highest motivation of our most talented employees; and Toyota's tradition of incessant striving toward ever greater quality. Most important of all, we have followed our tradition of Customer First: It had become clear that the market, and Toyota customers in particular, now expected such an automobile from us.

When we decided to produce the Lexus, we were committing all those resources and capabilities, that motivation, these traditions to the lofty goal of creating one of the world's very finest automobiles.

For us this was not only a tremendous challenge and a dream to fulfill, but an inevitable decision. Over the years we have concentrated our efforts and abilities on quality, reliability and value for the broad automotive market. But our tradition and capabilities had reached the point where building an automobile in the grand style was a natural challenge to accept. Simply put, it was time. And now that we have built that car, we are almost overwhelmed with the sense that this dream of ours has been fulfilled.

We sincerely hope that, in acquiring your new Lexus, you too are fulfilling a dream. As the proud owner of a new LS 400, you are already aware of its greatness. We hope, and certainly believe, that this feeling will grow as you experience driving and owning this masterpiece of our craft. It is the finest car we know how to build. It will reward your investment with the satisfaction that comes from elegant design, precise engineering, enduring construction and painstaking finish. It will reward you with smooth, abundant power. With efficiency that is surprising in such a powerful and luxurious automobile. And it will provide you with many years and miles of its primary function: swift, luxurious transportation.

As Chairman and President of the company whose tradition and guiding principles have created this Lexus automobile, we wish you our personal congratulations on your choice—and our personal best wishes for the enjoyment of your new Lexus. We sincerely hope that this book, which was created to celebrate a new automobile and a new name in automobiles, will add to that enjoyment.

Eiji Toyoda

Chairman, Toyota Motor Corporation

Dr. Shoichiro Toyoda

President, Toyota Motor Corporation





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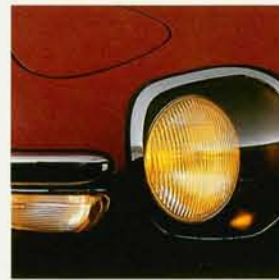
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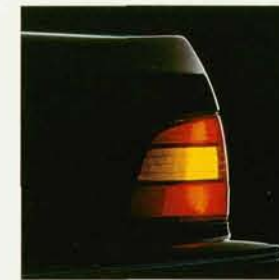
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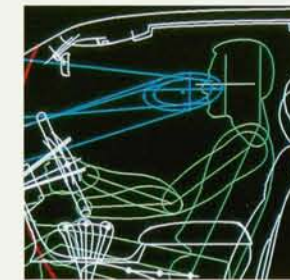
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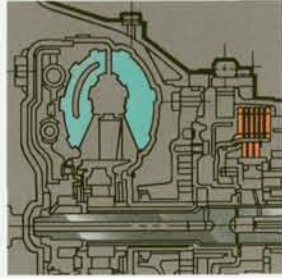
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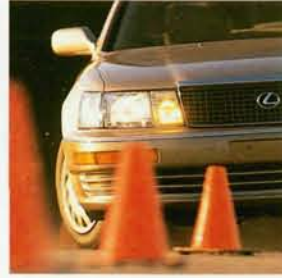
"400" MEANS 4 LITERS,
FOUR VALVES PER
CYLINDER AND FOUR
CAMSHAFTS



THE "INTELLIGENT"
AUTOMATIC
TRANSMISSION



THE EXHILARATION
OF HANDLING A TRUE
ROAD CAR



AT THE HEART OF
HANDLING: THE BODY
AS A FIRM FOUNDATION



FOR THOSE TENSE
MOMENTS: ANTILOCK
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PEACE OF MIND IN THE
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Quality production,
rigorous testing and a
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Lexus is committed to
unprecedented cus-
tomer satisfaction.



LS 400: THE LEXUS STORY

As the Lexus LS 400 makes its world debut, a new name joins the select ranks of great luxury cars. The LS 400 marks the elevation of one of the world's great makers of automobiles into the very elite of motorcar manufacturers.

Behind this exciting new luxury automobile stand that company's long history, its honorable traditions, enviable reputation and immense capabilities.

Beneath the LS 400's unique finish and elegant lines is a precision machine: endowed with leading-edge engineering and technology, equipped for supreme luxury and executed with painstaking care.

The mandate given to Lexus designers and engineers was bold and uncompromising: to create one of the finest automobiles ever made. The means at its creators' disposal—the research, design, testing, development and manufacturing resources—were unexcelled anywhere in the world. Their achievement is consummate: the Lexus LS 400.



A
MASTERFUL
BLEND
OF
LUXURY
AND
PERFORMANCE

As your eye takes in the lines of the Lexus LS 400, one aspect of its nature is instantly clear: this is one of the world's great luxury automobiles.

But then, as you experience the LS 400 maneuvering nimbly through traffic or cruising serenely on the open road, another side reveals itself: this is not merely a luxury car, but a dynamic driving machine.

It is no coincidence that the LS 400 is both. A true luxury car is also a *performance* car: with power to accelerate into fast-moving traffic, to maneuver decisively, to master the hills and mountains. A great luxury car is a *handling* car, one that can negotiate corners and curves with agility while treating driver and passengers to quiet comfort.

For muscular, yet velvety performance, the LS 400 is powered by a V8 engine that delivers not only abundant power, but remarkable quietness and fuel efficiency.* Allied to this is an automatic transmission that "thinks," interacting with the engine for virtually imperceptible operation.

See mileage statement on page 65 for details.









E N G I N E E R I N G

A N D

T H E

P L E A S U R E S

O F

T H E

R O A D

Performance and handling are more than just fulfilling the demands of traffic, curves and mountains. They are also tangible sources of pleasure—the pleasure of driving that today's luxury-car buyer expects.

No longer is enjoyment of the act of driving reserved for those who drive sports cars: Given the best research, engineering and technology, it is possible for a roomy, luxurious car to deliver acceleration, cornering and braking that challenge the world's great performance cars. This, too, is a premise upon which the Lexus LS 400 was built.

For responsive handling, the LS 400 has a highly advanced, race-car-inspired suspension system; wide alloy wheels and tires specially developed for Lexus; progressive power steering; and for those who want even greater comfort allied to these qualities, an optional air suspension system that goes beyond any such system ever offered.

UPON

ARRIVING:

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OF

TASTE

AND

DIGNITY

We do not spend all our time accelerating, cornering and braking—nor, for that matter, driving at all. Sometimes we revel in the mere act of arriving—whether in the sense of accomplishment and lifestyle or, more literally, going to places that speak to that lifestyle.

As a means of travel and an expression of lifestyle, a fine luxury automobile is both a functional necessity and a statement. Lexus designers saw their assignment as creating a style that not only meets functional needs, but makes the best statement about its owner: one of taste, reserve, dignity and intelligence, expressed in the vernacular of contemporary style and technology.









T H E

S T Y L E

O F

T E C H N O L O G Y

A N D

Q U A L I T Y

Style is more than just shape and line. In a contemporary luxury automobile, it is also the expression of technology: advanced function translated into advanced design. It is quality: materials, finish, care, attention to detail. Lexus designers concerned themselves with expressing the LS 400's superlative aerodynamics as elegant style. They attended to details as minute as the radius of a headlight lens...how the gap between hood and fender looks from the human vantage point... surface quality and lack of seams in a window molding. To refine and complement the LS 400's shape, they sought out new materials, created special finishes, researched the flow of air around an automobile body. What the eye beholds here is more than mere esthetics: it is the visual expression of technology and quality.

LET

THERE

BE

COMFORT

AND

SERENITY

A luxury automobile is enjoyed first and foremost from the inside. Here Lexus designers and engineers sought to create a warm, serene, comfortable environment—one that respects the human being in both functional and esthetic senses. At every step of creating the LS 400 interior, Lexus designers considered each functional aspect—the design and position of controls, seat structure and adjustments, instrumentation—along with surface contours, textures of materials and color coordination. As with the exterior, the Lexus creators endeavored to incorporate a quality of design that would speak to the Lexus owner's own position and lifestyle.









THE
VICISSITUDES
OF
LIFE,
CONQUERED

Perhaps most important of all, the great luxury car must be a reassuring car, with state-of-the-art road capabilities and strength that inspire peace of mind in the often jungle-like environment where we drive and park.

For enhanced stopping power, every LS 400 is equipped with an electronic antilock braking system (ABS). And for the eventuality that danger becomes unavoidable, Lexus engineers have built great strength into the LS 400 body while equipping it with easy-to-use, thoughtfully designed seatbelts and an airbag supplemental restraint system (SRS) for the driver.

Lexus Division has endeavored to make the LS 400 "a world-class high-performance quality luxury car," as Chief Engineer Ichiro Suzuki puts it. The Lexus Quality Committee and a masterful team of planners, researchers, engineers and designers directed vast resources toward creating the Lexus LS 400.

The extent to which they succeeded will ultimately be judged by those who own and drive the LS 400. This book celebrates the creation of Lexus and documents the LS 400's credentials: the history of the company that created it; the long gestation period; the car's features; the quality which ensures that the LS 400 lives up to its promise. And, finally, the Lexus philosophy: to create high-quality luxury automobiles now and in the future, cars that are a pleasure to look at, to drive, to ride in, and to own.



THE LEXUS HERITAGE: 54 YEARS IN MOTION

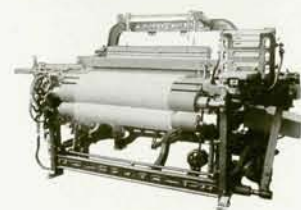
Lexus is a new name. The Lexus heritage, however, is a long and honorable tradition of quality machinery and motor vehicles. The name of that tradition is Toyota—or the family name, Toyoda.

It was inevitable that the Toyodas would eventually turn their attention to producing one of the world's finest luxury automobiles. Over the 54 years this pioneering Japanese family has built its worldwide reputation, it has always applied a philosophy which is simply stated: Customer First. This is the firm belief that whatever the price or level of sophistication of an automobile, the buyer deserves the very best that can be designed, engineered and produced. With the Lexus LS 400, this philosophy is now expressed in an automobile of the very highest level of sophistication.

Like Gottlieb Daimler and Karl Benz of Mercedes-Benz, Karl Rapp of BMW, and Ferdinand Porsche, the Toyodas began modestly, with inventiveness and a sense of independent achievement.



Sakichi Toyoda (1867–1930), often called Japan's King of Inventors, was the founding father of a heritage that would eventually lead to the creation of Lexus. Though his pioneering was in the field of spinning and weaving—he invented a revolutionary automatic loom—Sakichi deeply wanted the Toyoda family to become automobile manufacturers. He first became interested in cars on a trip to the U.S. in 1910. Later, nephew Eiji Toyoda—today the Chairman of Toyota Motor Corporation—would accompany his Uncle Sakichi on a trip to Shanghai and discover his own interest in automobiles.



Sakichi himself never made automobiles, but his interest in cars eventually led to the family's entering this more colorful field.

Toward the end of his life, Sakichi reiterated his wish that the Toyoda family enter the automotive world and added a thought of great importance to the future of Toyota: "Stay ahead of the times."

When Sakichi died, he left his son Kiichiro a sum of money to establish an automotive department at Toyoda Automatic Loom. With that department began

the long journey to becoming a world leader in automobiles. Sakichi Toyoda's influence on both son Kiichiro and nephew Eiji would be the spark that set off the Toyota tradition—and Lexus heritage.



Kiichiro Toyoda, son of Sakichi, established an automotive department within Toyoda Automatic Loom Works, Ltd. in 1933. Four years later, Kiichiro persuaded his adopted brother Risaburo, who headed the company, to incorporate the auto department as a second company. Thus Kiichiro, a highly competent mechanical engineer and manager who enjoyed solving technical challenges, became the founder of Toyota Motor Co., Ltd.

It was Kiichiro who, with the invaluable help of production expert Taiichi Ono, devised the Toyota system of production, which includes the *Kanban* ("just-in-time") system that's now so famous. "What Kiichiro had in mind was to produce the needed quantity of the required parts each day," recalls Eiji Toyoda. "Just make what is needed in time, but don't make too much." The method reduced capital costs, increased efficiency—and revolutionized automobile production. In the years since 1948, when the Toyota Production System was first introduced, Toyota has continually refined and improved the system. Today, it is being adopted by other leading carmakers.

Why Toyota, rather than the family name Toyoda? A contest was held in 1936 to find a suitable logo to replace "Toyoda" for the new company. From more than 20,000 suggestions, Kiichiro and other members of the automotive department settled on "Toyota," an alternate reading of the two ideographs that make up the

family name in the Japanese language's *Kanji* (漢字) writing system. The name was judged to have clarity in sound, and thus good advertising appeal.



The first Toyota passenger cars—the AA and its convertible variant, the AB—were fairly large cars that reflected aerodynamic trends of their day. The engine had six cylinders.



The Crown, Toyota's large car, was offered in America until the Seventies; it continues in much updated form in the Japanese and European markets today. Even in the Seventies, Toyota

products were compared with Mercedes. *Road & Track* reported, "In many ways [the Crown] reminds us of the small Mercedes sedans, in that both are solid and rattle-free and both have that completely honest no-nonsense look and feel about them."

Toyota's Crown was an early forerunner of the Lexus—an early indication of the company's striving toward top quality in automobiles.



Although Toyota began selling Crowns in the U.S. in 1958, it was the 1965 Corona that brought the name and reputation home to Americans. Quickly, the compact "razor-nose" Corona established Toyota's ability to build a car tough and reliable enough for American driving—something few imported makes had done at that time. The Corona also set an important precedent for Toyota and Toyota-built cars in that it was especially adapted for American tastes. For instance, it had a larger (1.9-liter instead of 1.5-liter) engine for the American market, and was available with an automatic transmission.



The Toyota Group (which today consists of 13 distinct companies) also produces high-quality trucks and buses. This activity was expanded in 1966 when Toyota formed a partnership with Hino, which made trucks, buses and a small car called the Contessa. In order to join with Toyota, Hino had to stop car production; as the largest Japanese carmaker, Toyota was forbidden by law from combining with another car company.



In 1968, Toyota introduced the Corolla—a step smaller than its popular Corona, and the car that truly put Japan on wheels. Like the Corona, it quickly acquired a reputation—in Japan and North America—of a tough little car that just ran and ran. By 1980, the company would be producing nearly 800,000 Corollas a year.

"Corolla," by the way, is derived from Latin and means essentially "crown of the flower." Like Corona ("crown of the sun"), this too was a



"crown." This naming tradition continues to this day: Crown, Corona and Corolla are all in the line (if not all sold in the U.S.). Even "Camry" belongs to this tradition, being derived from the Japanese word for "crown," *kanmuri*.

"Naming a car is something like naming one's children," writes Eiji Toyoda in his book *50 Years in Motion*. "One thing that is clear, though, is that no matter how good the name is, if the product itself is no good, it just won't sell."

Not all early Toyotas were for the masses. In 1967, the company produced a small number of this exotic sports car, the 2000 GT; it was the first proof that a Japanese car-maker could compete with the world's established makers of sporting automobiles.

The 2000 GT won rave reviews in American car magazines. Powered by a 2-liter dual-overhead-camshaft six-cylinder engine and equipped

with a five-speed transmission, it was capable of over 135 mph. Racing-style independent suspension (actually similar in concept to that of the Lexus LS 400) gave it remarkable handling. It even had four-wheel disc brakes—remarkable in 1967!

A racing version, with a special 200-horsepower engine, was campaigned on American road-racing circuits by American driver Peter Brock.



As befitted its advancing position in the automotive world, in 1974 the company established the Toyota Foundation. "We decided," recalls Eiji Toyoda, "to set up a private foundation as one part of our contribution

to society." This was the first large multipurpose foundation under the jurisdiction of the Japanese Prime Minister's office. By its 10th anniversary, the foundation's endowment had grown to 11 billion yen (about \$85 million at 130 yen to the dollar).

The foundation provides grants for research both in Japan and abroad. But it does more than just dispense aid: it also cooperates with leading foundations in other countries. For instance, it has provided scholarship grants to Japanese students studying abroad in a joint program with the Ford Foundation.

Among the Toyota Foundation's present programs is one called "Know Our Neighbors," which funds the translation of the literature of other cultures into Japanese and each other's languages, and of Japanese literature into other languages. The International Grant Program supports a variety of projects that respond to the needs of society in other countries.



Toyota Technological Institute (TTI) was opened in April 1981 "to train and educate young development engineers and scientists as a service to the nation." Eiji Toyoda explained TTI's purpose this way: "At Toyota, as at any corporation, there are a significant number of individuals who, although they had the desire and ability, did not attend college. What could we do to help these people go to school?"

To be eligible to enroll in TTI, a student must first be employed by some company—not necessarily one of the Toyota Group. This ensures that students at TTI meet that original criterion: that they be people who did not, for one reason or another, get their college degree before going to work.



Shoichiro Toyoda, son of founder Kiichiro and today President of

Toyota, is at left as Eiji Toyoda, cousin of Kiichiro and now Chairman of the company, shakes hands with then-U.S. Ambassador to Japan Mike Mansfield in 1982 on the occasion of a major Toyota reorganization.

By this time Toyota had evolved into the Toyota Group of 13 companies. Among them were (and are) Toyota Motor Corporation, the carmaker; the original Toyoda Automatic Loom Works; Nippondenso; and others.



Toyota's testing facilities have been expanded repeatedly to increase their capabilities. The proving grounds at the main offices serve all the Toyota engineering and research departments. Here a wide array of tests and experiments are conducted—activities that have led to many of the innovations in Lexus automobiles.



In addition to the test facilities at the main offices, the company has established immense proving grounds and laboratories at Higashifuji, an hour's ride by bullet train from Tokyo; and Shibetsu, on the northern Japanese island of Hokkaido. From the humble beginnings of Toyoda's automotive department in 1933 to the vast resources of Toyota today, everything has pointed toward the development of the ultimate luxury car: the Lexus LS 400. And it is resources like these—the capabilities of inventing and refining new developments, testing and retesting them until they are perfected, and constantly improving the efficiency and quality of production itself—that ensure the Lexus buyer of not only a dramatically advanced motorcar, but a well thought-out, meticulously developed and faithfully reliable one.

Among the facilities at all Toyota Motor Corporation proving grounds are an extensive array of high-and low-speed test tracks with various road surfaces. Indoor test chambers provide extreme high-and low-temperature environments for developing engines, transmissions and other mechanical systems so that they are reliable in many kinds of weather. Computerized test stands "drive" engines as the customer would, hundreds of thousands of miles at low and high speeds, in far less time than it would take if the engines were actually installed in cars.

FROM
THE
BEGINNING,
TOYOTA
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SIX-YEAR COUNTDOWN: THE LEXUS DEVELOPMENT STORY



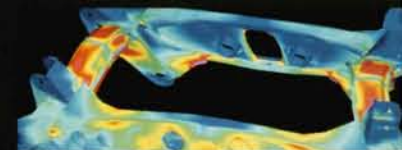
It was August 1983. Eiji Toyoda, Chairman of Toyota, was organizing his thoughts for a book on Toyota's half-century of making automobiles.

Having been there from the beginning, Eiji Toyoda was keenly aware of the company's historic accomplishments and engineering prowess. Now making more than eight percent of the world's automobiles, Toyota was on the rise in both size and standing.

It was time for new challenges. At a top-level, top-secret meeting, Chairman Toyoda posed the question: Can we create a luxury car to challenge the very best?

The answer from those gathered that day—the Chairman, President Shoichiro Toyoda, other top management, strategists and thinkers, engineers and designers—was a "yes" full of conviction. And more: Toyota *must* take on this challenge.

In that one meeting, the idea of Toyota's great luxury car had been advanced and approved. The LS 400 story had begun.



“F”

WAS

THE

30 CODE

FOR

FLAGSHIP

Inside the company, the luxury-car project was named F1: F for “Flagship,” 1 because it would be a luxury sedan of the highest class.

F1 would not be a finer, more luxurious Toyota, as worthy as that might be. It would be an exclusive new make of automobile—yet it would embody all Toyota’s experience and capabilities.

By late 1984, the F1 project had taken on its form and management. As the first Lexus Chief Engineer, Shoji Jimbo was assigned to oversee the F1 as well as the Toyota Cressida; Jimbo would be succeeded in February 1986 by Ichiro Suzuki, an expert in body-structure engineering. Kunihiro Uchida was appointed Chief Designer for the F1’s exterior. Tomohide Yamada would be responsible for the interior, Katsuhiko Shiro for colors. Even the engine compartment was assigned a Chief Designer, Kazuto Iwatsuki.

Under the direction of Jimbo and then Suzuki, a team of General Managers would head the development of aerodynamics, engine, drivetrain, chassis engineering, ride and handling, brakes, traction control, noise and vibration, electrics and electronics, paints, corrosion prevention, and quality.

“We wanted to develop a luxury car superior to Europe’s best, but priced lower than Europe’s medium-class models,” recalls Suzuki. “Some people in the company didn’t believe this was possible. But it would turn out that just setting this difficult goal would help us achieve so much.”

TO AMERICA: A LEARNING EXPEDITION

Because Americans buy more luxury cars than anyone else, the Lexus people believed that only by experiencing America firsthand could they develop the best concept for a luxury car.

Thus in May 1985, a study team headed by Shoji Jimbo set out for a one-month stay in America. This team devoted its time to “getting to know the customer,” attending focus groups and interviewing dealers in San Francisco, Denver, Houston, Miami and New York—all, of course, without revealing its purpose.

In the meantime, a five-man design team moved to the resort town of Laguna Beach, some 50 miles south of Los Angeles—“a very good environment for creating this car,” Uchida explains, “because of its scenic beauty, fashions and especially its interesting people.”

All five lived in a large architect-designed home with a magnificent view of the Pacific. Because they were designing a car for people who buy luxury imports, they rented imported luxury cars to drive.

The five—Uchida, Chief Interior Designer Shigetoshi Odawara, Tadao Ohtsuki, Masahiko Kawazu and Hisashi Seto—did their creative work at Calt, Toyota’s American design office in nearby Newport Beach. Michikazu Masu, a designer already working at Calt, worked with them as did Calt Chief Designers Dennis Campbell and David Hackett.

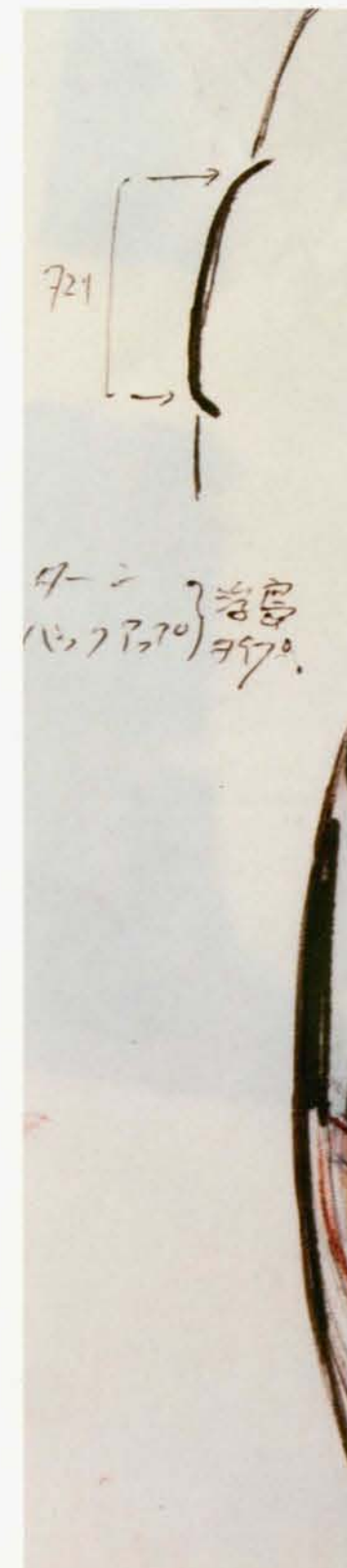
Being in America reminded Kunihiro Uchida that “a car looks different in different environments. We couldn’t design this car primarily for Japan,” he explains, “and have it look the way we wanted it to look in America. Buildings, the width of streets, other cars on the road, even the vegetation...they all affect how a car looks.”

In all, recalls Uchida, it was an exciting experience. By the time the team returned to Japan, they had a design concept complete with drawings and a scale model. Calt had contributed a full-scale model and a presentation on the lifestyles of American luxury-car buyers: “After all,” says Hackett, “living here in Newport Beach, we felt we were a natural for this project.”



“To start with, we stated the premise that a motor vehicle’s basic function is to carry passengers speedily, safely and comfortably to where they want to go. From there, we concluded that a high-class luxury car must deliver very high levels of these same functions—speed, safety and comfort. That is what we worked toward at every step of the LS 400’s development.”

Ichiro Suzuki
Chief Engineer



Concept sketches like these were done during early stages to set themes for LS 400 styling.



An early rendering of the LS 400's instrument panel and front passenger compartment.



Modelers at work on a clay model for the LS 400 in a Lexus styling studio. Developing the design details of the LS 400 required hundreds of renderings and other drawings.











"What we wanted was a combination of the best aerodynamics and elegant style. But as a designer, you can't determine unilaterally what constitutes elegant style—you also have to learn what your customers mean when they say 'style.' To do this, we felt we had to go and live in America, to get to know our most important customers."

Kunihiro Uchida
Chief Designer, Exterior

TOWARD THE FINAL DESIGN: A LONG ROAD

Nobody ever builds a car from the first sketch or clay model, but the fine-tuning process of the Lexus design was the company's most painstaking ever.

The drawings and clay model Uchida's team took back to Japan were not their first; many sketches and several clay models preceded them. And even after the basic design concept was decided on, there ensued an arduous give-and-take. The Lexus design-engineering team wanted the LS 400 to have world-leading aerodynamics, yet traditional elegance—goals that can conflict with each other.

Aerodynamic considerations, for instance, dictate the highest possible trunk. But a high trunk isn't necessarily pleasing to the eye; so the Lexus designers and aerodynamicists spent long hours in the wind tunnel, trying every imaginable contour to get low wind resistance and high-speed stability along with the desired look. "We ran more than 50 tests in the wind tunnel," says Hirohide Iwase, General Manager in charge of handling and stability testing; Uchida adds, "and used tons of clay." To make those wind-tunnel tests as accurate as possible, the designers and aerodynamicists took the highly unusual step of testing clay models fitted with actual underbody components—suspension, brakes and so forth.

Form-versus-function wasn't the core of all the struggles of the Lexus design either. Management must "sign off" on any car design for production, and neither the designers nor top management had ever done a luxury car primarily for America. (Toyota's large Crown and Century were designed mainly for the Japanese market.) So they went through the process of presenting a proposal to management, then refining, then presenting again. It took eight presentations over a period of 16 months, far more than is customary at Toyota, to get the Lexus design just right. Final design approval came in May 1987, two years after the process began.



Top and second photos: two LS 400 styling models show different front-end treatments considered. At left, the Lexus wind tunnel; above, an LS 400 in the tunnel during aerodynamic testing.

THE

NEXT

PHASE:

ENGINEERING

AND

TESTING

THE

LEXUS

As the styling was refined, Lexus proceeded with the immense F1 engineering effort. In addition to 60 designers and stylists, management assigned no fewer than 24 engineering teams to the F1 project: 1400 engineers, 2300 technicians and 220 support workers. Each of the engineering teams was instructed first to identify the best achievements of the world's carmakers in its area of expertise, then develop even better concepts and hardware.

It is a testament to the speed and efficiency with which this massive force worked that a running prototype was completed by July 1985. This would be the first of 450 test cars built—and that doesn't count the many components and systems that were also built and tested.

Take the engine, the core of any automobile. Suzuki's engine experts set rigorous standards for what it would have to withstand at the hands of owners. Well before that first running F1 car prototype was ready, prototypes of its powerful V8 engine were working hard in the dynamometer chambers at the company's headquarters in Toyota City, near Nagoya.

To test an engine without the car, engineers connect it to a dynamometer, which provides resistance like the actual loads of driving a car. One test simulated the tortures of flat-out *Autobahn* driving. The engine was run on the dynamometer several hours at the equivalent of the car's maximum speed or even faster.

Lexus engineers used such tests to ensure that the customer could put an LS 400 through almost unimaginable paces without problems. When a prototype engine did fail in any of these trials—and that's part of the process—the failure was analyzed and an improvement made to ensure it wouldn't happen again. Other components and systems of the Lexus, from transmission to suspension to door latches, were subjected to their own torture tests in the engineering laboratories and on Toyota's proving grounds at Toyota City, Higashifuji and Shibetsu...

ANTI-AGING: A CONCEPT FOR LONG LIFE

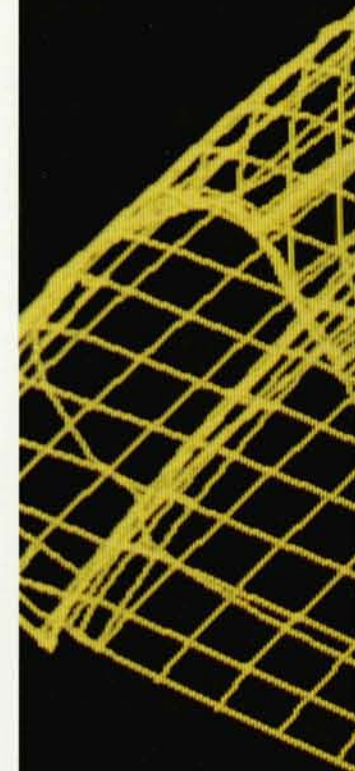
A fine automobile should deliver long-term ownership and driving pleasure. To ensure this, an "anti-aging" program was established. Its goal, among others, was to ensure that an LS 400 with 50,000 miles on its odometer would not look, feel, sound or perform perceptibly differently from a brand-new one. After intense study, Lexus engineers focused in on no fewer than 96 areas of the automobile that are critical to durability.

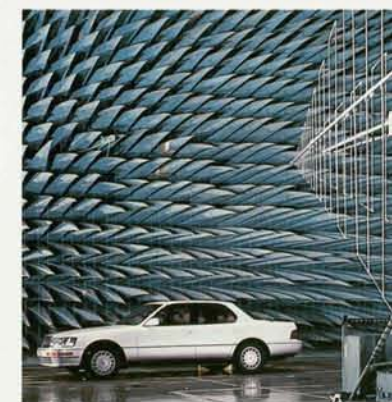
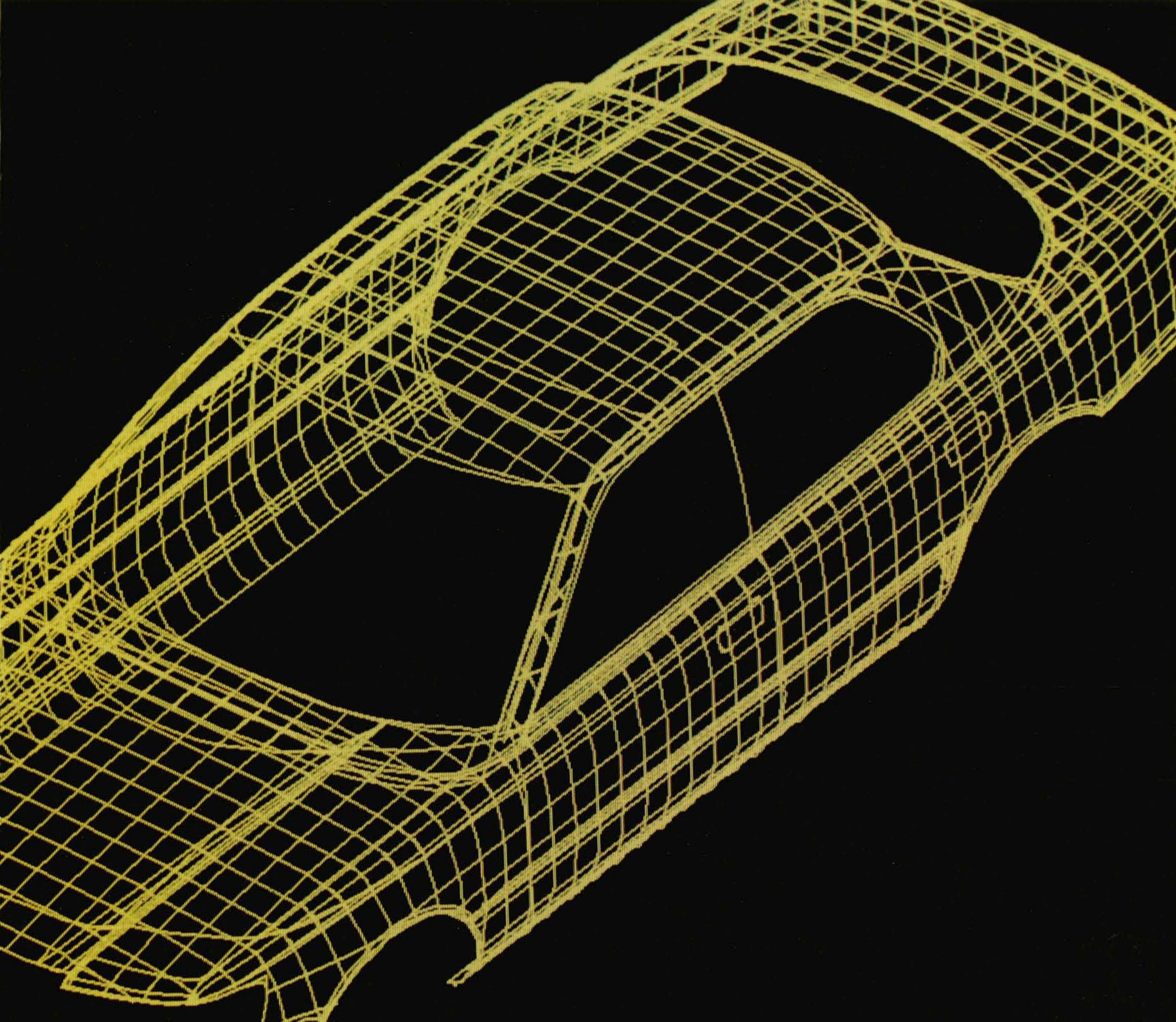
Over the next five and a half years, they studied the fading characteristics of paints, plastics, rubbers and fabrics; the wear, noise and vibration characteristics of mechanical components; corrosion; prevention of squeaks and rattles. They put the world's finest, most durable automobiles through high-mileage torture tests, disassembled them, analyzed their wear and corrosion—and worked to make the Lexus as good or better. Some prototypes were even fitted with special low-noise tires and driven unmercifully over the worst imaginable roads so that the Lexus test drivers could detect any squeak or rattle.



"Our philosophy in developing the Lexus flagship was to make its performance superior to that of other world-class luxury sedans. To realize this aim, we called upon all the Toyota resources that have been developed over the past 50 years. Lexus is the fruit of our labors and represents an enormous amount of development funds, investment in new equipment, and commitment of manpower."

Fumio Agetsuma
Senior Managing Director





The LS 400 was tested for every eventuality. Top to bottom: the electromagnetic interference chamber, where the effects of random electromagnetic disturbances in the air on the electronic systems were simulated...handling, water-splash and ABS tests on the proving ground.





"When I drove an advanced prototype of the LS 400 in early 1988, it was clear to me that the development teams had done their work well. For comparison, I drove its principal competitors as well as luxury cars costing much more. The LS 400 outperforms them all."

Dr. Shoichiro Toyoda
President

AROUND THE WORLD: LEXUS INCOGNITO

As intense as lab and proving-ground tests are, there's no substitute for the real thing—for testing on the roads where, some day, your customers will drive production cars.

At first this was done with "mules": FIs disguised in Toyota Cressida bodies. Later on, the first "full" prototypes were built with something approaching the final shape; when the test engineers went out on public roads, hand-formed panels were welded on to disguise them.

TO GERMANY FOR SOME AUTOBAHN FLYING

Suzuki's team took a "mule" to Europe in May 1986 to test it under the high-speed driving conditions there. Suzuki was adamant from the beginning that the LS 400 be able to do anything the European competition could—including running at top speed on the *Autobahn* all day.

On the next Lexus foray to the U.S., in September 1986, Americans would evaluate the seats as well as the ride comfort, handling and stability; Lexus engineers would evaluate them on American roads. Ten months later, with the suspension already improved on the basis of input from the previous trip, the Lexus team was back in Germany, Belgium (with Suzuki himself at the wheel) and the U.S. to fine-tune the standard suspension and optional air suspension. And so it went, month after month.



Top-speed *Autobahn* driving was part of the LS 400 test program.



...AND AMERICA FOR STEREO LISTENING

In summer 1987, Lexus audio engineers fitted three Toyota Cressidas with simulated LS 400 interiors and concept audio systems. The cars were then shipped to California for sound-quality evaluations by a panel representing a broad range of tastes, interests and incomes.

The purpose was to develop the system's sound for American listening tastes. Competitive models with high-performance systems were brought in for comparison: BMW 535i with its standard Alpine system, Corvette with Bose, Lincoln Continental with JBL. Lexus's objective was a standard system that would outperform other *premium* systems.

After the basic design of the LS 400 audio system was completed, the system was subjected to three additional evaluations in California. A respected American audio consultant and published critic was called in to assist in fine-tuning the system's sound and confirm that the very aggressive performance objectives had been met.

Lexus also wanted to offer an optional audio system that would establish new standards of audio performance for automobile manufacturers. In late 1988 a prototype with an experimental Nakamichi system was shipped to America for evaluation; the same panel and consultant judged the Nakamichi system spectacularly good, and it was approved as a premium option.

...AND SWEDEN FOR SNOW AND ICE

Winter 1987-88 saw the Lexus team in Sweden to perfect the FI's new Traction Control System and antilock braking system. Here they would drive the Lexus and competitive models with similar systems, their purpose being to make these important LS 400 features the best of their kind. In January another team was in Canada to run cold-weather operational tests and then, with teams from the tire companies, to test the Lexus tires on snow and ice.

By mid-1988, members of the engineering teams were shuttling constantly between Japan and America, putting on the final touches to make sure the LS 400 fulfilled its promise. Lexus teams worked separately and with the permanent staffs of Toyota's Technical Centers in Los Angeles and Ann Arbor, Michigan, systematically refining things like how the automatic transmission shifts and how the steering feels. All this

culminated in cross-country drives—now in prototypes undisguised except for taped-over nameplates and emblems—to confirm the correctness of these latest engineering changes.

Suzuki recalls driving from Los Angeles to St. Louis in July 1988: "Because of its unique styling," he recounts, "the LS 400 attracted a lot of attention. Occasionally we'd be chased by curious drivers. Of course it could have been a problem if the car had been photographed, which apparently it was not. But I think we'd have been more worried if nobody had noticed it!"

In August 1988, famous race-car driver and Lexus dealer Roger Penske journeyed to Shibetsu to evaluate the LS 400. Along with Suzuki, the many development specialists, and potential customers who attended market clinics in late 1988, Penske provided valuable input for final fine-tuning of the LS 400 before production began.

By the time the first LS 400 was driven off the Lexus assembly line at Tahara, Japan, the 450 prototypes had been tested, improved, retested—in all, over a million miles had been racked up in perfecting the LS 400.

LISTENING TO THE CUSTOMERS

Nine months before production startup, the LS 400 was shown to prospective customers in Los Angeles and Westchester County, New York. Present owners of luxury cars were invited to these "clinics" to view the LS 400 (as yet without emblems) along with competitive models from BMW, Mercedes and Lincoln; here owners filled out detailed questionnaires about the cars' features and prices. In "focus groups," smaller gatherings of luxury-car owners got an opportunity to discuss their attitudes about luxury cars in general and these cars in particular.

Because they are the ones most likely to buy an LS 400, these people's opinions were of crucial importance to the Lexus marketing team. Their input was fed into final decisions about marketing, pricing, even details of styling and equipment.



On the road: a Lexus test team with the LS 400 and competitive cars in the U.S., July 1988.





The test team pauses to compare notes and discuss plans for the next segment of its test program.



Testing alternatives: a Lexus technician changes tires on the July 1988 cross-country drive.



Left and below: LS 400 prototypes in winter testing, November 1988. At right: a market clinic.





"At Toyota we already have very high quality standards. For Lexus, we established even higher standards."

Setsuro Sekiya
Senior Managing Director

BEFORE THE FIRST LS 400 ROLLED OUT...

As the development engineers and designers worked to perfect the LS 400's performance, handling and luxury, another team of engineers was planning its production. After all, the factory must produce what the stylists and engineers have labored to design—and produce it with quality. Early on, a joint task force called the FQ (F1 Quality) Committee was formed. Made up of members from technical-engineering, production-engineering and manufacturing departments, the FQ Committee would apply stringent technological standards at every step of the LS 400's development process.

At the core of the FQ Committee's work was management's commitment that "Lexus cars will be built with 'flagship' quality characteristics," explains T. Nishizawa, General Manager of the Tahara plant's administration department. This plant was built in 1979–80 with the most advanced automated production equipment and has been updated each time a new model was introduced.

In preparation for Lexus production, Tahara was again updated. A new high-precision body works was built for the LS 400: sophisticated new robot welding systems, new computerized inspection machines. A new foundry was built to cast the V8 engine's cylinder block and heads. Finally, an exclusive new assembly line was installed at Tahara for Lexus, and the test track there was expanded for testing LS 400s before shipment.

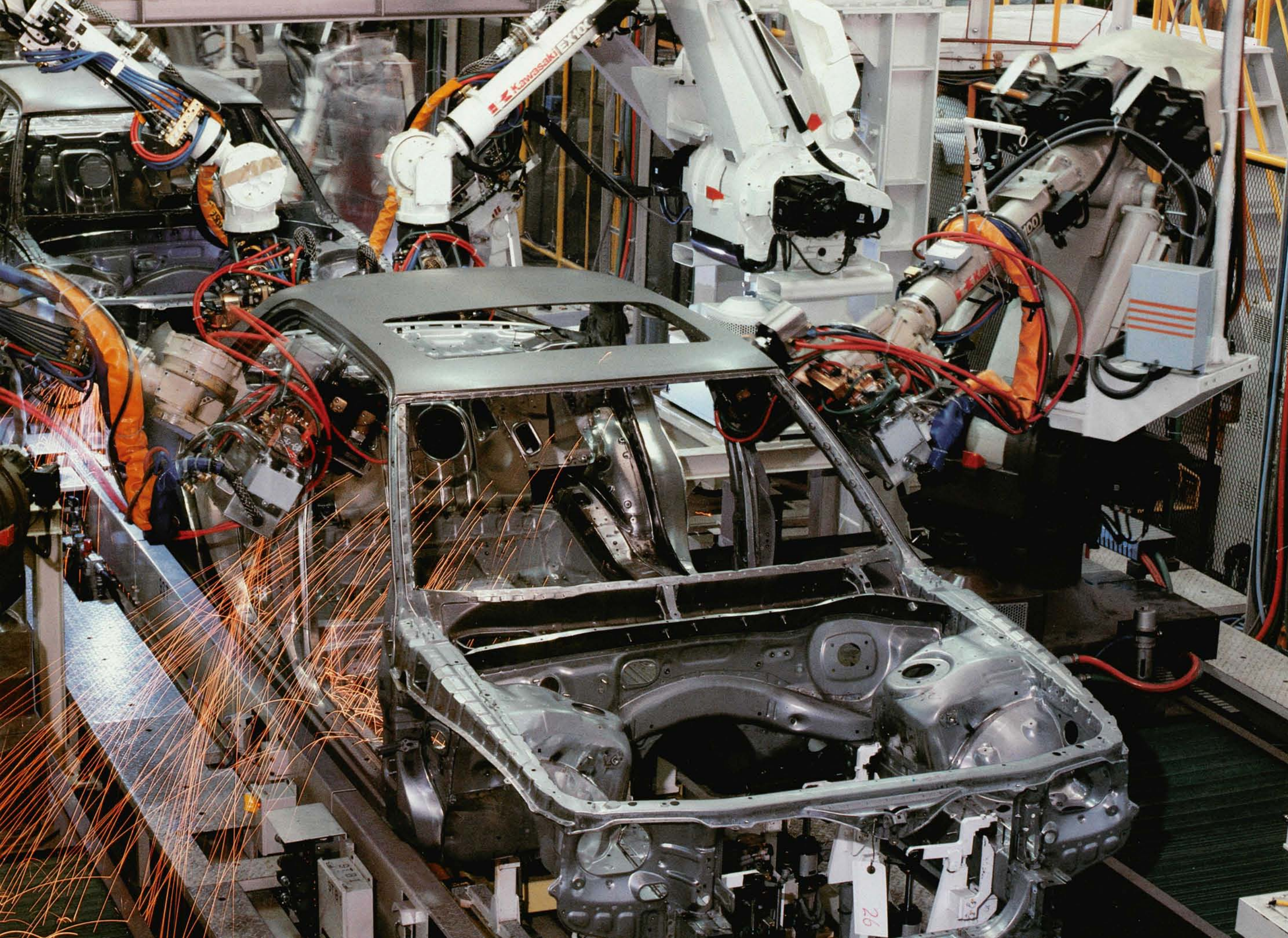
The massive plant investment included corresponding investments in new machinery, new testing devices and new worker skills. Again and again, Lexus production engineers were called upon to design not only equipment for precision manufacture, but systems and devices to test and ensure that the precision is maintained.

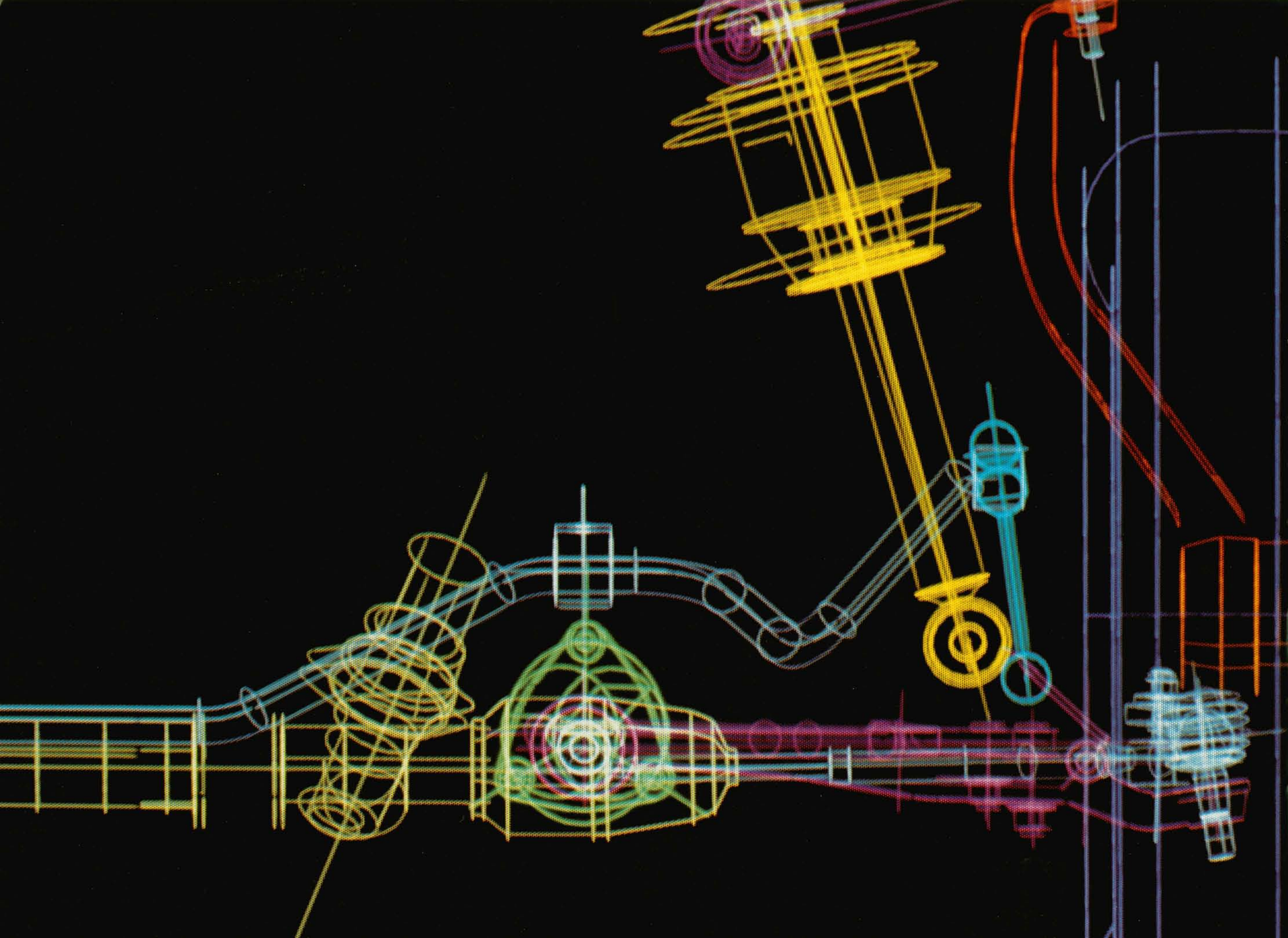
When the first LS 400 was driven off the Lexus assembly line and out onto the Tahara test track, key members of the F1 development and production engineering team were on hand to celebrate—and to experience the sense of accomplishment that goes with a job well done. On a highly personal level, they knew the immense effort behind the occasion—beginning in August 1983, culminating in May 1989, and launching a fascinating new era in the history of the automobile: the era of Lexus.



Lexus craftsmen and precision machines at work. Top to bottom: hand-forming a prototype metal panel, cylinder-head assembly, marking a section of wood trim for the interior. Right: robot welding of body.







LEXUS LS 400: MASTERFUL BLEND OF ESTHETICS AND TECHNOLOGY

Chief Engineer Ichiro Suzuki knew that in all its technical and functional aspects, the LS 400 must be equal to, or better than, the best that the world's finest luxury automobiles had to offer.

And when Chief Exterior Designer Kunihiro Uchida's team of designers and stylists returned to Japan in August 1985 from their three-month "learning expedition" to America, they were quite clear that the new Lexus body must be designed as a masterful blend of technological advancement with traditional esthetic values.

It was these two overall goals that influenced the LS 400's esthetics and technology as the Lexus design and engineering teams progressed through the amazingly complex, painstakingly detailed, years-long process of turning an ambitious concept into a fine luxury automobile. The process would lead them to new solutions, new technologies, new automotive milestones. Their inspired creation is documented in the pages that follow.







RECONCILING

GOALS

OF

BEAUTY

AND

FUNCTION

An automobile body shaped just for aerodynamics might look like a teardrop or a jellybean. But ask people which cars look luxurious, and chances are they'll pick the opposite: cars with upright, classic grilles and squarish body contours.

Lexus planners faced this paradox. For performance and roadability, they wanted the best possible aerodynamics. But they also wanted a look of prestige and luxury.

It took three years of painstaking design work to reconcile these goals. More than 50 times, they refined a contour, changed a small detail, and then took a prototype back to the wind tunnel to check its effect on aerodynamics.

Every automobile's shape has a "coefficient of aerodynamic drag," or C_D . The lower the C_D , the less the air resists the car's movement—this means lower fuel consumption and less wind noise.

Wind also tends to lift a car's body at high speeds. This reduces stability, so the body should also be shaped to minimize the wind's lifting effect. Another coefficient, C_L , quantifies lift; again, the lower the better.

As Lexus designers and aerodynamicists began their work, the most aerodynamic luxury cars had C_D s around 0.32-0.34. Those with more classic appearance ranged from 0.38 to over 0.40. The Lexus people wanted a C_D of less than 0.30, antilift characteristics to match fast sports cars, and no overt aerodynamic "devices" to detract from its luxurious character, such as a large rear spoiler.

All that work in the design studios and the wind tunnel paid off in a C_D of 0.29, at this writing the best for a U.S.-specification luxury sedan. The LS 400's C_L came in at 0.04 in front—also outstandingly low, equivalent to that of the Toyota Supra with spoilers.

Subtly wedge-shaped, both streamlined and elegant, the LS 400's overall shape fulfills the goals set for it. But many small details also contribute to the Lexus look.

DETAILS THAT COUNT

Though classically styled, the LS 400 grille has a gentle curvature that meets the wind smoothly. Headlights are flush; the gaps between headlights and foglights are tiny and the side-light units are actually spring-loaded for tightness!

This remarkable attention to detail resulted in both excellent aerodynamics and refined appearance.

The gaps between hood and fenders and trunklid and fenders are not merely narrow, but also intentionally uneven. Reason: as you look at the car from front or rear, a slightly tapered gap actually looks more precise than a parallel one! Subtle refinement like this requires great precision in production.

To help preserve the driver's view in wet weather, neatly recessed rain channels in the windshield posts and roof direct water away from side windows, yet don't obstruct wind flow. All glass is flush; so are the door handles. The rear window's slope is ideal, and the trunklid has a discreet, integrated "ducktail" spoiler.

If you look underneath, you'll find more remarkable details: "spats" ahead of the front wheels; a "bellypan" under the front end; smooth aerodynamic fairings on the exhaust system and even the rear suspension. Each of these details had to be worked out in precise tests in those 50 visits to the wind tunnel by skilled Lexus aerodynamicists.

THOUGHTFUL FUNCTIONAL TOUCHES

Lexus designers worked to make life with the LS 400 more pleasant. The lower body sides are clad in chip-resistant polyurethane; at the bottom is a rubber seal that covers the sill, keeping it free of moisture and mud that could soil occupants' legs or coats. For ease in loading or unloading heavy objects, the trunklid opens down to the rear bumper.

RIGIDITY: A CONCEPT FOR QUALITY AND SAFETY

A decisive factor in a car's quality is its body's rigidity. Whenever a wheel hits a bump, it tries to bend or twist the body. The more the body gives, the more likely squeaks will develop.

Too, when the car is cornering or maneuvering at speed, the body is under stress. If it flexes appreciably, the suspension cannot guide the wheels precisely; handling suffers.

And in an accident, the body shell naturally needs to be strong too. So the Lexus body engineers made the structure as rigid as possible without making it so heavy that the car became sluggish or a gas guzzler—by applying the most sophisticated computer-aided design techniques. Their success is measured in the LS 400's resistance to bending and twisting, which is far and away the best among luxury cars.



"In general, we wanted a high level of design, engineering, function and—admittedly an elusive quality—prestige. In a more specific sense, we wanted crisp, yet smooth powertrain performance along with high fuel efficiency. We also set as a goal rock-steady straight-line stability and precise handling combined with a comfortable, flat ride."

Ichiro Suzuki

Chief Engineer



"We believe we have achieved our goal of both a good C_D and elegant style. We designed the basic body shape very carefully, then concentrated on attention to detail in designing every component part as well."

Kunihiro Uchida

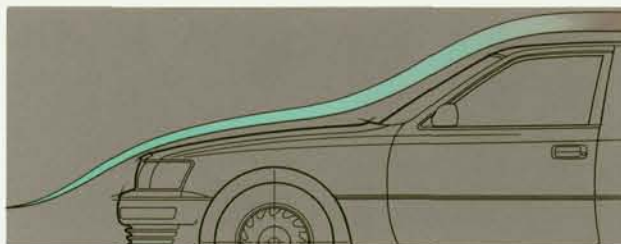
Chief Designer



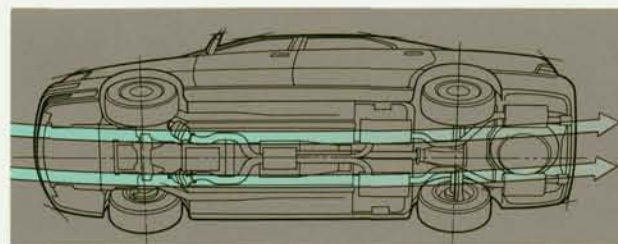
"We considered the body structure as a foundation for enhancing vehicle performance. Through computer analysis and repeated inspection of the actual car, we were able to achieve a light body with high rigidity for excellent performance in every respect. I feel confident we have produced a highly advanced body structure."

Kiyokazu Seo

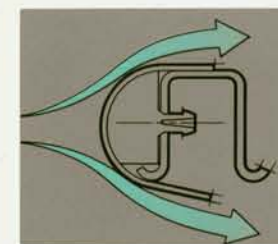
Assistant General Manager,
Body Engineering



The low, gracefully sculpted front end helps guide air smoothly over the LS 400's body.

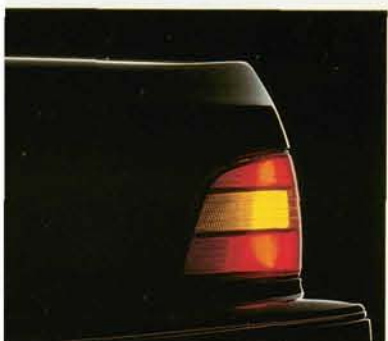


Even the body's underside is shaped for smooth airflow and minimum aerodynamic lift.



Unusual attention to detail: the lower rear suspension arms have aerodynamic fairings.







"Traditional hand-and-eye methods just aren't adequate for sophisticated new technologies like the LS 400's airbag and Traction Control System, so we developed new facilities to produce them and even special machines to test them. At every step, Lexus production embodies the most advanced and highly computerized production methods to achieve absolutely top quality."

Kaneyoshi Kusunoki

Executive Adviser to the Board,
Toyota Motor Corporation
Chairman of the Board,
Toyota Motor Sales, U.S.A., Inc.

PRECISION BODYWORK AND ASSEMBLY

In the old days, the finest cars were handmade. Today, for all but final assembly, the best work is done by automated precision machinery—robots. So Lexus designed and installed the very latest in automatic production and inspection machines in the new LS 400 plant at Tahara, Japan.

Because stamping generates heat and some manual labor is involved, Lexus body panels are made in an air-conditioned stamping plant. The process that welds these panels into a complete body shell is totally automated; each sub-assembly is held in a jig as it moves to the next welding station. For outstandingly smooth appearance, the body shell's main side panels are laser-welded.

When it is completely welded, the body shell goes to a separate line for its final dimensional inspection. Next, the outer body panels are polished to a glass-smooth surface for painting. Lexus engineers studied the world's best paint processes, then developed a better one. The Lexus paint specialists formulated three lustrous mica-pigment colors; three mica-metallics; and a new, exclusive MIO (Micaceous Iron Oxide) dark green that gives a unique depth and sheen as well as subtle change of color with changing light.

Tasteful color coordination was a top priority. The flexible impact-absorbing bumpers and chip-resistant lower body cladding are made in seven different colors, and even the tinted glass is color-coordinated to the body and interior colors.

Special anti-aging materials were developed for the exterior moldings. Front and rear side windows are framed in a finely crafted *single-piece* zinc molding and discreetly accented with a trim molding that's also a single piece for each door. Likewise, the rear-window trim molding is a single piece; it is made of a new, exceptionally corrosion-resistant type of stainless steel.



Paint layers for MIO color:

1. Cathodic Primer
2. Second Primer
3. Color Base Coat
4. MIO Base Coat
5. Lower Clear Coat
6. Upper Clear Coat

It's in final assembly that the human touch becomes most important. Every procedure ensures quality in the first place. Yet there are many inspections too—more than 300 of them beyond those performed on the Toyota Supra, for example. In addition to the actual inspectors, each assembly worker is also an inspector, able to stop the assembly line should the need arise.

Sophisticated electronics help these conscientious human beings ensure precision in such critical matters as aiming the headlights. An oscillating machine at the end of the assembly line, specifically built for testing the LS 400, bounces the car as it is "driven" (with all four wheels on rolling drums) to check for squeaks and rattles. Each LS 400 is then tested on rolling drums at high speed in a super-quiet test chamber to ensure that it meets Lexus standards of quietness.

After these inspections, each LS 400 gets a thorough visual and tactile going-over by inspectors with gimlet eyes and trained fingertips. But the Lexus isn't ready for shipping yet. During early production, every LS 400 will undergo a 10-mile "final exam" on a special test track. Here an expert Lexus test driver accelerates to high speed, listening one last time for wind noise; negotiates a tortuous cobblestone road for another squeak-and-rattle check; brakes and accelerates on a slick road to test the antilock braking and (if the car is so equipped) Traction Control systems.

The highest quality is integrated into every step of Lexus production and testing. When the LS 400 leaves the Tahara plant, it is ready for the most discriminating, demanding driver.

AN

ATMOSPHERE

OF

LUXURY

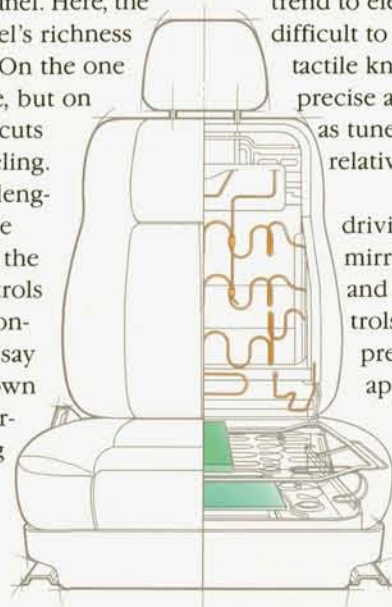
AND

FUNCTION

Styling per se, the Lexus designers will tell you, is not the primary mark of a luxury car's interior. "What we were aiming at was to create a luxurious atmosphere," says Tomohide Yamada, who headed the design of the LS 400 interior.

The most difficult single component of Yamada's design job, he says, was the instrument panel. Here, the stylists had to carefully balance the panel's richness as a form against the space it occupies: On the one hand, rich and full forms were desirable, but on the other, if the panel gets too bulky, it cuts into space and creates an oppressive feeling.

And feeding into this already challenging equation is the necessity to make the instrument panel *work*: Sightlines from the driver's eye to the instruments and controls must be unobstructed, reaches to the controls must be short and natural. In fact, say the Lexus designers, these factors—known as ergonomics—were every bit as important as spaces and contours in designing the LS 400 interior. Challenges like this could not have been resolved without the capabilities of the Human Factors Laboratory staff.



THE PRECISE SCIENCE OF ERGONOMICS

There was a time when an automobile's interior was a pretty simple thing. Seats, steering wheel, a few instruments; that was about it.

But times have changed. These days a car, especially a luxury car, can do so much. A state-of-the-art audio system, for instance, presents the driver with many choices: AM or FM stations; presets or manual tuning; seek or scan; a variety of cassette controls; separate bass, midrange and treble; balance and fader.

Or seat adjustments. Once upon a time we had seats that could be adjusted merely back and forth. No more. Lexus planners took advantage of state-of-the-art power systems to provide a wide variety of seat adjustments, adjustable seatbelt height, even power tilt or (optionally) tilt-and-telescopic steering-wheel adjustments.

All these choices could easily add up to information overload. That's where the capable designer's

talent comes in. The Lexus interior designers under Tomohide Yamada took care to locate controls within a short, natural reach for the driver, and to design those controls so that they can be operated without diverting too much attention from the road.

For the audio system, for example, they resisted a trend to electronic volume controls, which can be difficult to adjust. The on-off/volume control is a tactile knob that is familiar in operation and allows precise adjustment; frequently used buttons, such as tune/seek, tape and CD selectors, are relatively large.

Even controls that are seldom used while driving, like those for the power seats and mirrors, were designed for minimum effort and natural operation. The power seat controls' motions are such that the occupant presses on the appropriate part in the appropriate direction.

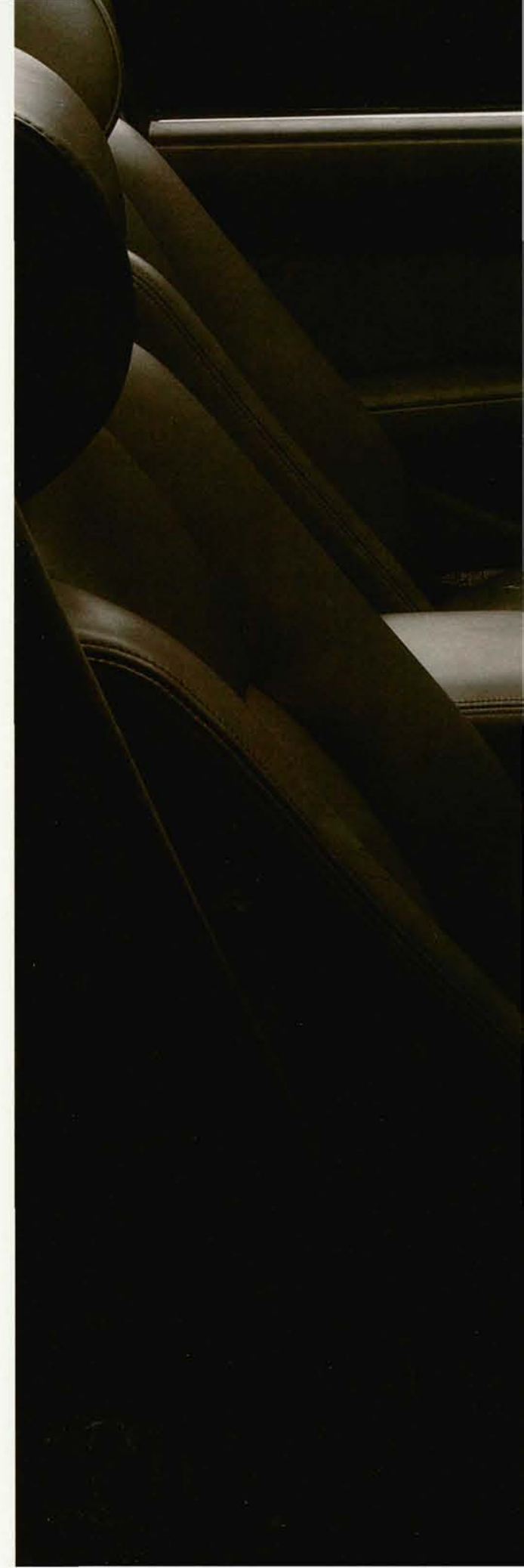
SEATS FOR REAL HUMAN BEINGS

Attention to ergonomics pervaded every facet of the LS 400's interior layout as Yamada and his team did their work. A top priority was accommodating the

stature of virtually every human being who might get into the LS 400. So it was that they provided a power driver's seat whose cushion and backrest angles are separately adjustable; whose lumbar support can be tailored and positioned at the touch of a button.

But even this was not enough. To accommodate short and tall people with equal comfort, they added adjustable front shoulder-belt anchors and the world's first tilt-and-telescopic steering wheel with an airbag supplemental restraint system. And an optional package includes a power tilt-and-telescopic wheel, power-adjustable front shoulder-belt anchors, and a memory system that captures all these adjustments as well as those of the power outside mirrors for two drivers.

All the power adjustments in the world, however, won't make a seat comfortable if it isn't built right in the first place. So Lexus seating experts turned their attention to factors like reducing vibration, and providing different degrees of firmness in the various zones of the seat cushion to support the body ideally.







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OBJECTS IN MIRROR ARE
CLOSER THAN THEY APPEAR

LEXUS
ALL INFORMATION ON THE ROAD

LOCK

OVER-
DRIVE

SPORT
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HIGH
HEIGHT
LOW
PWR
ECT
LOW





From top: instrumentation illuminates progressively when ignition is switched on. Next: Controls are designed for easy, natural operation. Bottom: the cellular telephone.



"We wanted to make the owner feel that high technology has been used, and give the instrumentation an elegant feeling as well. The instrumentation chosen incorporates much new technology, including the first fluorescent-tube pointers in the world."

Hiroshi Arai
General Manager,
Electric and Electronic Systems



"We endeavored to select materials with the utmost natural feel, then add the craftsman's skill to enhance that feel. For the wood, we looked at 24 different types before settling on the California walnut. For the leather, we spent two years deciding on the right tanning methods, grains, textures and feel."

Tomohide Yamada
Chief Designer, Interior

RICH INTERIOR MATERIALS

Selecting interior materials for a top-class luxury car is a major challenge. On the one hand, the materials must be luxurious and comfortable; on the other hand, they must be long-lasting.

Lexus planners wanted neither the hardness of some European leathers nor the overt plushness of those used in some American models. It took almost two years of research into tanning methods, grains, textures and stitching to come up with the right leather for Lexus; the American leather selected, says designer Michikazu Masu, is pleasant to the touch, visually appealing, and outstandingly durable.

Likewise for the fine wood on the Lexus' doors and console. Masu wanted to utilize both a natural material and the skilled craftsman's hand. He and his team carefully considered the grains, colors and character of 24 woods. Their choice was fine California walnut with a rich, glossy finish.

So went the design and engineering teams' efforts to create a tasteful, truly luxurious ambience, along with the kind of solidity and durability luxury-car owners demand and expect.

AUDIO SYSTEM: APPROPRIATELY ULTIMATE

Early on, Lexus planners decided to give the LS 400 a standard audio system to equal the best premium system offered by any automobile maker. Pioneer was selected as the supplier.

With input from a panel of audiophiles and an expert consultant, Lexus audio engineers fine-tuned the system to suit the most discriminating ears. In addition to the finest tuning and reception electronics, the system features seven high-quality speakers: two tweeters mounted high on the doors, four full-range speakers in door enclosures, and a large rear-mounted sub-woofer. The main amplifier drives all but the sub-woofer, which has its own high-power amplifier for a truly "moving" sound experience.

For the best possible reception, a remarkable antenna system was developed. A power antenna on the rear fender automatically adjusts to the best height for the FM station selected. The second antenna, in the rear window, monitors the FM signal at a second location; a "diversity tuner" continuously selects the stronger of the two signals.

For the absolute last word in sound, Lexus will be the first automobile manufacturer ever to offer a Nakamichi sound system. Until now, Nakamichi has been committed to making the finest in home audio and aftermarket car audio; it is a sign of respect for the LS 400 that Nakamichi joined the Lexus project.

All of Nakamichi's experience in audiophile home and car systems was focused on the LS 400 system. As an example of the no-compromise approach taken for this system, the fixed equalization level for the leather interior is different from that for the fabric—because leather and fabric interiors reflect or absorb sound differently. Power output is nearly doubled, and the speaker materials are strictly space-age. But as impressive as this system's features and specifications are, the "Nakamichi sound" actually transcends them.

A six-CD compact disc auto-changer is available.

CLIMATE CONTROL: MANUAL OR AUTOMATIC, AS YOU WISH

A powerful, quiet automatic climate-control system was also a major Lexus goal. Lexus engineers were not satisfied until they had created a system that can make a blistering hot interior livable in five minutes or a frigid cabin toasty in record time. Always seeking excellent ergonomics, they designed a straightforward, easy-to-use control panel whose touch controls allow either automatic or manual operation of the system and make it so natural and easy that it doesn't distract from driving.

A lot of thought went into the instruments too. The planners reasoned that Lexus drivers would prefer analog instruments to digital, but wanted to improve this more traditional form of instrumentation. Their solution was a new technology: pointers that are actually super-thin self-illuminating fluorescent tubes.

The instruments are behind smoked glass that looks black until the pointers and numerals light up super-white and crystal-clear. To allow large dials, a novel concept was developed for some of the warning lights. Normally invisible, they take up no space around the instruments. When lighted, they project onto the smoked glass—right over the instruments, to catch the driver's attention.



"Our biggest challenge was to attain the quality we wanted, in our own way. For instance, we didn't want Teutonic hardness, nor the super-plush feeling of an American luxury car. We were looking for what we thought was a better balance."

Tomohide Yamada
Chief Designer, Interior

QUALITY INSIDE THE LEXUS: NOT JUST A MATTER OF DESIGN

It's especially important in a luxury car that the textures and colors of adjoining or related components match or harmonize. To ensure this, just two—rather than the customary several—manufacturing procedures were used for major molded components such as dash, console, door trims, armrests and so forth. In places where a less luxurious car might use several molded pieces, the Lexus uses just one; the resulting lack of seams contributes to a feeling of luxury and quality.

Where there are seams or joints, the interior designers and engineers developed a "zero-gap design" to ensure that they're precise. For the glovebox door, where a gap is necessary, they developed a "forced alignment" fitting method that wedges the closed door accurately in its opening.

The color teams also established strict color standards, to which molded components coming in from the supplier are tested before being approved for installation. But this test only ensures that the components are color-matched when they're new—what about years down the road?

Lots of testing was required to be sure colors would still match after years of exposure to wide temperature variations, intense sunlight and oils from the human skin that touches them. Lexus components were exposed to "accelerated aging" processes, such as intense artificial sunlight around the clock for months. When there was unacceptable fading or color change, the material was re-formulated—again and again if necessary—so that the Lexus owner can be assured of beautiful appearance in the long term.

Another sure sign of quality is a quiet interior. Wherever possible, Lexus engineers eliminated noise and vibration at their sources—with the LS 400's uncannily balanced drivetrain, for example, or aerodynamics that reduce wind noise to a whisper. Then they added high-tech insulation.

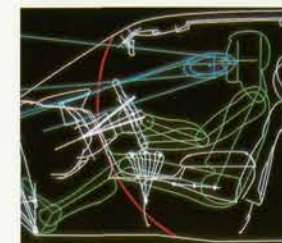
There are, for instance, unique new "sandwich" panels at the front and rear of the passenger compartment. Between two steel sheets, vibration-killing nylon damping resin and a metallic powder filler made it possible for the first time to weld such panels into place. They weigh little and resist noise effectively.

And what's another mark of a really fine car? The way its doors close, of course. It's one thing to have a door open, close and keep wind and weather out—certainly the Lexus doors, with their special quadruple seals of weather-resistant material, perform these basic functions.

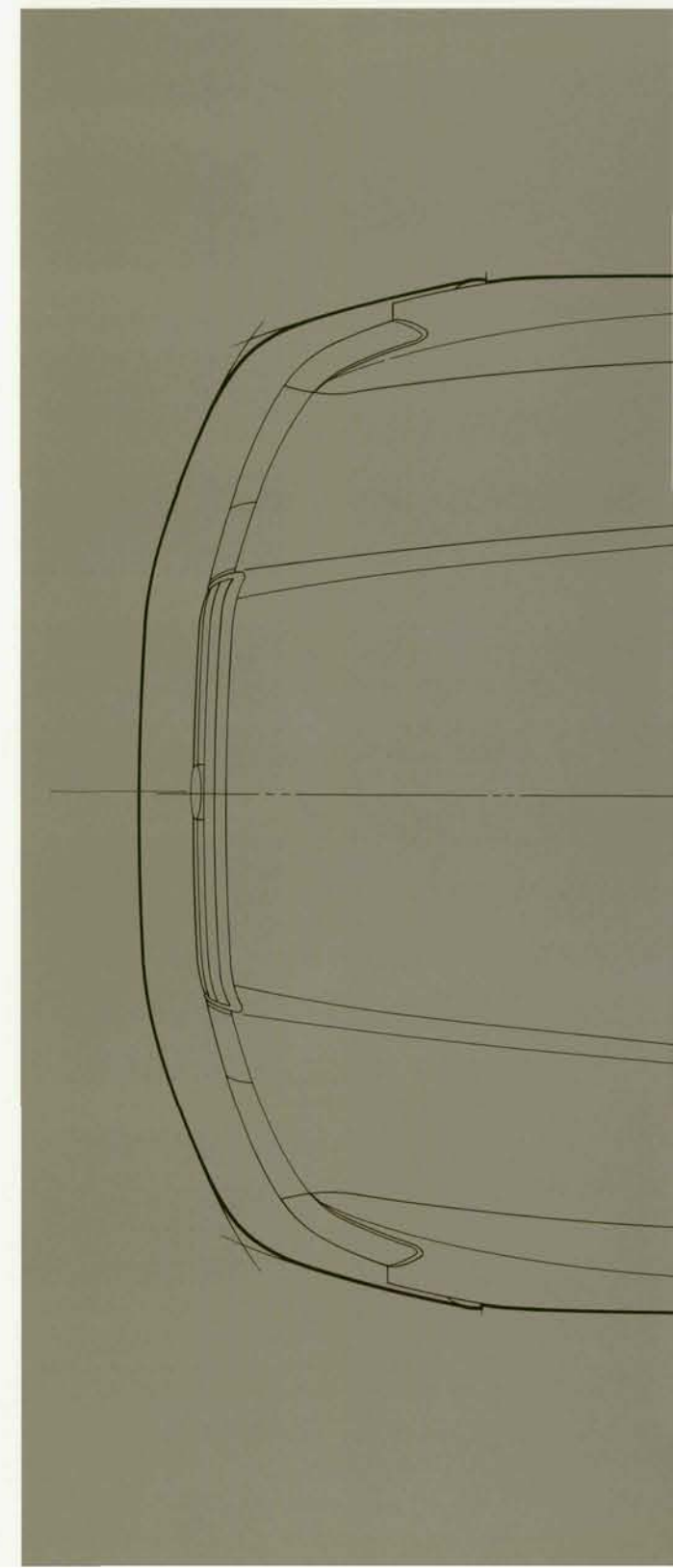
But Lexus engineers also took the trouble to make them sound right when you close them. They studied the sound patterns of doors clicking into their locks, studied how that sound could be improved, and then designed locks with strong silencers to achieve a solid, quiet "thunk."

The engineers' attention even to tiny details like the front ashtray was just as thorough. To open it, one first pushes gently inward; then it glides out. Same for the drink holder in the center armrest. There's remarkable attention to detail even in the fully carpeted trunk, where you'll find a fold-out base for easy access to the spare tire, a pop-out toolkit with penlight and hand towel, and a fully equipped first-aid kit.

Those Lexus people apparently understand what it is to enjoy a car.

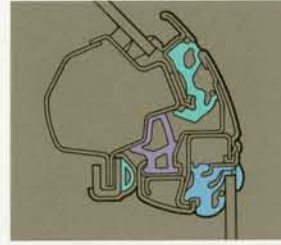


The LS 400's driver environment is designed for natural reaches and unobstructed sight lines.

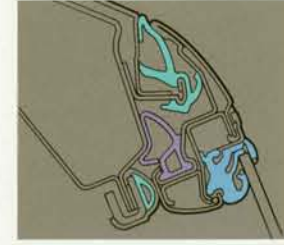




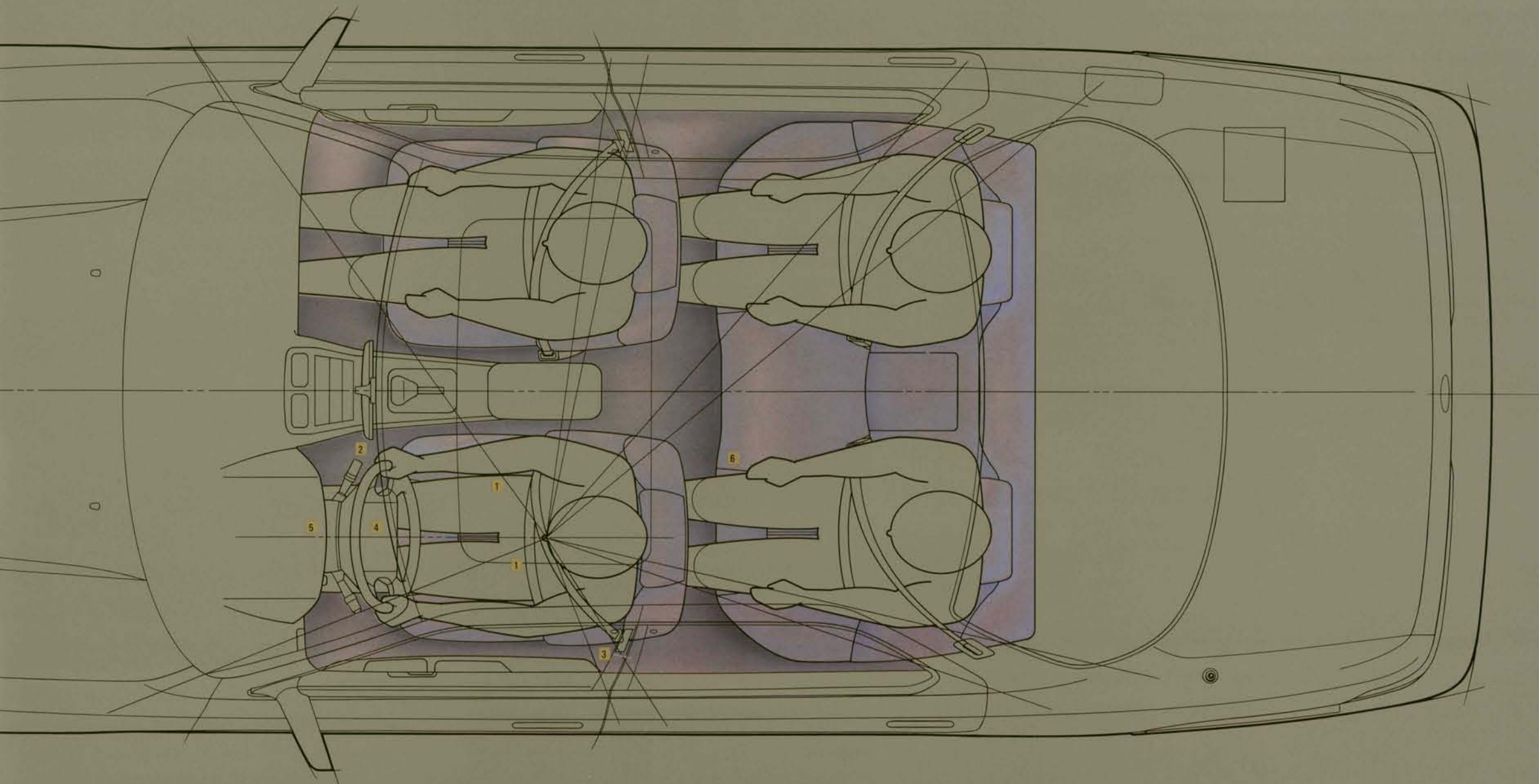
Leather-covered steering wheel has a large padded center area and affords a good grip.



Special quadruple door seals keep wind, weather and noise out: here at the windshield pillar...



...and where the door meets the roof. As these drawings show, their design is highly complex.



1. Driver sight lines
2. Easy-to-reach controls
3. Adjustable front shoulder-belt anchor
4. Tilt-and-telescopic steering wheel with airbag
5. New instrument lighting technology
6. Vibration-reducing, highly supportive seats

VELVETY

V8

PERFORMANCE

60 TO PLEASE

THE SENSES —

AND THE

INTELLECT

Twenty years ago, most luxury cars in America were American, and nearly every American luxury car had a V8 engine. Today, luxury cars come from America, Japan and Europe, and a V8 is more of a rarity; there are V6s, inline six-cylinders, V8s and the occasional V12.

For the LS 400, Lexus engineers decided that a V8 was the ideal power unit. Smooth, quiet and compact, the V8 has all the requisites for a luxury car. Fewer cylinders mean less smoothness; more than eight cylinders add complexity, but bring only a subtle gain in smoothness and don't necessarily add power.

What the Lexus team had in mind was not just a V8, but a highly advanced V8: an engine incorporating the best available technology, producing high performance without sacrificing fuel economy. They wanted velvety smoothness and hushed quiet. Low scheduled maintenance was a must.

The rest of the Lexus powertrain would complement this mighty engine: a new "intelligent" automatic transmission that continues its makers' tradition of innovation; a precision-balanced propeller shaft to preclude vibration even at very high speeds; a super-quiet differential. And, as an option, a new Traction Control System to harness the power and aid the driver on slippery roads.



"Toyota has led the way in many important areas of engineering. For example, Toyota has become a leader in engines with four valves per cylinder—a technology that contributes a lot to the LS 400's outstanding performance. So far, Toyota has made almost 1 million four-valve engines, a figure not approached by any other manufacturer."

Kiyoshi Matsumoto

Executive Advisor to the Board



"High performance means more than just high power. To us, it also means high efficiency, smooth and flexible running, and a general quality of operation appropriate to a top-class luxury car. Lightness and compactness count too: a light engine contributes to good handling, and compactness both preserves space inside the car and makes for easy servicing."

Yoshihiko Dohi

Assistant General Manager, Engine





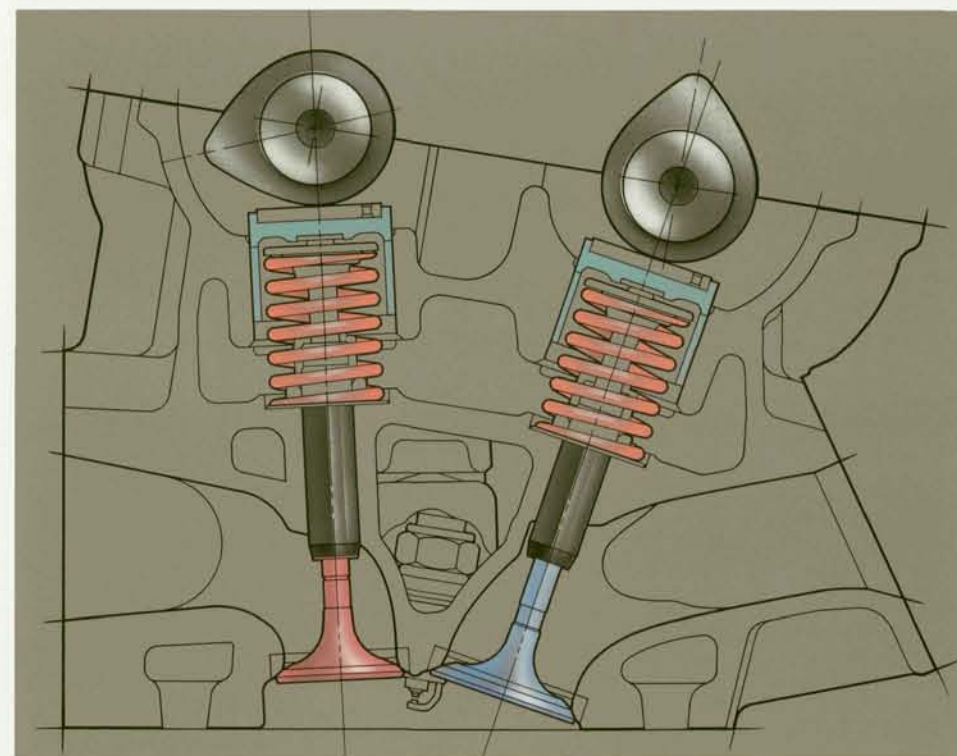
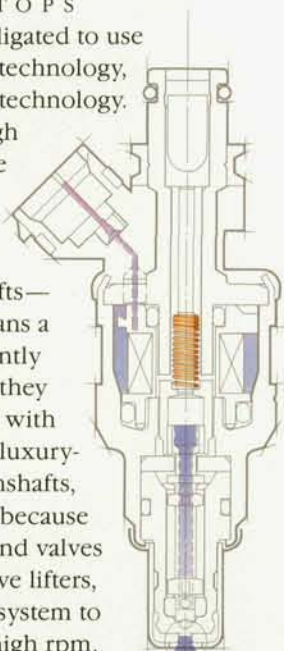
"400" MEANS 4 LITERS, FOUR VALVES PER CYLINDER AND FOUR CAMSHAFTS: PULLING OUT ALL THE STOPS

The Lexus engineers were not obligated to use off-the-shelf parts or inexpensive technology, so they chose only the best engine technology.

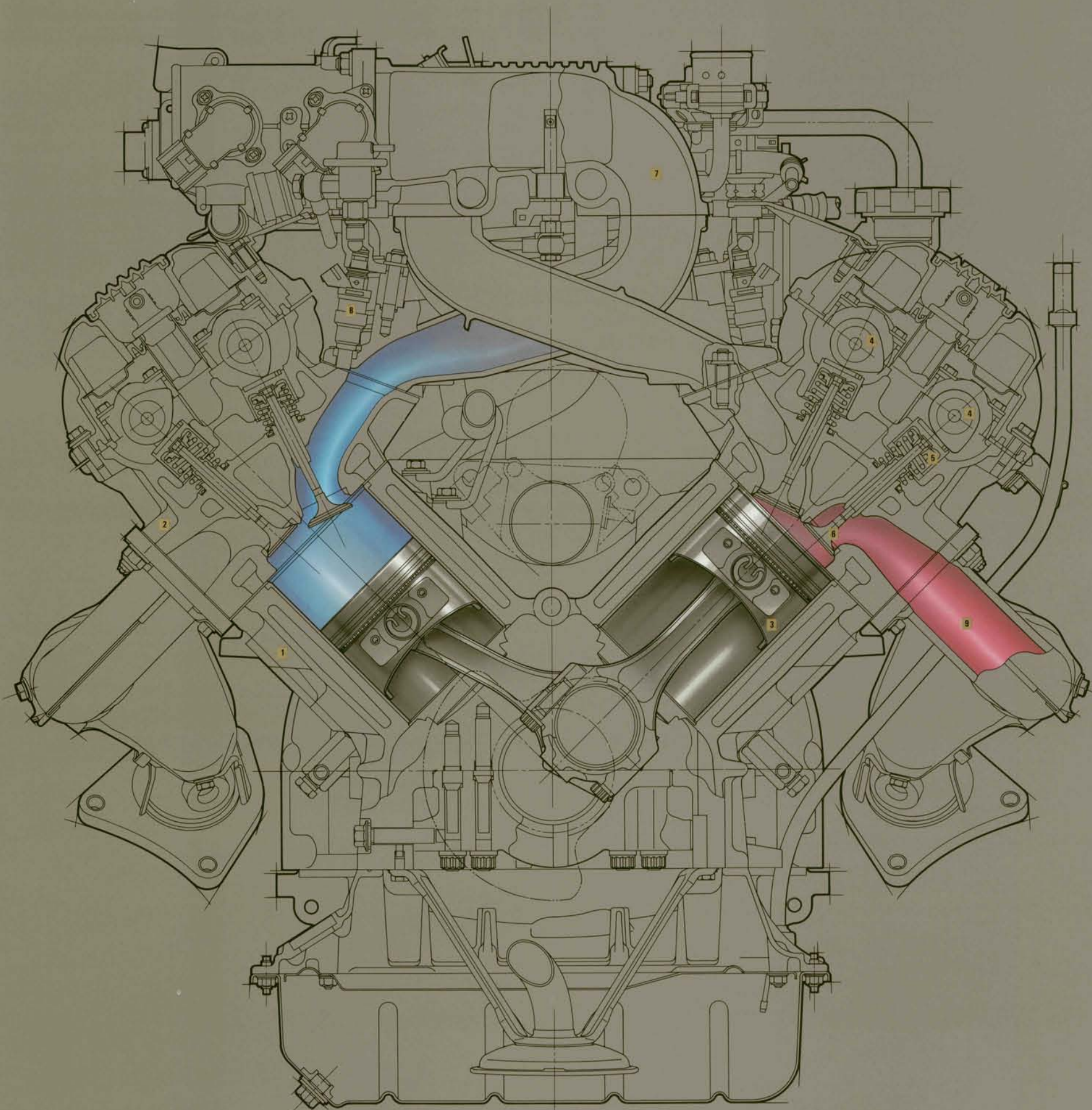
For free "breathing" and high power, they gave the Lexus engine modified pentroof combustion chambers with four valves per cylinder. The valves are actuated by compact dual overhead camshafts—very costly, because in a V8 it means a total of four camshafts, but eminently desirable. To drive the camshafts, they selected a toothed belt reinforced with Aramid fiber cord. (Most European luxury-car engines have chain-driven camshafts, but the Lexus engineers favor a belt because it is quieter.) Between camshafts and valves are the world's first aluminum valve lifters, which reduce inertia in the valve system to help the engine run smoothly at high rpm.

A tuned intake manifold "rams" air into the cylinders, improving performance at midrange speeds, and a dual exhaust system also aids breathing while creating a distinctive "Lexus sound" outside the car. Yet another no-compromise engine feature is the very high (10.0:1) compression ratio, which "squeezes" each charge of fuel and air for maximum power and efficiency.

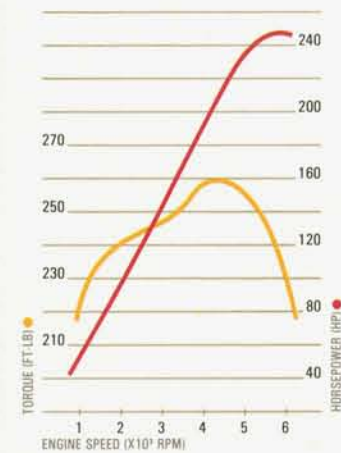
The engine's computerized fuel-injection and ignition control system incorporates knock control. Anytime there's even a hint of knocking (as when the gasoline octane isn't high enough), sensors in the engine block instruct the ignition system to retard itself. This way, the engine can run at optimum spark advance—and hence optimum efficiency—nearly all the time, but protect itself if inferior gasoline or unusual driving conditions call for it.



LS 400 engine's valves are actuated by two camshafts per cylinder bank. One camshaft per bank is driven by the toothed belt; the other is driven by scissors gears between the two camshafts. At left: one of the engine's eight fuel injectors.



1. Aluminum cylinder block
2. Aluminum cylinder heads
3. Aluminum pistons
4. Dual overhead camshafts
5. Aluminum valve lifters
6. Four valves per cylinder
7. Tuned intake manifold
8. Fuel injector
9. Dual exhaust system



LS 400's 4.0-liter V8 engine is engineered to the highest technological standards throughout and produces abundant power.



WEIGHT- SAVING ALUMINUM USED EXTENSIVELY

On top of this, most of the engine—block, cylinder heads, cam covers, intake manifold, pistons, valve lifters, oil pan, oil pump, water pump—is aluminum. Weight is thus reduced “up front,” contributing to balanced handling, improving performance and reducing fuel consumption.

Over the six-year LS 400 development period, more than 900 prototype engines logged countless hours of testing. When it was all done, Lexus engineers had created an engine that delivers 250 horsepower and 260 pounds-feet of torque.

Other performance “numbers,” like its acceleration from zero to 60 mph (7.9 seconds) or through the standing-start quarter-mile (15.9 seconds), are equally impressive. Compared to other luxury cars in the LS 400’s field, these are highly competitive figures and indicative of a responsive, strong performer.

Remarkably—and unlike many powerful luxury cars—the LS 400 accomplishes all this without incurring a federal “gas-guzzler” tax. Lexus engineers, and not just those who designed the engine, are understandably proud. The engine’s high compression ratio, precise fuel injection and knock control, dual exhaust system and low-friction design throughout all contribute. So do the transmission engineers’ innovations; the body engineers’ efforts to reduce weight and aerodynamic drag; and the work of all those who refined the LS 400’s performance.

GENERAL

Curb weight, lb.	3759
Wheelbase, in.	110.8
Track, front/rear	61.6/61.6
Length x width x height	196.7 x 71.7 x 55.3 (air suspension: height 55.1 in.)
Fuel capacity, U.S. gal.	22.5

ENGINE

Type	Four-Cam 32-valve V8
Bore x stroke, in./mm	3.44 x 3.25/87.5 x 82.5
Displacement, cc/cu in.	3969/242
Horsepower @ rpm, SAE net	250 @ 5600
Torque @ rpm, lb.-ft.	260 @ 4400
Compression ratio	10.0:1
Fuel injection	electronic multi-point
Ignition	breakerless electronic
Engine-management system	computer control of fuel injection and ignition
Fuel requirement	premium unleaded
Emission control	two 3-way catalytic converters (California: three), four oxygen sensors

DRIVETRAIN

Automatic transmission	electronically controlled 4-speed overdrive with super-flow torque converter, dual shift programs
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Ratios:

1st	2.531:1
2nd	1.531:1
3rd	1.000:1
4th	0.705:1
Reverse	1.880:1
Final drive ratio	3.615:1

CHASSIS

Front suspension (standard)	double wishbones, coil springs, gas-pressure telescopic shock absorbers, anti-roll bar
Rear suspension (standard)	double wishbones, coil springs, gas-pressure telescopic shock absorbers, anti-roll bar
Air suspension (optional)	substitutes computer-controlled variable- rate air springs and variable-damping shock absorbers with Normal and Sport modes; self-leveling
Steering	rack & pinion, speed-sensitive variable power assist
Overall ratio	18.1:1
Turns, lock to lock	3.3
Turning radius, ft.	19.6 (curb to curb)
Wheels	cast alloy, 15 x 6½JJ
Tires	steel-belted radial, 205/65R15, V-rated
Brake system	10.8-in. ventilated discs front, 11.4-in. ventilated discs rear; vacuum assist, dual hydraulic circuits, 4-sensor antilock braking system

BODY & ACCOMMODATION

Construction	unitized all-steel structure
Shoulder room, front/rear, in.	57.1/56.3
Head room, front/rear	38.6/36.8
Leg room, front/rear	43.8/34.3
Usable trunk space, cu. ft.	14.2

PERFORMANCE DATA

Acceleration, 0–60 mph, sec.	7.9*
Maximum speed, mph	150*
Fuel economy, EPA mpg, city/highway	18/23**

* Estimated performance figures based on manufacturer's prototype test; for comparison only.

** Preliminary mileage figures determined by Lexus. 1990 EPA mileage estimates not available at time of printing. See your Lexus dealer for details.



"We wanted this engine's high technology and performance, as well as the Lexus quality image, to be evident to anyone who opens the LS 400's hood. At the same time, we wanted to make it easier to do the little routine maintenance things."

Kazuhito Iwatsuki

Chief Designer,
Engine Compartment

HIGH PERFORMANCE WITHOUT HIGH MAINTENANCE

At every stage of development, Yoshihiko Dohi and his team of engine engineers strove to combine high performance with low scheduled maintenance. For the long-life timing belt, they installed an automatic tensioner that never needs adjusting. The valve lifters shouldn't need adjusting for 60,000 miles. Platinum-tipped spark plugs are designed to last 60,000 miles, double the usual life; the ignition and electronic fuel injection are maintenance-free.

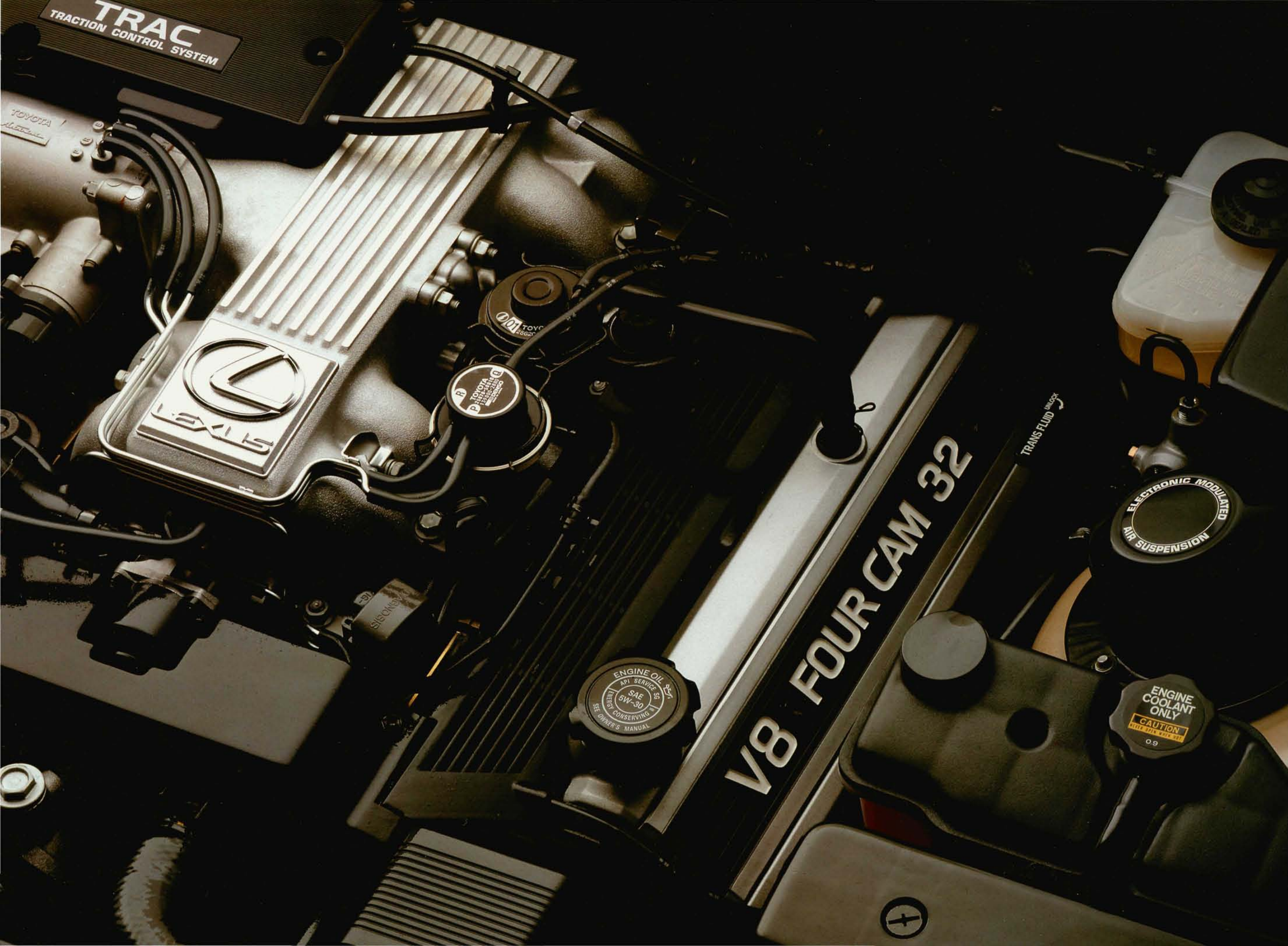
UNDER THE HOOD, A SIGHT TO BEHOLD

An engine doesn't *have* to be beautiful to perform beautifully. But Lexus engineers and designers wanted their V8 and its surroundings to be a source of pride and pleasure for the owner.

This is why a Chief Designer was appointed to take charge of the engine compartment: Kazuhito Iwatsuki. "We wanted to reveal this engine's technology, performance and quality to anyone who opens the LS 400's hood," explains Iwatsuki. "At the same time, we wanted the little routine maintenance things to be easy."

Iwatsuki and his assistant Toshiaki Mizutani laid out the engine compartment entirely in black and silver. Molded plastic components surrounding the engine lend neatness and order; cast aluminum cam covers, intake pipes and air collector are visually appealing. The clearly labeled "do it yourself" items—dipsticks, oil caps and reservoirs—add a user-friendly note to the ensemble.





TRAC
TRACTION CONTROL SYSTEM

TOYOTA
Motors

V8

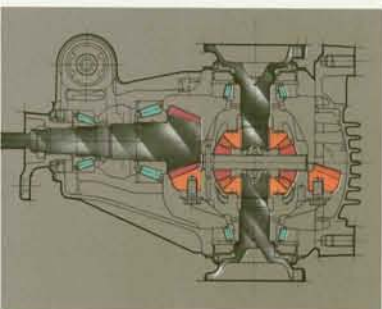
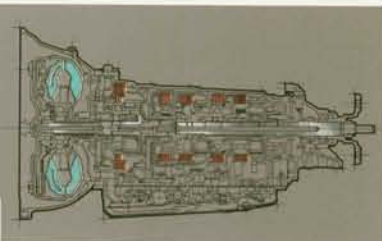
V8 FOUR CAM 32

ENGINE OIL 5W-30
SAE 5W-30
SEE OWNER'S MANUAL

ENGINE COOLANT ONLY
CAUTION
DO NOT MIX WITH OTHER FLUIDS

ELECTRONIC MODULATED
AIR SUSPENSION

TRANS FLUID



"Intelligent" automatic transmission, top, enhances V8 engine's performance and efficiency. For quietness, the differential (bottom) is inspected by a sophisticated new process.





"Our objective was to develop the world's most sophisticated drivetrain: silky-smooth, quiet, precise, quick-responding and efficient. All members of our project team enjoyed pursuing the dream of every drivetrain engineer; we are proud to have achieved a drivetrain so smooth and quiet that the customer is barely aware of it."

Yasuro Suzuki
General Manager,
Drivetrain Engineering

THE "INTELLIGENT" AUTOMATIC TRANSMISSION

The people who developed the LS 400's automatic transmission have an impressive record of innovation. In 1977 they introduced the first overdrive four-speed automatic; in 1980 they created the first four-speed automatic with a fuel-saving torque-converter lockup clutch. A year later they were first with an electronically controlled automatic. Today most luxury cars have these features.

Not content to rest on those laurels, the Lexus transmission group, headed by Yasuro Suzuki, developed an even better concept.

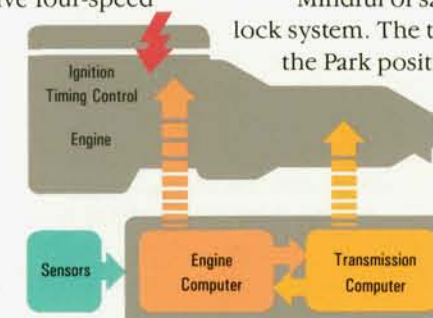
Their concept is the "intelligent" automatic transmission with four speeds, overdrive fourth gear, lockup clutch and a highly refined electronic control system. Its computer interacts with the engine computer, "instructing" the latter to retard ignition timing for a split second during shifts. This reduces engine torque, enabling the transmission to shift more smoothly.

The clutches that do the gearshifting in the transmission are also electronically controlled. The hydraulic pressure that applies these clutches is controlled according to the rate of acceleration so as to provide the smoothest gearshifts.

In addition, there's "feedback control," which continuously monitors the electronic clutch control and compensates when necessary. And finally, the engineers developed a new, longer-lasting mineral-oil-based automatic-transmission fluid which keeps shifts smoother in the long run.

The engineers also developed a high-performance, high-efficiency super-flow torque converter, which allowed them to achieve brilliant performance while improving fuel economy.

Mindful of safety, Lexus engineers included a shift lock system. The transmission cannot be shifted out of the Park position unless the ignition switch is on and the brake pedal applied.



PRECISION PROPELLER SHAFT, DIFFERENTIAL AND HALFSHAFTS

Because vibration and noise are anathema to a true luxury car,

the Lexus powertrain engineers took amazingly detailed steps to quell both—even at the high speeds the LS 400 can attain.

For instance, they arranged the two-section propeller shaft in a straight line and then put a high-precision universal joint in its center and flexible couplings at each end to ensure that the tiniest deviation from this theoretical straight line is compensated for. On top of that, they specified such precise manufacture of the shaft that it's one of the best-balanced in the world.

They endeavored to make a differential with less noise and vibration than any other. Precisely manufactured constant-velocity joints for the rear axles. In short, everything in the powertrain that might generate a noise or vibration a sensitive driver or passenger would notice—everything was designed, redesigned and fine-tuned until it was as good as human beings could make it.



With the Traction Control system, control of the car under slippery road conditions is greatly improved (path at right).

NEW DRIVING AID: TRACTION CONTROL

A car of the LS 400's caliber, so reasoned Lexus planners, wouldn't be complete if it didn't offer an innovation called Traction Control System.

Traction Control actually senses when the drive wheels are beginning to slip on slick surfaces, and limits that slip by automatically adjusting the throttle and applying the brakes. Say the driver is stopped at a traffic light on an icy morning. The light changes to green; the driver steps on the gas.

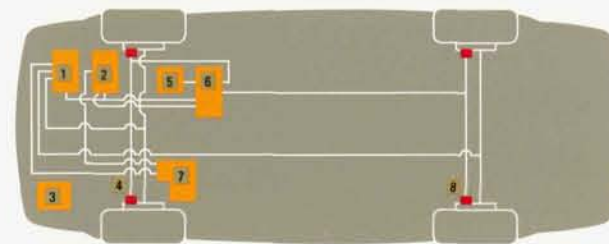
Normally, the driver would have to go easy on the accelerator to avoid wheelspin. With Traction Control, the same sensors in the wheels that tell the anti-lock braking system when to "pump" the brakes for best stopping now signal this system to do two things: apply the brakes and reduce engine power.

But why *two* actions to limit wheelspin? Applying the brakes brings spin under control very quickly; the slower action of reducing engine power stops the wheelspin at its source. This accomplished, the brakes are released—it wouldn't do to keep applying them while the engine is driving.

In gasoline engines, power is increased or decreased via a throttle—a circular plate in the engine's air intake, connected to the accelerator pedal. When the pedal is pressed by the driver, it opens; when released, it closes.

The Lexus Traction Control System adds a second throttle, electronically controlled by the system's computer. Upon the appropriate signal from the computer (set off by the signal from a spinning wheel), this throttle begins to close. So even if the driver keeps pushing on the accelerator, the engine is "throttled down" to produce less power.

To perfect the system, Lexus test drivers and engineers spent many months on Japan's northern island Hokkaido and in Sweden, Canada and Alaska. Lexus owners who encounter slippery winter driving conditions will find Traction Control a dramatic enhancement of the driving experience. You can push as hard as you like on the accelerator, even to the floor. But the engine produces only the amount of power that can be transmitted to the road with virtually no wheelspin—even if that road is gravel, or snow, or ice.



Traction Control System utilizes the antilock braking system's wheel-speed sensors and adds elements to regulate the throttle and apply the brakes.

- | | | |
|------------------------|------------------------|----------------------------|
| 1. ABS Actuator | 4. Front Speed Sensor | 7. TRAC Pump & Accumulator |
| 2. TRAC Brake Actuator | 5. Throttle Actuator | 8. Rear Speed Sensor |
| 3. Power Source | 6. TRAC & ABS Computer | |





"Two of Toyota's greatest engineering strengths are engines with four valves per cylinder and the ability to produce engines to high standards of precision. The Lexus V8 employs both of these strengths to the greatest degree of any engine we have ever built."

Shiro Sasaki

Executive Vice President

PRECISION IN PERFORMANCE

Raw power may be all right in a sports car, but in a high-performance luxury car the horses need tight reins and soft horseshoes. This was the Lexus powertrain engineers' challenge: to deliver the authority of 250 horsepower with a gentle step.

Choosing a V8 engine, which is inherently well balanced, was a major first step. On top of this, the engineers reduced internal unbalanced masses (a normal thing in any engine) by one-third to one-half below usual standards; reduced tolerances in clearances between internal parts by over one-third; and reduced tolerances in the weights of moving parts by up to a half.

For the precision propeller shaft, new steps were added to the balancing process. Instead of straightforward testing and correction of imbalance, the production engineers devised separate, more effective testing and correction of *primary* and *secondary* imbalance.

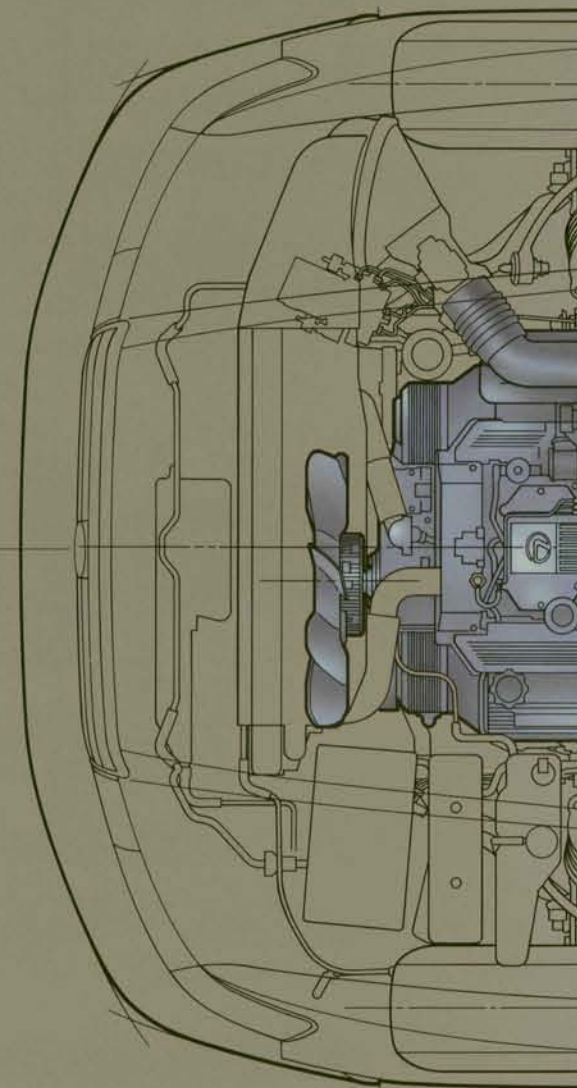
And for as seemingly minor a component as the differential, the Lexus team went to remarkable lengths to subdue what are normally very subtle disturbances. First, to reduce vibration in the gearset, they improved the tooth contact ratio by increasing the number of gear teeth. Then they reduced "backlash"—the slight slack between any two gears meshing with each other—by one-quarter to one-third. Allowable dimensional tolerances in the parts themselves were also cut by a third.

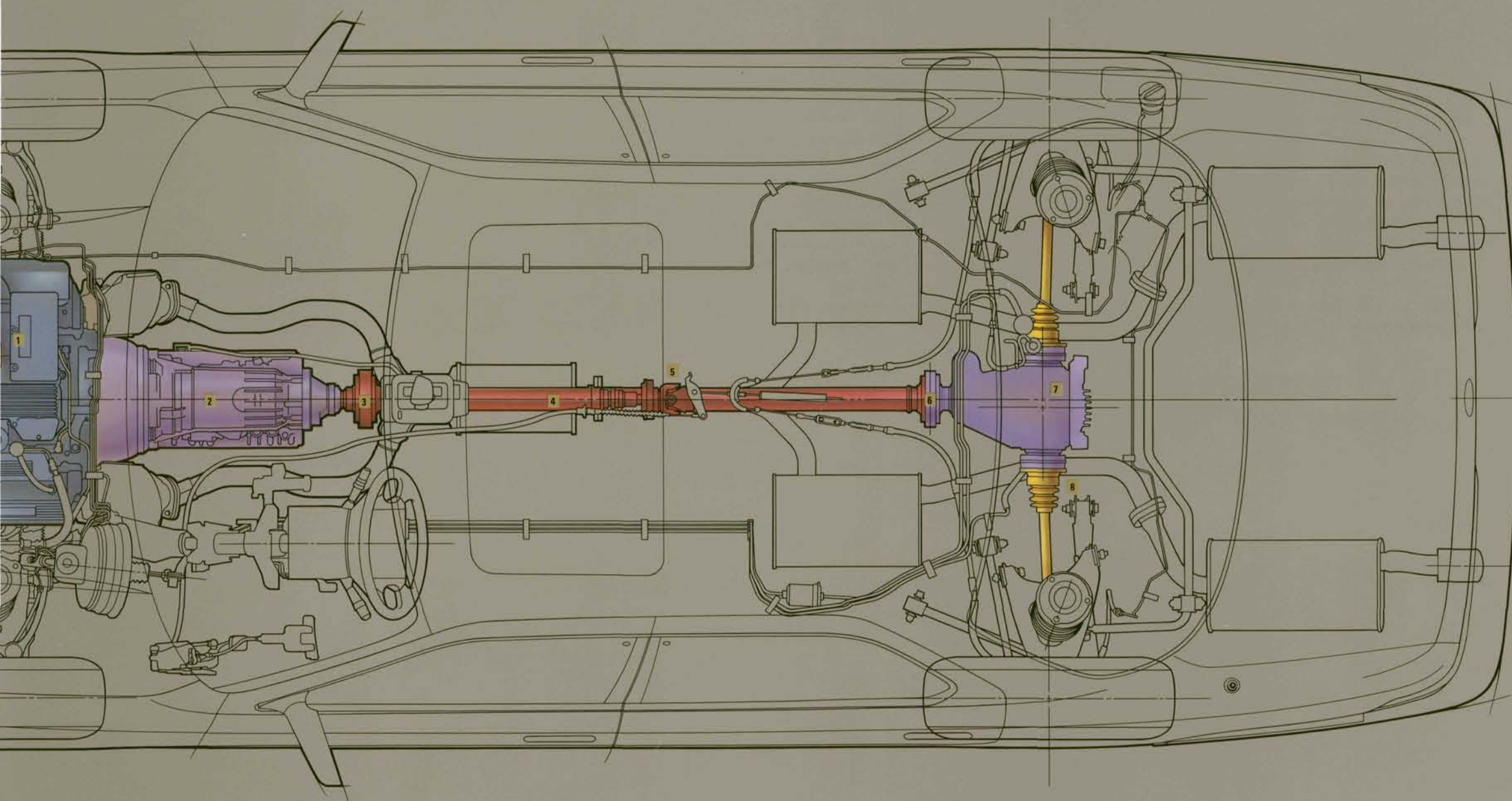
And finally, the Lexus people adopted a brand-new inspection process called *image processing* to inspect the pattern of gear-tooth contact—which is the final determinant of how much noise a gearset makes. A special test rig rotates the differential gears; contacts between its ring gear and drive pinion are "shot" by a video camera. The images are fed into a computer, which compares what the camera sees to a programmed image of acceptable tooth contact. Only if tooth-to-tooth contacts are acceptable is the differential approved for installation in an LS 400.

The final result is one of the world's most refined powertrains—one that is whisper-quiet and virtually free of vibration.



Precision automatic equipment (top) machines cylinder block to exacting quality standards. Sophisticated electronic testing devices used in post-assembly inspections ensure correct operation of LS 400 systems.





- 1. 4.0-liter V8 engine
- 2. "Intelligent" automatic transmission
- 3. Front flexible coupling
- 4. Two-piece propeller shaft
- 5. High-precision universal joint
- 6. Rear flexible coupling
- 7. Differential
- 8. Constant-velocity joint

THE
EXHILARATION

OF

74 HANDLING

A

TRUE

ROAD

CAR

It used to be that if you wanted handling, you bought a sports car. If you wanted a nice ride, you bought a luxury car.

When today's best suspension technology is applied, this traditional compromise is no longer necessary. Lexus engineers decided right from the beginning that the LS 400 would have the best; that it would deliver the highest levels of stability, cornering and riding comfort. Likewise, it would have powerful brakes with an antilock system. And its steering would give the driver the best of both worlds: easy parking, yet firm road feel.

After setting these basic goals, Lexus chassis engineers embarked on years of testing and refinement. They drove and evaluated LS 400 prototypes on various kinds of roads, at every speed from parking-lot maneuvers to flat-out on the *Autobahn*. They collaborated with tire manufacturers on the development of a new, exclusive tire that complements the LS 400's advanced suspension, steering and brakes.

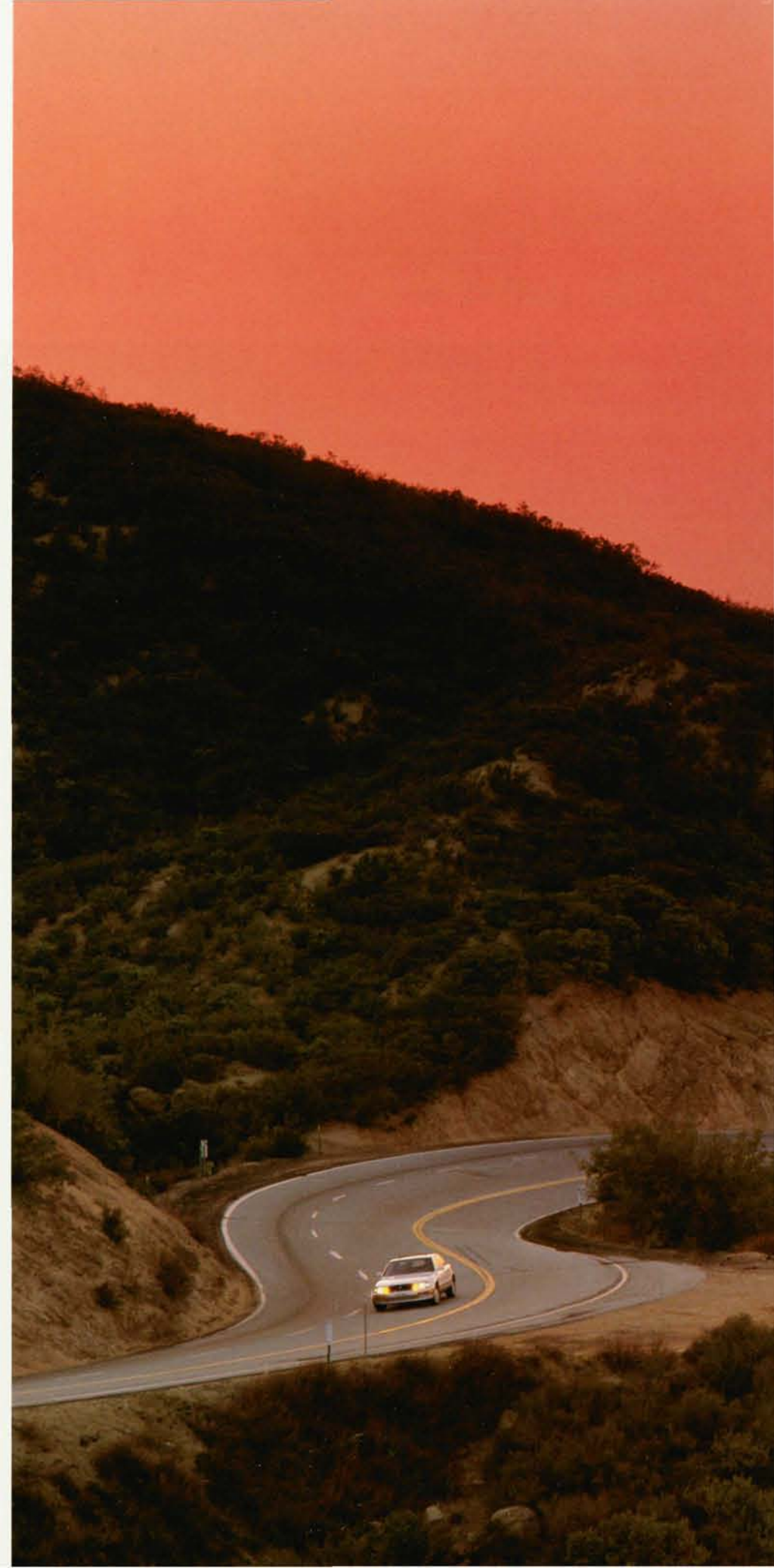
When that exhaustive development work was finished, the Lexus team had created not only a great luxury car, but a great road car.



"From the start, our goals were to achieve high-speed stability, excellent cornering, and yet a high level of riding comfort. To achieve these objectives, we first selected the best basic suspension design, double wishbones front and rear. Then we tested, tested and tested—on our proving grounds in Japan, at high speeds in Europe, on American roads—until we got it just right."

Hiroki Sato

Assistant General Manager,
Chassis Design







AT THE HEART OF HANDLING: THE BODY AS A FIRM FOUNDATION

Those who drive the great luxury cars often enthuse about a feeling they call "solid," or "substantial," or "firm."

What they're talking about is something the engineers call *rigidity*. The rigidity, or strength, of the structure that carries the whole car—the body-chassis unit—makes all the difference in the way a car handles and rides. And simply speaking, the more rigid the better, for several reasons.

First, the suspension is mounted to the body-chassis unit. If that unit is highly rigid, the suspension's movements will be precise—they'll be what the engineers designed them to be. That means better handling.

And because a rigid body doesn't flex, twist or vibrate much, there will be fewer squeaks, creaks and vibrations. That means a better ride.

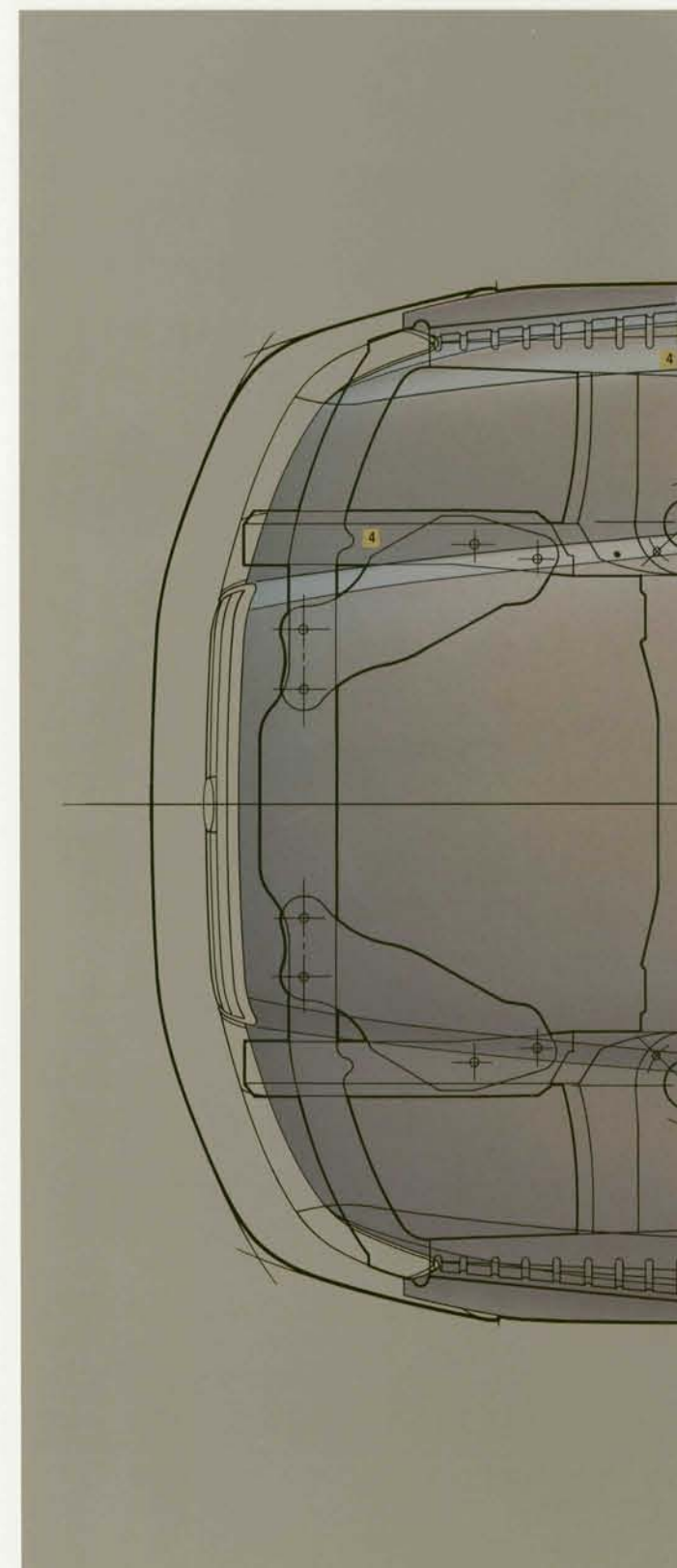
But it takes a strenuous engineering effort to make a body strong and rigid without also making it too heavy. The metal has to be thick enough where strength is needed, but not too thick where it would just be dead weight. The passenger cell must be strong to help protect the occupants in an accident, yet the front and rear ends need to be "crushable" to absorb and redirect the forces of an impact.

Happily, advanced computer-aided design (CAD) techniques, when skillfully applied, aid remarkably in resolving these seemingly conflicting goals. Using complex, specialized software, the engineers simulated the Lexus structure on their computer screens, exploring ways to achieve their goals of rigidity and yet reasonable weight. Where they found extra strength was needed, it was designed into the structure, evaluated in prototype bodies and refined again and again.

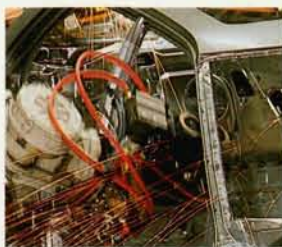
These sophisticated CAD methods, and the Lexus team's considerable experience in designing body structures of high integrity, enabled them to produce the kind of body one expects in one of the world's finest luxury sedans.



LS 400 body is outstandingly rigid in both bending (left) and twisting (right) modes.



Computer-aided design techniques helped Lexus engineers achieve a highly rigid body structure.



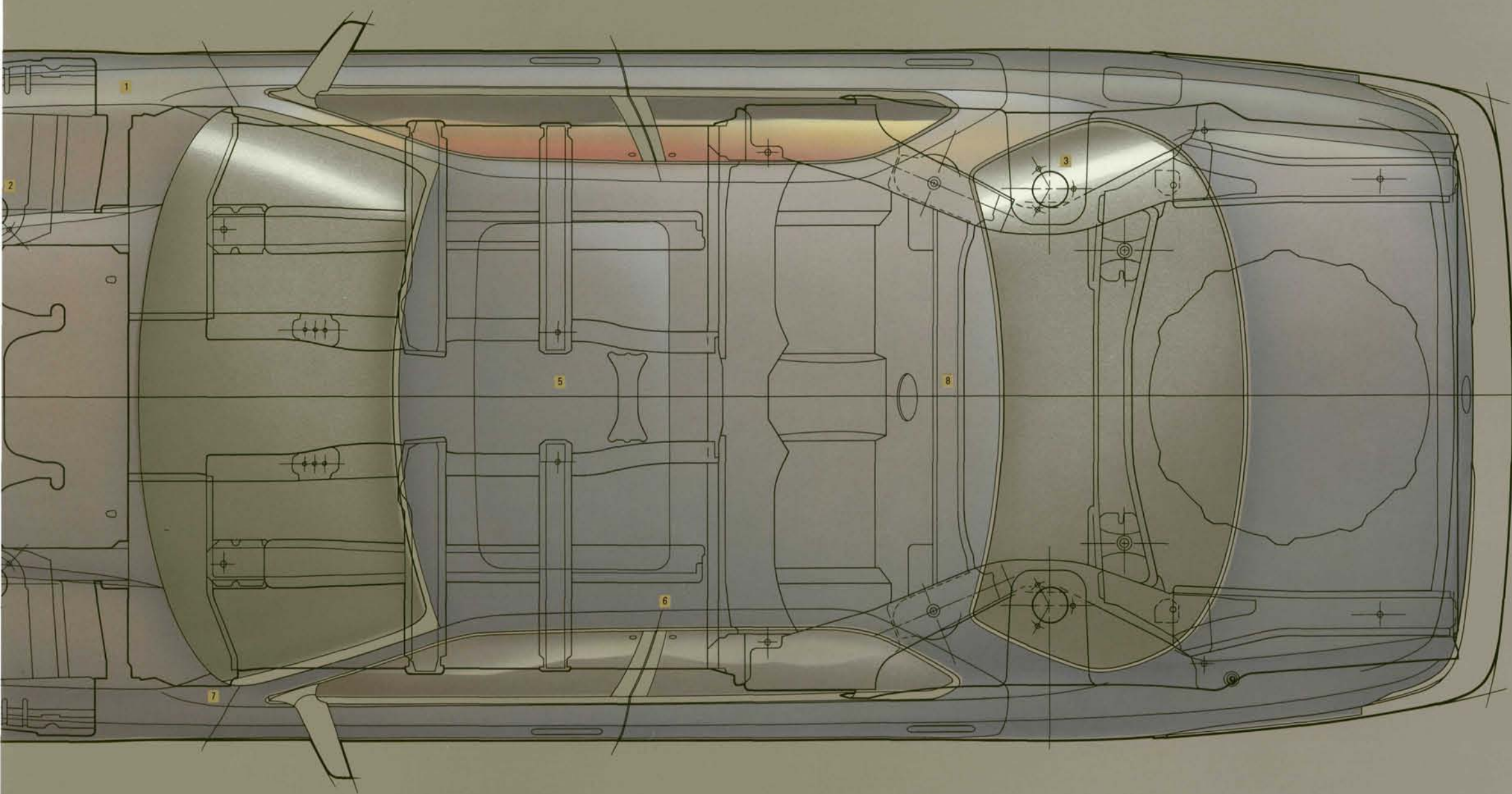
The process that welds steel panels into a complete body shell is totally automated through...



The use of high-precision welding robots that work more accurately and consistently than human beings.



Left: individual body dimensions are checked by sophisticated measuring devices during assembly. Right: once completely welded, the body shell goes to a separate line for its final dimensional inspection.



- 1. Rigid body shell
- 2. Front spring tower
- 3. Rear spring tower
- 4. Crushable front members
- 5. Reinforced floor tunnel
- 6. Reinforced pillar joint
- 7. Reinforced cabin joint
- 8. Reinforced bulkhead







SUSPENSION INSPIRED BY RACING CARS

A car's suspension system can be described as one "type" or another. Of a multitude of types, one has won universal appeal for the fastest sports cars and racing cars: *double-wishbone* suspension.

"Wishbone" refers to the shape of the suspension's main arms. In early systems, one upper and one lower lateral arm in this shape were pivoted on the chassis and carried the wheels.

Lexus engineers chose double-wishbone suspension because, to quote Lexus Chassis Design Assistant General Manager Hiroki Sato, it is "the best basic suspension design." But instead of merely adopting a traditional system, they refined it thoroughly.

The LS 400's front suspension has an upper arm that really does look like a wishbone. The lower arm is a functionally superior interpretation with a fluid-filled strut-bar cushion to reduce road shocks.

At the rear, too, the upper arm looks like a wishbone. The lower one consists of three pieces. One of these, called a strut rod, swings longitudinally and stabilizes the wheel under acceleration and braking.

To perfect this sophisticated suspension system, the Lexus engineers went out on the company's proving grounds in Japan, America's highways, and Europe's demanding Alpine passes.

The LS 400 suspension system solves that age-old compromise between tight handling and a comfortable ride by delivering both. And thanks to the rigid body and extensive sound damping, the LS 400 exhibits less "shake" and road noise than its European competitors.

In fact, the LS 400 rides so smoothly that someone accustomed to traditional European cars might assume it can't handle well. But that's the beauty of the LS 400: it handles outstandingly well.

"STROKE-SENSITIVE" AIR SUSPENSION

"Air suspension" means that inflated air springs made of reinforced rubber replace conventional steel springs.

Air springing has real advantages. One is that no matter how many people or how much baggage is carried, the car rides essentially the same. Another is self-leveling; a compressor "pumps up" to level the vehicle when more passengers climb in.

For the LS 400, Lexus engineers designed an optional air system that goes beyond these traditional advantages. Automatic-adjusting shock absorbers, for instance, "firm up" the suspension in two stages when appropriate.

Thanks to springs with main and sub-chambers, the system is also able to vary the firmness of the air springs themselves according to road and driving conditions.

Thus when the LS 400 with air suspension encounters a bad stretch of road, the shock absorbers and air springs firm up (independently at the front and rear wheels, a world first) to prevent unpleasant pitching. If the driver steps hard on the accelerator or brake pedal, again they firm up to reduce "squat" or "dive." In hard corners, firm again—to reduce body lean. And at high speeds, the system electronically switches the springs to firm, the shock absorbers switch to their medium setting, and the system lowers the car for greater stability!

So the air-suspended Lexus offers a silky-smooth ride when the going is easy—and gets firm only when there's a reason for it. Just the same, Lexus engineers also recognized that some drivers prefer a firm ride for its own sake—so they provided Lexus Ride Control with Normal and Sport settings. In Sport, the air springs stay firm and the shocks operate only on their medium and firm settings. When extra ground clearance is needed, the driver can raise the car via a switch.

POWER STEERING THAT ADAPTS

In the typical American luxury car, power steering is designed primarily for low-speed driving. This provides easy parking, but at higher speeds the steering may be too light to suit some drivers.

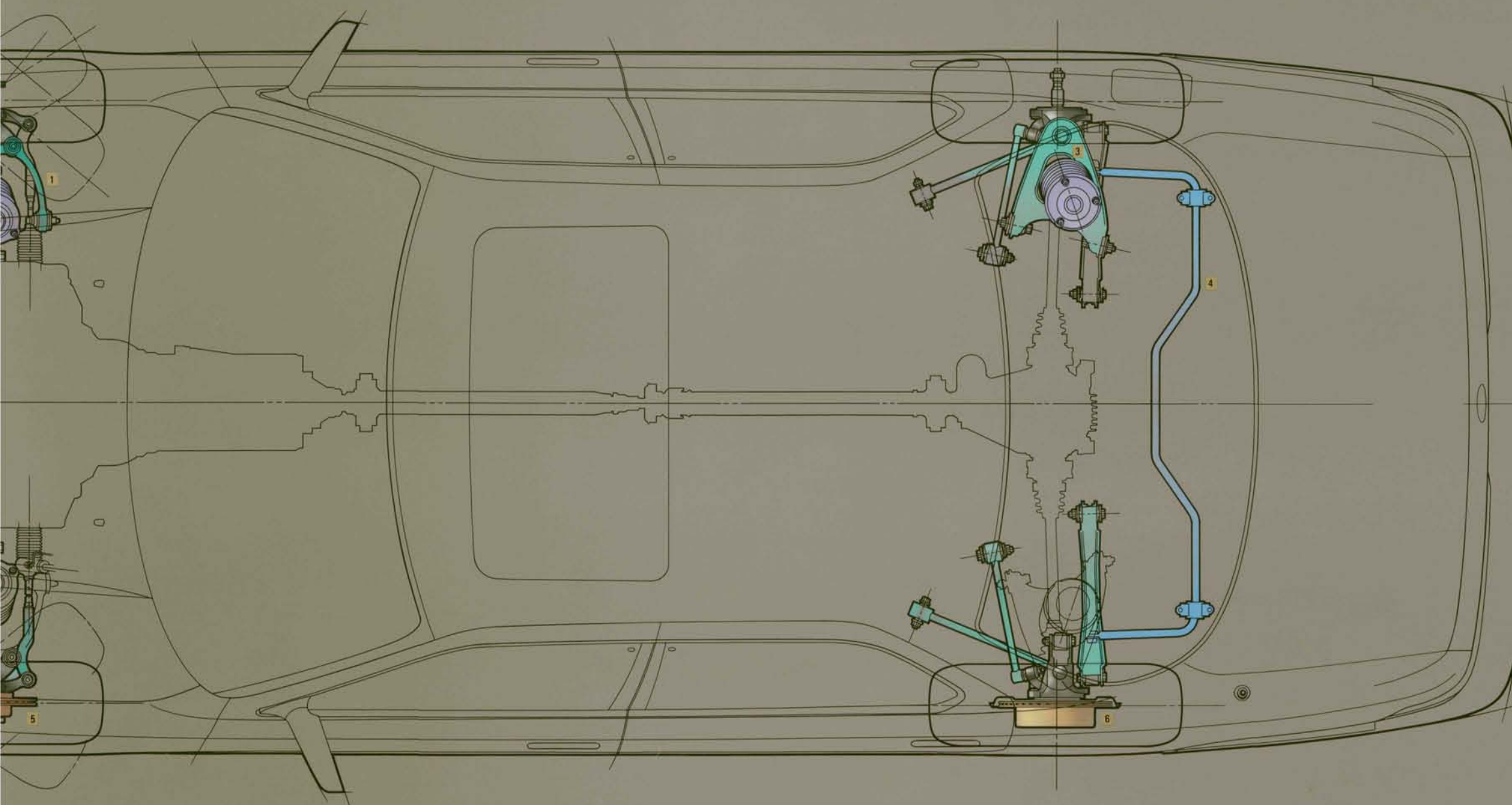
By contrast, European luxury cars give firm road feel but can require hard work in parking. Aiming for the best of both worlds, Lexus engineers linked the power steering with the car's speed.

At low speeds, such as in parking or U-turns, the power assist is greatest, taking the work out of steering. As speed picks up, the system reduces power assist progressively so that there's firm road feel at higher speeds. Thus another of the old compromises in car engineering is eliminated.





The LS 400's suspension system (standard coil-spring system shown below) is engineered to control body motions optimally and provide responsive handling.



1. Double-wishbone front suspension
2. Front anti-roll bar
3. Double-wishbone rear suspension
4. Rear anti-roll bar
5. Ventilated front disc brake
6. Ventilated rear disc brake





Antilock braking system (ABS) consists of wheel-speed sensors, a tiny special-purpose computer and a hydraulic control unit.

1. ABS Actuator
2. Front Speed Sensor
3. ABS Computer
4. Brake Master Cylinder
5. Rear Speed Sensor



FOR THOSE TENSE MOMENTS: ANTILOCK BRAKING

For powerful brakes to back up the LS 400's powerful performance, Lexus engineers specified large discs, ventilated for resistance to brake fade, and equipped them with a high-technology antilock braking system (ABS).

A sliding tire has less traction and can't be steered. So most of us have learned that if braking produces a skid, it's best to "pump" the brake pedal. ABS pumps the brakes automatically.

The basic ABS components are magnetic speed sensors in the wheel, a tiny special-purpose computer and a hydraulic control unit. Anytime one of the tires begins to slide even a little, that wheel's speed sensor signals to the computer. Instantly, the computer "instructs" the hydraulic control unit to reduce hydraulic pressure at that wheel.

This done, the wheel begins rolling again. As soon as this happens, the system allows hydraulic pressure back to the wheel, restoring braking force. The computer issues commands every five-thousandths of a second, so ABS can pump the brakes far faster than a human being. It pumps the front brakes individually and rear brakes as a pair—also something a driver can't possibly do. Pulsation in the brake pedal tells the driver the ABS is working.

MOVING AHEAD ON SLIPPERY ROADS: TRACTION CONTROL SYSTEM

The same wheel-speed sensors that serve the LS 400's ABS are also part of its optional Traction Control System. Traction Control helps ensure that the rear of the car does not break away in turns and that directional stability is always maintained; even on gravel, snow or ice the driver can push hard on the accelerator and the driving wheels won't spin.

LINK BETWEEN LEXUS AND ROAD: SPECIAL TIRES FOR THE LS 400

All the suspension and brake technology in the world can go to waste if that vital link between car and road, the tire, isn't up to the job. Realizing this, Lexus chassis engineers

asked tire manufacturers to develop new tires that combine excellent performance with outstanding comfort.

Two types of tire were developed: summer and all-season. For the former, the teams created a high-performance radial tire that combines outstanding cornering and high-speed stability with quietness, comfort and energy efficiency. The all-season tire offers excellent cornering and riding comfort, is energy-efficient and quiet, and delivers good snow traction.

PRECISE HANDLING MEANS PRECISION PRODUCTION

Even the most sophisticated suspension, steering and brakes can deliver their best only if they are produced to the highest standards of quality.

Once the LS 400 is assembled, it is subjected to final inspections that will ensure this. At the end of the assembly line, the wheels' alignment is checked on a high-precision machine. Only then is the steering wheel positioned on the steering column.

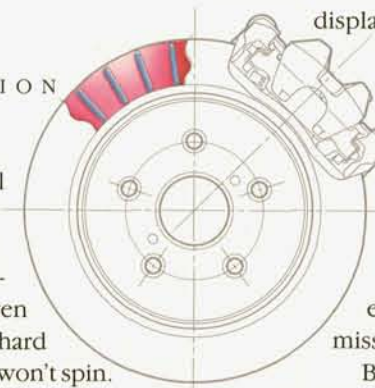
Now a specially trained inspector gets into the driver's seat to put the Lexus through its paces. A specially designed computer is at his left outside the car. With all four wheels rotating on special rollers recessed into the floor, he brakes hard. The computer evaluates ABS operation. If all is in order, the screen displays "ABS OK."

Next, if the car is so equipped, the external system tests the Traction Control System. Is the computer functioning correctly? If so, "TRAC OK."

And if this car has it, a similar function check is run for the air suspension system; the air conditioner, engine control computer, cruise control and electronically controlled automatic transmission are also tested.

But even after the LS 400 passes all these tests, it has one important test to go, on the special track at the Tahara plant complex. As part of a 10-mile test, an expert driver brakes hard on a special low-friction road to test the ABS in actual driving. Again, if anything isn't up to snuff, it's back into the assembly area to correct it.

When the LS 400 is shipped, it will ride, handle and brake as the Lexus engineers meant it to.



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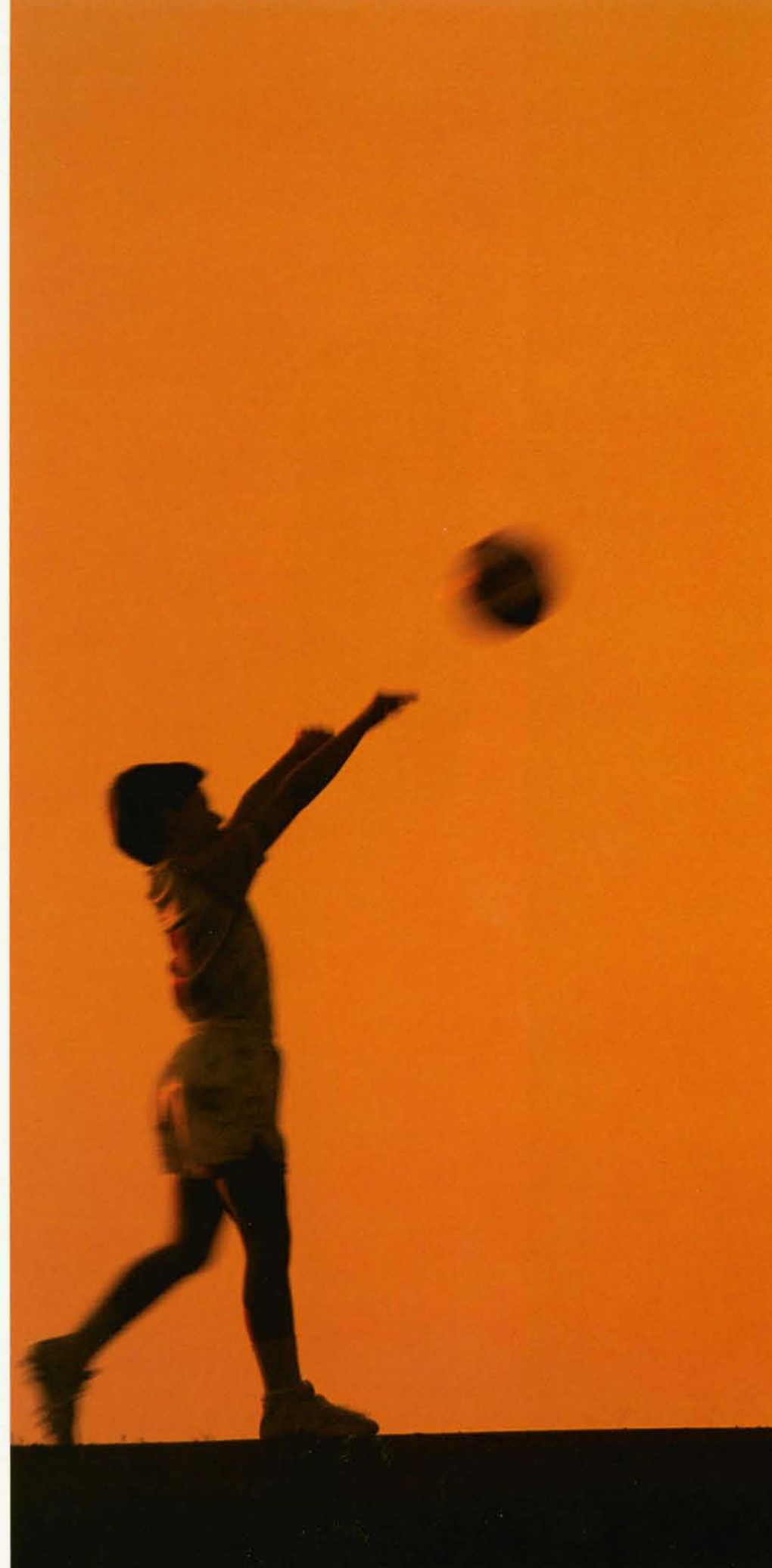
It is a fact of life, especially contemporary urban life, that going places entails risks. Unpredictable drivers, thieves, parking attendants who bash your doors or even get your key duplicated while you have dinner—at every turn there may be someone or something that threatens the enjoyment of your automobile.

Lexus planners, designers and engineers first studied these risks, then took steps to minimize them. For those factors that help a driver stay out of accidents, the chassis team endowed the LS 400 with outstanding handling and braking, including a standard antilock braking system and the optional Traction Control System. To help protect the occupants when an accident happens, other teams worked to create a strong body shell, make interior surfaces benign in an accident, design effective seatbelts, devise a reliable driver's-side airbag supplemental restraint system. For security against intruders, other Lexus engineers developed a theft-deterrent audio system, a new type of key, a lock that is particularly difficult to pick, and an effective alarm system.

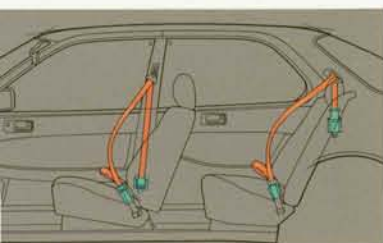


"We developed a strong passenger cell with crushable front and rear ends, an interior with soft surfaces and few projections, and comfortable seatbelts as well as the world's first tilt-telescopic steering wheel with an airbag. Three hundred and fifty people drove 168 airbag-equipped test cars for two years to monitor the operation of the airbag system. In all, we tested the systems and components for more than 2.7 million miles."

Yutaka Kondoh
Project Manager,
Corporate Technical
Planning Office







PROTECTION THROUGH STRENGTH

Made mainly of high-strength, extra-thick stamped steel sheet, the LS 400 body shell is extremely rigid. Extra-strong laser welding is used extensively; critical structural points are reinforced. To ward off corrosion, the steel for inner and outer body panels is highly corrosion-resistant.

At both ends, where the bulk of the energy of most crashes must be absorbed, the body is designed for "crushability." Main structural members, such as the frame rails from the floor and windshield to the front end, are designed to bend at strategic positions to help the front end crumple in the intended way in a crash. This means optimum energy absorption and added protection for the passenger cell. For greater protection in side impacts, each door is specifically reinforced.

The LS 400's flexible front and rear bumpers are engineered to withstand impacts of 5 mph, or twice the impact speed U.S. law requires. And to ward off both stone chips and lower door dings, all lower body surfaces are of chip-resistant polyurethane.

PROTECTION THROUGH INTERIOR DESIGN

Lexus stylists and engineers worked together to combine attractive appearance and function. Switches and knobs project minimally; padding covers the instrument panel, steering wheel, forward end of the roof, console, door trims and roof pillars.

For comfortable seatbelt use, the interior team fitted the front three-point seatbelts with adjustable upper belt anchors. Together with inner buckles secured to the seat itself, the adjustable anchors accommodate a wide range of human stature. Outboard rear seating positions also have three-point belts, with dual-action locking reels so that child seats can be fitted.

WORLD'S FIRST TILT-AND-TELESCOPIC STEERING WHEEL WITH AIRBAG

The LS 400 is the first car on the market to combine an airbag supplemental restraint system (SRS) with a tilt-and-telescopic steering wheel. ("Supplemental" because the airbag is intended as added protection, not a substitute for the seatbelt.) A major challenge

was making the unit strong enough to withstand collision forces, yet adjustable both ways and light enough to resist shake on rough roads. An aluminum steering-wheel frame made this possible.

The airbag system consists of the bag itself, in the steering wheel's padded center section; the inflator; three crash sensors and two low-g sensors; a computer; and a warning light to indicate any malfunction. The airbag is carefully sized to provide protection, yet not block the driver's vision when it deploys.

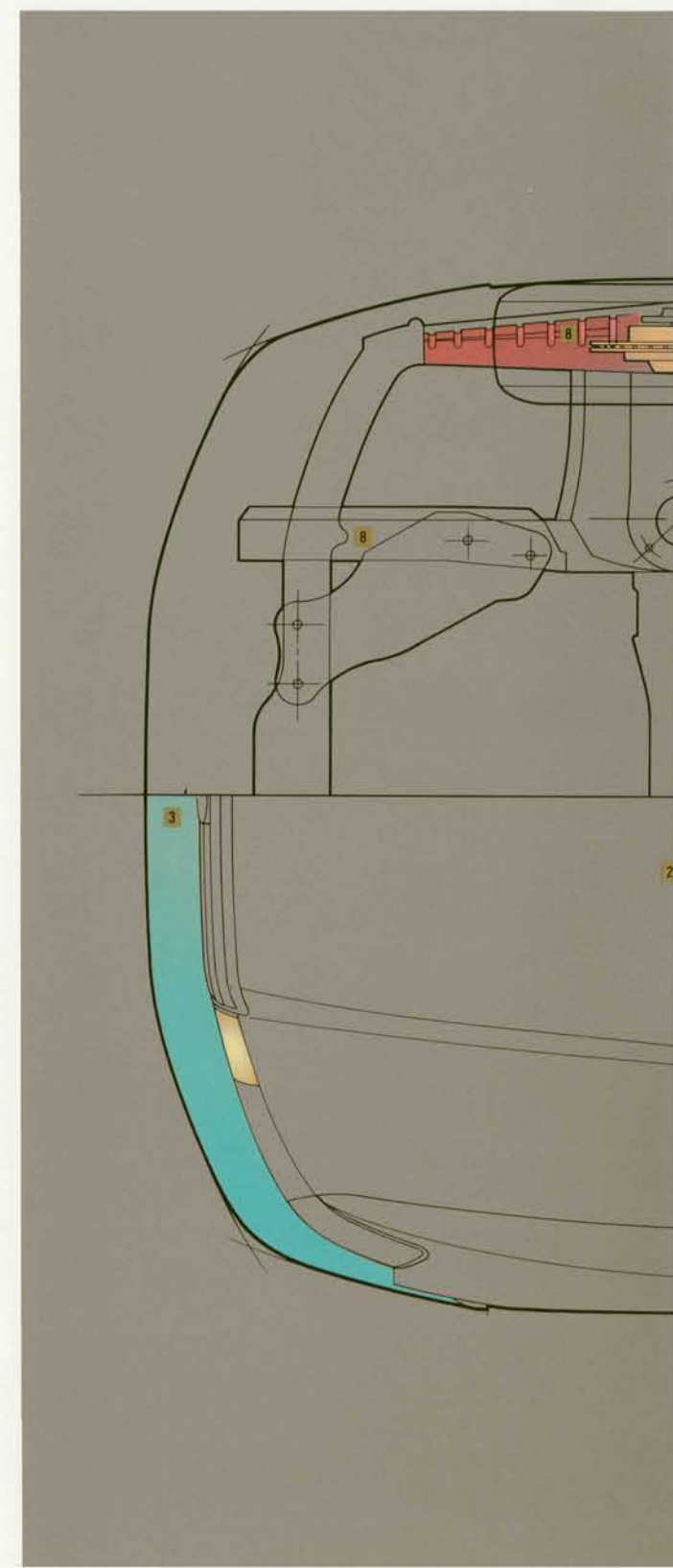
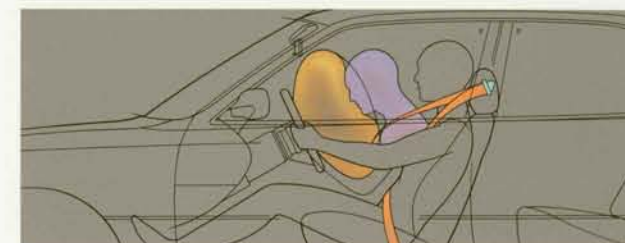
On the basis of data from the crash sensors, the computer determines precisely what is taking place and whether to deploy the airbag. To help ensure reliable operation, the system has gold-plated electrical terminals and highly specialized electrical cables. There's even a backup capacitor to power the airbag system should it be disconnected from its power supply during a crash.

The system is programmed to deploy in any impact equivalent to crashing head-on into a fixed barrier at approximately 12 mph or more. In addition, to help facilitate exit from a damaged car, the LS 400's doors are designed to avoid jamming in an impact.

TO DISCOURAGE THEFT

Because auto theft and other crimes are common, Lexus equipped the LS 400 with many effective theft-deterrent and security measures.

One is a new type of key, inner-grooved by an end mill in a process few thieves could afford to duplicate; the lock is also extremely difficult to pick. Another is a standard alarm system, actuated either by the key or an incredibly compact remote control built into the key head.



A driver's-side airbag supplemental restraint system (SRS) is standard in the LS 400.



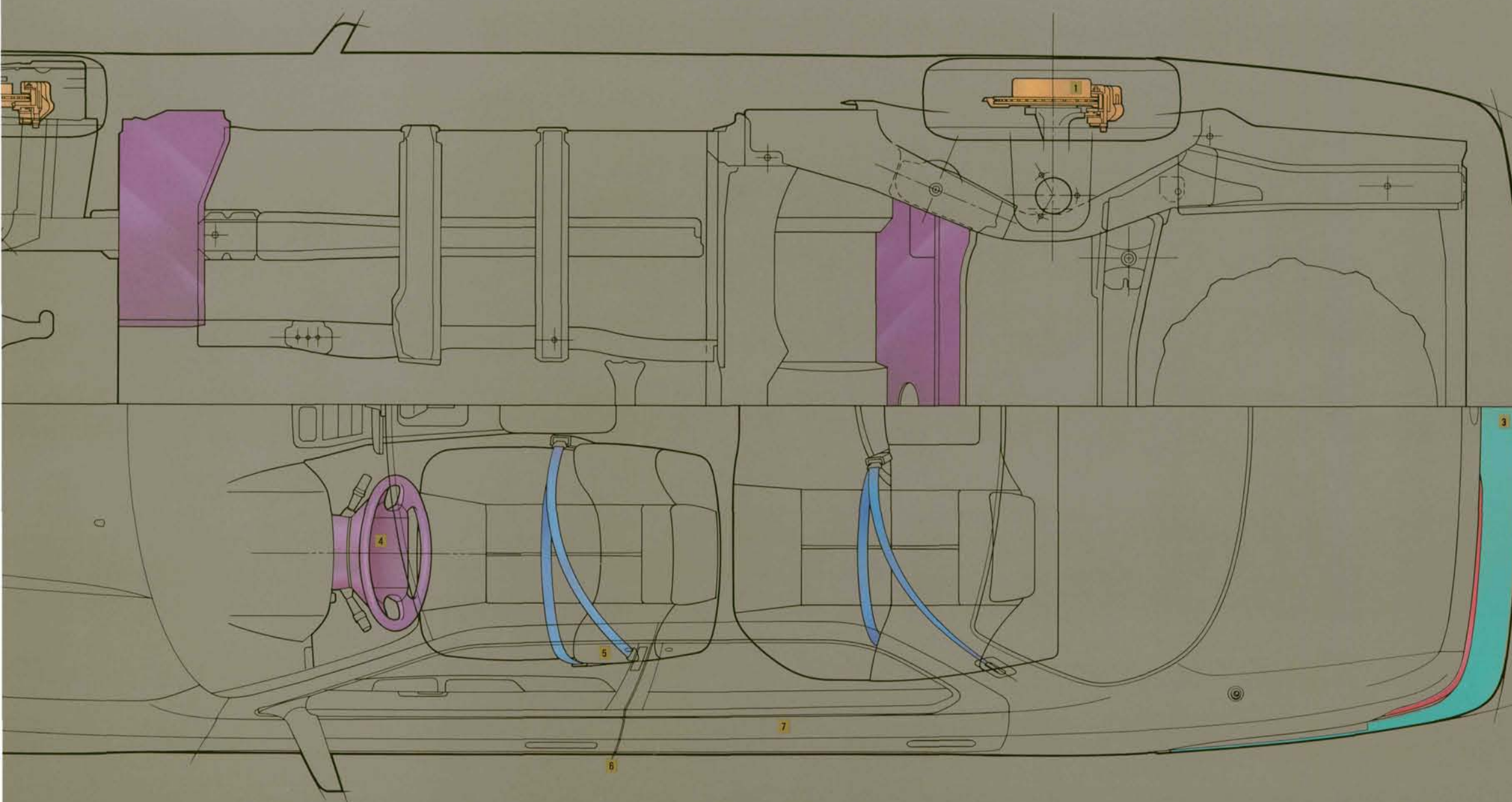
High-speed photography captures deployment of the airbag, which occurs in hundredths...



...of a second. Here it is just beginning to inflate, before the test dummy starts moving forward.



Now inflated, (left) the airbag is ready to cushion the test dummy as it is thrust forward by impact. At right, the dummy is fully "into" the airbag, which will deflate after it has performed its function.



1. Antilock braking system
2. Rigid body shell
3. 5-mph front and rear bumpers
4. Airbag supplemental restraint system
5. Adjustable front shoulder-belt anchor
6. Jam-resistant doors
7. Side-impact beam
8. Crushable front members



Crash testing is a highly disciplined science. At top, technician prepares test dummies. In photo just above, telltale paint from dummy on airbag defines area of contact. At right, an LS 400 prototype after crash into fixed barrier.





"We subjected this car to a wide variety of functional tests. Some 100 LS 400 prototypes were crashed in various tests."

Katsuhiro Konno
General Manager,
Vehicle Evaluation and Testing

TESTED, TESTED AND RETESTED

In the course of developing and testing the LS 400, some 350 drivers participated in a large-scale field test of the airbag system; numerous prototypes were crashed in various tests, and the system was monitored for over 2,700,000 miles.

LS 400s were crashed straight into fixed barriers at 30 and 35 mph. Into fixed barriers at 30 mph and a 30-degree angle. Test cars were hit in the rear by the moving barrier at a closing speed of 35 mph. Rolled over at 30 mph.

Special tests for the airbag systems added their own dimension to the testing. Prototypes were driven intentionally at furious speeds over brutal bumps, dips and potholes to ensure that the airbag wouldn't deploy just because the car was abused. Each component was tested again and again in labs at temperatures from -30 to +220 degrees Fahrenheit. At low atmospheric pressures, simulating altitudes up to 13,000 feet. Subjected to longterm exposure at extremely low and high temperatures, and sprayed repeatedly with salt. In a giant test chamber built for the purpose, the LS 400 was subjected to wildly random electromagnetic interference to make sure lightning or radio-TV waves in the air wouldn't cause the airbag to deploy.



THE LEXUS COMMITMENT

Lexus is a new name, a new line of automobiles. At the same time, Lexus is part of a well established company—one with a long history of reliability, quality and customer satisfaction. Lexus is new, but not starting from ground zero by any means.

"Everything about this new company is planned with a sense of permanence," says J. Davis Illingworth, Vice President and General Manager of Lexus. Recalling the challenge laid down in August 1983 by Chairman Eiji Toyoda—to build the world's finest luxury car—Illingworth says that "Every level of Toyota management took Chairman Toyoda's challenge to heart. We are committed to a new class of high-performance luxury cars that are the ultimate expression of Toyota's commitment and manufacturing capabilities."

Toyota President Shoichiro Toyoda sums up the challenge, the accomplishments and the commitment this way: "We created the Lexus LS 400—from a clean sheet of paper—especially for American customers."



A

UNIQUE

LUXURY

CAR —

AND

A

UNIQUE

COMMITMENT

TO

THE

CUSTOMER

"That's something we've never done before. This Lexus is completely new. It was created to be the very best there is. We want to stress how serious we were in developing this Lexus; how great the resources behind it are; how strongly we are committed to it."

To this remarkable commitment of Toyota Motor Corporation in Japan, Toyota Motor Sales U.S.A. (TMS-USA)—parent company of Lexus in America—adds its commitment to unparalleled customer satisfaction. "On this side of the ocean," promises Illingworth, "we're supporting the product with the best dealer body in the country."

When word about Lexus first got out, more than 1500 dealers enquired about a Lexus franchise. All those that were chosen have two things in common: proven ability to satisfy their customers, and a highly refined understanding of the personalized service expected by buyers of luxury automobiles. Each Lexus dealership represents an investment of 3 to 5 million dollars. "We are providing our dealers with the best support programs in the industry," continues Illingworth, "and we expect to have customer satisfaction unequaled in the automotive industry."

Aside from the excellence of Lexus cars, one key to this is that Lexus will remain a relatively low-volume, exclusive line. Another is the strength of the company behind Lexus: Toyota. This is an automobile manufacturer with the research, development and manufacturing capabilities to make a dependable longterm commitment to the luxury-car market. The prestige and resale value of existing luxury makes is no accident: It was built up slowly, systematically over many decades. Lexus, too, is dedicated to this kind of longterm effort.



"With more than 50 years of experience in building high-quality motor vehicles, Toyota now enters the luxury field with Lexus. We promise absolutely the best in quality and technology."

Tatsuro Toyoda
Executive Vice President



"We've been preparing for Lexus for a long time. To ensure the best customer satisfaction, we have created a total system that encompasses Toyota Motor Corporation, Toyota Motor Sales U.S.A. and Lexus dealers. We begin with automobiles of the highest quality. Then we support them with the best facilities and most qualified people, specially and intensively trained to satisfy the customer."

Yukiyasu Togo
President,
Toyota Motor Sales, U.S.A., Inc.



"In addition to this totally new car, we have established a whole new dealer network for Lexus. To make the Lexus ownership experience as pleasant and rewarding as possible, each of these dealers has invested much capital, time and personnel training. We sincerely hope, and are certain, that all these efforts—in creating the LS 400 and providing an effective system of caring for it—will deliver the experience the Lexus owner expects, and deserves, from the investment in this fine luxury car."

Dr. Shoichiro Toyoda
President







"As we introduce more models over the next several years, they will reflect the same Lexus image of luxury, quality, exclusivity, sophistication and craftsmanship. And in time, Lexus products will earn the most valuable image of all: prestige. I say 'earn' because prestige can't be bought or self-declared. It comes at its own pace as owners spread the word about how highly they prize their cars."

J. Davis Illingworth
Vice President and General Manager
Lexus Division,
Toyota Motor Sales, U.S.A., Inc.



"Our goal is to deliver a perfect car to every customer."

Richard L. Chitty
Corporate Manager,
Parts, Service & Customer Relations,
Lexus Division,
Toyota Motor Sales, U.S.A., Inc.



"Experience has taught us that great cars don't just happen. You have to take the time, commit the resources and pay attention to every detail. Over the past five decades, Toyota has become world-famous for that kind of extra effort. To the quality, reliability and value the world has come to expect from Toyota, Lexus adds luxury and performance that even Toyota has not achieved before."

Robert B. McCurry
Executive Vice President,
Sales and Operations,
Toyota Motor Sales, U.S.A., Inc.

THE LEXUS COMMITMENT

The third key is the Lexus commitment, which begins to influence the owner's experience as soon as the Lexus automobile leaves Japan. Even after the extraordinary inspection and testing procedures each LS 400 undergoes at the factory, it is inspected and test-driven twice more before delivery to the customer—once each at the port and the dealership. The 1000-mile inspection is free of charge. So is the first regular maintenance, at 7500 miles. The Lexus warranty includes a nationwide roadside-assistance program with toll-free 800 number, and provides a loaner car in case the warranty repairs extend overnight.

Instead of the usual microfiche, Lexus parts catalogs and service information are on compact disc—a remarkably efficient data medium that allows the dealer's Service or Parts department to find the correct part in half the usual time. And to facilitate service diagnosis, each dealership will employ a specially trained Diagnostic Specialist.

Lexus has also instituted the most advanced factory-dealer communication system ever. All Lexus dealers are connected via satellite to each other, the area sales offices and Lexus national headquarters. A complete history on every Lexus car will be kept by the system; this helps dealers maintain each car properly and, as a consequence, may add to its resale value. This system is totally different from any other, revolutionizing the way dealers take care of their customers.

Over the years, Toyota has evolved into a broad range of compact and midsize family cars; sports cars, specialty cars, high-performance cars. The college students of the 1970s bought Corollas and trucks; today they're happy with their Camrys and Supras and loyal to Toyota, but they're upwardly mobile. Beyond comfortable, dependable transportation, they want the "toppings": luxury, performance, sophistication, exclusivity.

Until now, they had to "go European" to get the greatest measure of these quantities. No more. Lexus provides that special feeling that demanding customers seek in an automobile. The Lexus Experience has begun.

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