Industrial designer Richard Ten Eyck, who serves as consultant to Cessna Aircraft Company, created Cardinal's four-foot-wide door and low profile to enhance ingress and egress. Flush-mounted automobile-type hinges improve airflow.

Photos by Robert G. Ames (AOPA 167764)

THE SECRETS OF AIRCRAFT DESIGN

New airplanes don't just spring into existence. Behind each model revision lies a painstaking history of thoughtful design to achieve certain goals. Here is a look at the approach of one of the country's leading industrial designers

by ARNOLD M. LEWIS, JR. / AOPA 312542

■■ *Cardinal*—the closest aircraft manufacturers have come to matching automobile comforts in a single-engine airplane.

This may sound like a long-winded promotion for Cessna Aircraft Company. It isn't. It is about a man who gives the ad writers something to stir their creative minds—the unsung crowd-pleaser generally found hidden back in the industrial design shop.

Such is Richard Ten Eyck & Associates.

For 20 years, Ten Eyck (AOPA 278454) and his small staff of designers, artists and human factors specialists have been bending their efforts toward making Cessna products more pleasing to the eye.

His reasoning is simple: "People are more inclined to believe what they see rather than what they hear. Our job is to make the manufacturer's integrity obvious.

"Take spaciousness, for example. One of our biggest jobs is to interest new people in flying. With many, it is a simple matter of inducing a willingness to just ride in an airplane," Ten Eyck explained.

"Many people have slight to moderate phobias for tight confinement. Our effort is to expand the market for general aviation, so we fight phobias with large windows and light interiors, which serve to make a small space feel larger," he added.

Thus, it is not by chance that in recent years, while general aviation has experienced its greatest surge of growth and development, aircraft manufacturers have striven to get away from the post-World War II image of the "little yellow Piper *Cub*."

A primary consideration in aircraft design is to improve comfort, convenience and utility for the passenger. Probably more consideration has been given the passenger in the *Cardinal* than in any previous model, the idea being that the passenger should find the transition from riding in an automobile to flying in an airplane easier to make.

"The interiors of today's Cessnas in many ways exceed the comfort and facility of an average automobile," Ten Eyck said.

"Comfort is an interesting phenomenon in itself," he added.

"A real bugaboo of transportation today is seats, for example. The fact is, no matter how comfortable the seating for certain positions, it is the ability to shift around and change positions which alleviates the fatigue associated with having to maintain a single position over a period of hours.

"We all realize that we could have more speed if we were willing to have fewer passengers in the airplane and at the same time sacrifice comfort," Ten Eyck said.

In the *Cardinal*, the emphasis was on more spaciousness than in any previous Cessna model. And with added spaciousness, the *Cardinal* was engineered so the floor of the cabin was only 23 inches from the ground.

Within the trade, Ten Eyck is called a consulting industrial designer. Although he has no official vote in the outcome of a particular design feature, his representation of Joe and Mary Pilot often carries the day.

Such representations have been profitable for the 47-year-old native of suburban Chicago, as well as for Cessna. Since setting up shop at the old Wichita Municipal Airport—now McConnell Air Force Base, which is shared by the Wichita Division of the Boeing Company—he has built what reportedly is one of the largest industrial design firms in the country. Yet, few would know it.

Ten Eyck has surrounded himself and his work with 10 acres of wooded and sculptured seclusion along the Cowskin Creek in suburban Haysville, Kan., several miles south of the "Air Capital City," and difficult to find, even with carefully explained instructions.

"All of which helps to maintain the seclusion which goes with proprietory confidences," he points out.

The plant—but a few steps from his richly landscaped, plushly furnished (mostly by his own hand) two-story white house—was an old farm house previously used to store hay. The door of his small, modest office leads directly to the firm's woodworking shop: "You can tell where my real interests lie."

Ten Eyck himself didn't learn to fly until 1965. "I'm one of those people with a deep-seated fear of heights. Tall buildings still turn my legs to jelly."

Learning to fly presented an attraction to the designer, however, both as a business tool and as a "latent challenge to my fears." The firm last year purchased its second airplane, trading in a Cessna *Skylane* for a *Super Skylane*.

Merely strolling through Ten Eyck's design shop is enough to make any aviation writer's eyes pop out. Thus, before any such tour begins, there is an immediate understanding about certain questions not being asked and certain information not being offered. Something about advance information about upcoming aircraft models having a negative effect on sales of current models, and so on.

Ironically, the firm's national reputation is built on its design applications to heavy equipment, not airplanes. Several major manufacturers of farm and construction equipment are listed among Ten Eyck's clients, as are makers of such widely diverse products as barbecue grills and office chairs.

According to Ten Eyck, however, much of his work volume is for Cessna. "Most people think of us as doing only the paint schemes for Cessna products. The truth is, that's a relatively small percentage. Much more is in the actual design of the airplane and its hardware, such as the instrument panel, control wheel and door handles," he added.

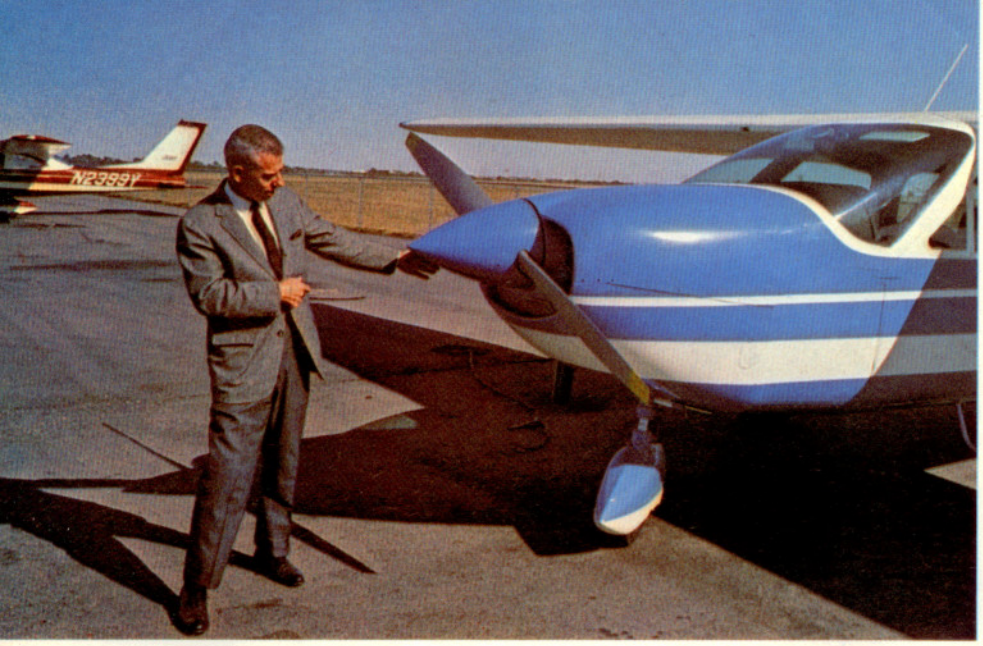
His firm's specific concern for any product—and in particular the airplane—can be indicated by a single question: "How does the customer feel about the product?"

From that springs Ten Eyck's philosophy of operation:

- "We want to attract favorable attention to a given product visually.
- "We want to instill confidence in that product visually, confidence that it will do well what it is intended to do, whether it is a chair or an airplane.
- "We want to help build repeat business by having people live well with what we've done."

The fact that the *Cardinal*—or any other proposed Cessna model, for that matter—actually turned into hardware is the unique thing for Ten Eyck & Company.

Cardinal's unique landing gear fairing improves appearance and reduces drag. It conceals a new one-piece tubular spring steel landing gear.



Richard Ten Eyck & Associates gave the Cardinal a "turbo look" by moving carburetor air intake up directly under the spinner, providing a single, semicircular airscoop. The change also afforded more efficient air intake.

When the *Cardinal* first appeared in his shop on paper in 1964, it was just one of many such exploratory designs that regularly cross his desk.

In practice, management at the nearby Cessna factory directs its preliminary design group to come up with a design within certain parameters of configuration, space, power plant requirements and price. The preliminary design group interprets these criteria, puts them on paper in the form of a preliminary aircraft design and passes it on to Ten Eyck for polishing.

"They ask for our suggestions and recommendations and we project an independent viewpoint. Only by such critical analysis do you find the opportunities for creative improvement. We'll never analyze far enough, but we'll try," Ten Eyck said.

"This kind of exploration continues constantly. The initiative is on us for creativeness. Decisions are the prerogative of management," he added.

More specifically, Ten Eyck and his staff are interested in cleaning up the little things on the aircraft; isolated items of hardware that, when taken as a whole, make up the entire airplane.

With an all-new design such as the *Cardinal,* but one that was never intended to depart from the traditional Cessna look, Ten Eyck and his staff had the opportunity to take advantage of new tooling to foster improvements in many areas which on previous models would have been prohibitive.

"Since we had a new airplane and new tooling, we could go all the way," he explained. They did. Each new development on the Cardinal seemed to lead directly to another new development.

Generally speaking, this rapid period of *Cardinal* evolution began with the fully cantilevered wing which, shifted farther aft than on previous high-wing Cessna models, improved the pilot's vision to the sides and upward. At the same time, it allowed a more rakish slant to the windshield.

Because of the cantilever wing, however, designers had to maintain a great deal of structure in the cabin area, which tended to create some problems. On the plus side, they were able to cut a much larger door, hinged right up to the forward structure and even with the instrument panel. Flush door hinges are similar to those used on automobiles.

With complete elimination of the strut, the step could be taken off of the landing gear and placed forward under the door, eliminating climbing over the landing gear to get in and out.

Another design problem was encountered when the door tops had to be contoured to fit the underslope of the wing, forcing elimination of the former pop-out window feature. A new feature with the *Cardinal* was the crank-out foul weather window on each side that can be left open up to speeds of 120 m.p.h.

Cessna's traditional spring steel landing gear was replaced with a new one-piece tubular steel spring gear—said to provide greater landing smoothness—complete with fairings to reduce drag and improve looks.

Through the period of exploration and innovation, Ten Eyck & Associates made many detailed design studies to improve the *Cardinal's* total presentability.

The "extreme notch" effect present on earlier models where the rear window meets the tail cone has been made less severe, with a resulting "fast back" look.

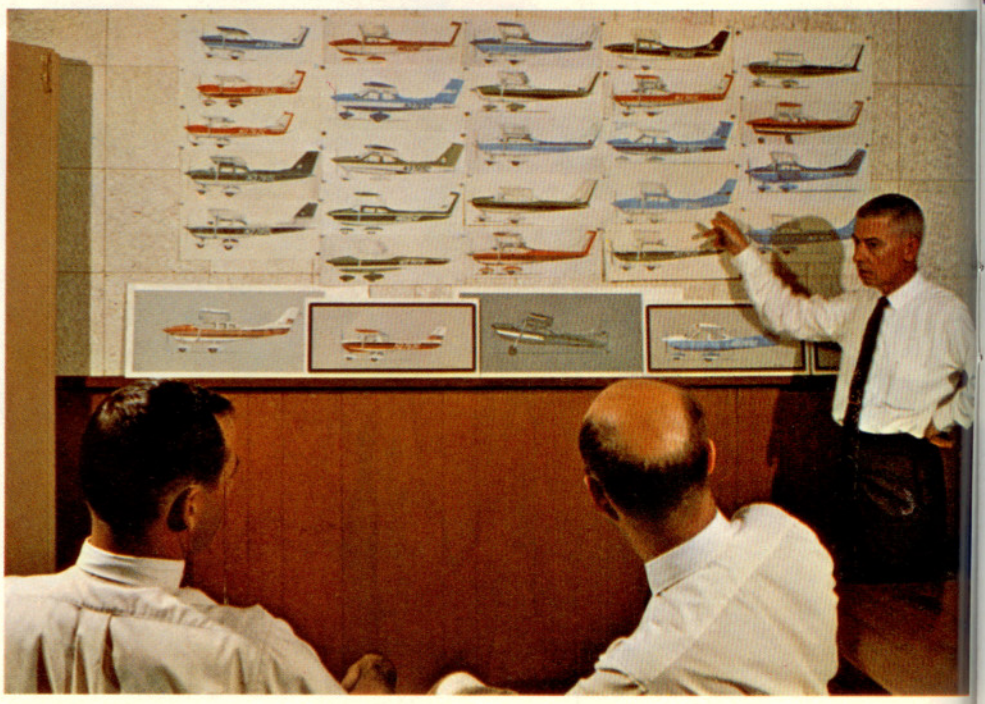
Many hours of study went into the design of a new instrument panel for the *Cardinal* by a human factors specialist on Ten Eyck's staff who also is a 2,000-hour, instrument-rated pilot.

Improvements to the panel include constant-size, three-inch instruments and a better grouping of instruments which places all primary switches, controls and dials directly in front of the pilot.

"There is a more orderly look to the panel, which is something for which we have been striving for years," Ten Eyck said.

A significant and striking change from the traditional Cessna look is the *Cardinal's* new rakish cowl with a "turbo look."

According to Ten Eyck, it was widely



Richard Ten Eyck discusses possible paint color schemes for the Cessna Cardinal with two members of his professional staff. Final paint treatment is an integral part of his design function and can require up to three months to select the appropriate scheme for a particular Cessna model.

believed that the carburetor air intake was in a bad location and not doing a very good job of taking in air.

So the carburetor air intake was moved up directly under the spinner, creating a single, semicircular air intake, divided into three sections to provide more efficient intake of air.

There were some areas of study by both Cessna engineers and Ten Eyck's organization which were never completely reconciled. One was the *Cardinal's* wing tip, which was studied in hopes of finding some added aerodynamic usefulness and yet enhancing the sleek look of the airplane itself. The problem was exploited simultaneously from both esthetic and engineering standpoints, but to no avail.

"Designers are supposed to have a poor relationship with engineers. Our relationship with Cessna engineers has been excellent. They ask us for our esthetic exploration, and as modifying decisions are made by management and engineering, they are reflected in constant changes which take place from inception until the final product appears on the market," Ten Eyck said.

"Our objectives constantly change, becoming more specific as the product continues through the developmental process."

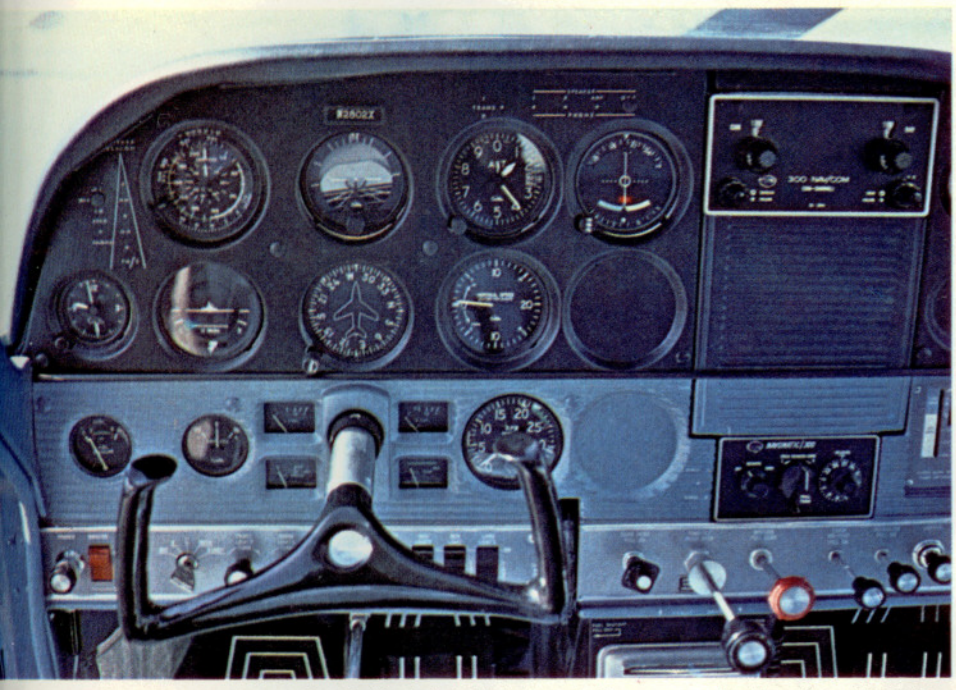
Explaining it another way, Ten Eyck added: "Our job is in the more subtle area of trying to improve acceptance from the psychological standpoint. The key to the whole thing is psychological. The way we feel about things is very real to all of us, and we either like a product or we don't. In fact, we expend 70 to 85% of our waking energy visually every day, every one of us," he said.

Looking back to past Cessna design changes which originated in his shop, Ten Eyck gestured to a painting of a Cessna twin on his office wall.

"The pointed look of Cessna twins—it looks like the speed you expect, which is one of the specific devices we can use to convey the points about a product that we want to convey.

"I don't want to play down the importance of paint," he added, explaining that "the paint scheme enhances the total picture of the machine as it actually is."

However, Ten Eyck relies more on the configuration of the airplane itself to create a visual attraction than on the paint scheme. All colors for Cessna products are selected by Ten Eyck and his staff out of doors, in natural daylight, and to fit the specific design of the aircraft.



Human factors specialist on Ten Eyck's industrial design staff came up with ideas for primary features of the Cardinal's new, cleanly-appointed instrument panel. Coupled with his designing talent was more than 2,000 flight hours and an instrument rating.

He called it "a difficult process," one that can take up to two or three months for each model. "We develop the paint schemes here in rough form and refine, further define and expand, and devise and either discard it, or work it up until we've a choice of ideas for any given unit. When we're satisfied, we present the illustrated ideas to a product and styling committee."

Consisting of a production management representative, the chief engineer, a marketing division designee, the interior stylist and Ten Eyck, the product and styling committee must pass on the proposed paint schemes before they are presented to top management for final approval or rejection.

"In designing a paint scheme, we wish to make the airplane look long and low and finished, and have built-in contrasts for easy to be seen contrast. Our main objective in the paint treatment is 'the Cessna look'—striking and individual," Ten Eyck said.

He was quick to point out that the ability of being seen by other aircraft is not a function of color, as is generally assumed by the customer.

"One reason that red is the biggest seller is the belief that it is more easily seen. It actually is the darkness and lightness of the airplane configuration itself—the highness of the wing or tail—that helps you spot the thing. Its shadows and shades are far more significant," Ten Eyck said. "Color is almost imperceptible in our peripheral vision."

In the case of the first two *Cardinal* prototypes, however, Ten Eyck's theory did not entirely hold water. All decked out in their new commercial paint schemes, the first two *Cardinals* drew so much attention in the skies over Wichita that their schemes were quickly traded in for a nondescript olive drab.

"But the configuration of the aircraft was so distinctive that it attracted attention even in olive drab," Ten Eyck said, explaining that although the new paint job implied that the new aircraft was not to be considered a commercial model, it was never implied that it was a military model either.

One of Ten Eyck's pet grievances is with the Federal Aviation Administration regulation requiring 12-inch registration numbers on all aircraft; numbers, he asserts, that "don't serve any purpose whatsoever."

Yet the same regulation applies to Boeing 707's and Cessna 150's alike. On the 150, the "N" number's billboard size becomes the dominant visual element to the extent you can see the number before you can tell what kind of plane it is, Ten Eyck said.

For the future, the designer sees a continuation of efforts on the part of general aviation aircraft manufacturers to make their products more comfortable for the passenger and easier to fly for the pilot.

"This will not necessarily mean a simpler airplane to build, but rather a reevaluation of the human factors and an adjustment of the hardware to fit the human. For years, we have been doing it wrong," Ten Eyck said.

"New configurations? Yes, there will be new configurations, and snappy ones too. But the real significant thing will be the improvement of the job of actual flying. A great breakthrough is beginning to show on our horizon," he added. □

THE AUTHOR

Arnold M. Lewis, Jr., has been flying for the past two years and has worked as a newspaperman for about 5 years. He soloed in Wichita, Kan., in 1966, receiving his private pilot certificate the same year. He is currently employed as aviation writer with The Wichita Eagle. This is his first article for The PILOT.
