# Cycle

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BRITISH SHOCKER
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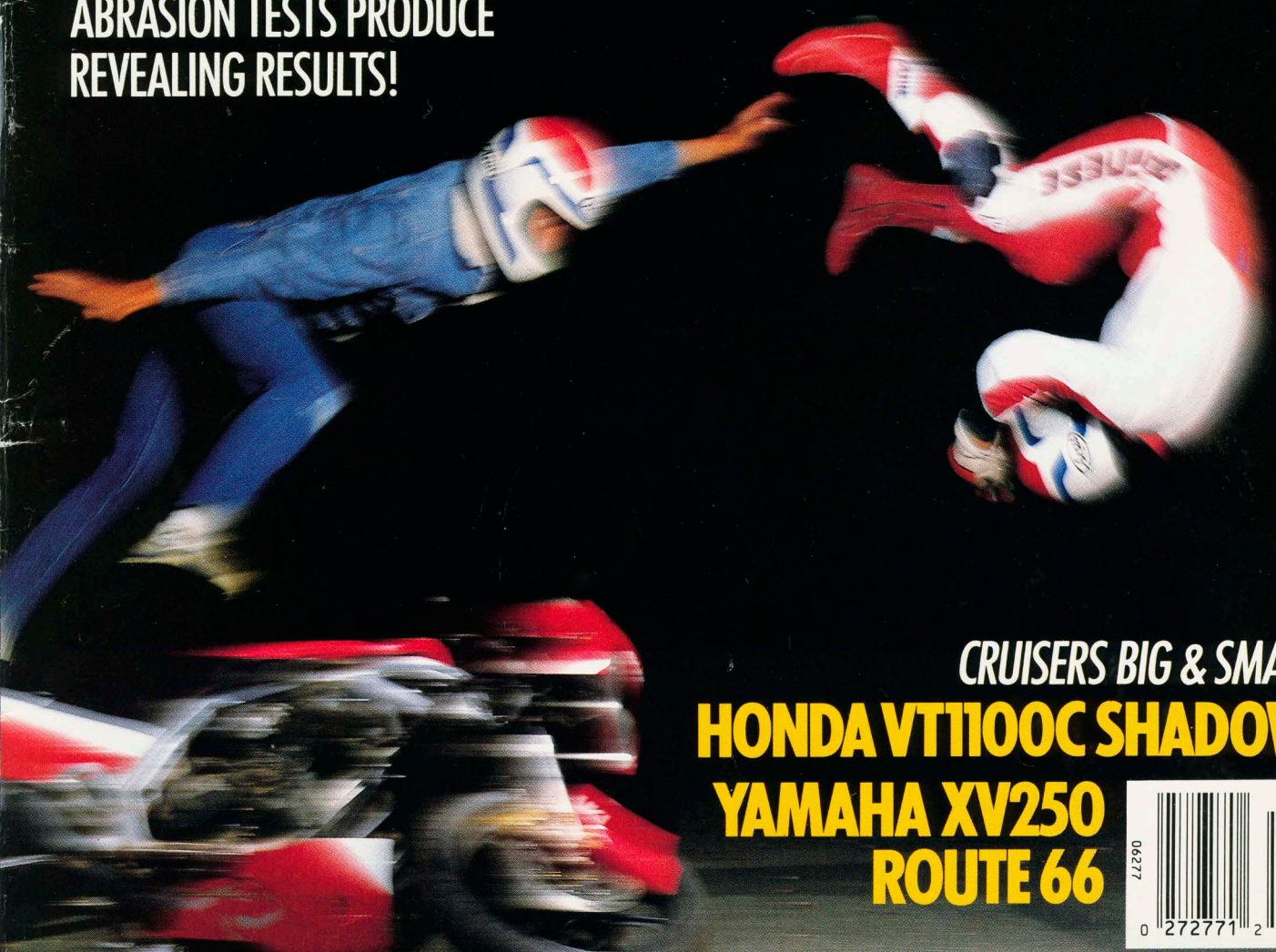
# WHAT YOU WEAR, AND WHY IT MAKES A DIFFERENCE

MOTORCYCLE CLOTHING MATERIALS: ABRASION TESTS PRODUCE REVEALING RESULTS!



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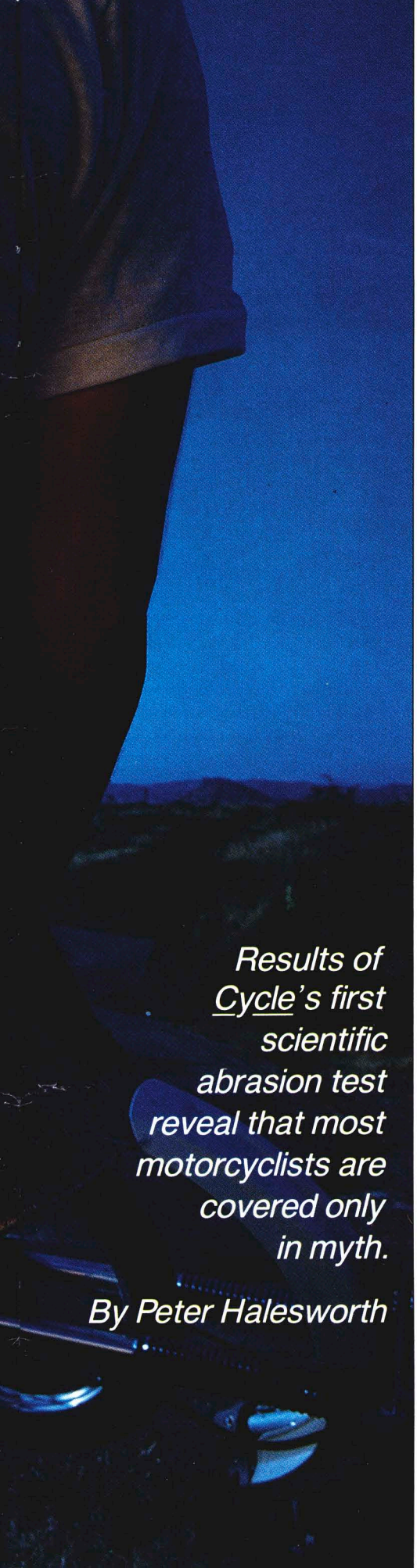


*Results of Cycle's first scientific abrasion test reveal that most motorcyclists are covered only in myth.*

*By Peter Halesworth*

☐ Your jeans are tough, right? After a full summer of wear, they're just starting to break in. Comfortable, hip and strong, your "cool blues" fit in everywhere from brickyard to winebar—an icon of American function and style.

But watch those blue jeans subjected to a different sort of task: A test swatch of denim is mounted to a spinning platform, beneath a pair of descending grinding wheels. At first contact, the wheels turn blue instantly—their abrasive surfaces peeling the dyed surface finish from the cotton. After 70 revolutions, the abrasion discs have gnawed deep into the fabric. Strands of white yarn hang loose like broken guitar strings.

A little more than a minute later, the lab analyst signals material failure. The grinding wheels have broken through the denim's last defenses—the jeans are gutted.

Now, try those riding jeans in the "real world." Mounted on a rack attached to the rear bumper of a pickup truck, another test strip of denim slaps down onto the surface of a road at 50 miles per hour. A loud report—the muffled explosion of thousands of threads bursting apart—alarms the witnesses. The denim's demise occurs in an instant. Four feet after it met the road—in less than a second—the jean material tore through.

Consider this: when applied to the enormous stress forces of high-speed abrasion, denim fails almost instantly. Falling off a motorcycle wearing your favorite blue jeans leaves you to face the pavement virtually naked.

There is nothing new in all this. Thousands of riders—and many more jeans—have been ripped by the rasp of asphalt. Road rash isn't the most dangerous injury motorcyclists face, but it's painful—and in many cases preventable.

**ABRASION TESTING**

# TORN IN THE USA

PHOTO: ADAM BRÜSS

*Drag tests (opposite) distinguished the abrasion-resistant materials: competition-weight leather stood tall above the rest, with only Kevlar and Cordura able to endure more than five feet of the road's grinding.*

## ABRASION TESTING: DRAG TEST

Yet motorcyclists have been slow to take action against this risk. Why? For safety, a helmet gets the nod before a good pair of riding pants, and few enthusiasts would seriously argue that choice. And, on the rider's priority list for apparel, abrasion resistance generally ranks somewhere below pocket capacity.

That's because a garment's ability to protect a motorcyclist from abrasion is—until they hit the road at speed—both invisible and unknown. In the absence of any real data on abrasion resistance, motorcyclists have relied on personal experience, anecdotal knowledge and what passes for common sense. There's been almost no science involved in making protective garment choices.

With this article, *Cycle* presents the first objective, comparative test of fabrics commonly worn by motorcyclists. The test samples were selected with regard to materials rather than specific pieces of gear, such as "Bates Competition Leathers."

The results of this test are surprising, disturbing and enlightening. Using this data, motorcyclists will be able to make more informed choices with regard to the abrasion resistance of apparel.

### Task and Testing

"Abrasion" is the temporary adhesion of two bodies, and in this process surface material rubs off one or both bodies. Consider the contact between skin and a road surface. Pavement contains shards of quarry rock known as aggregates, which rise up like tiny saw-teeth that can penetrate and tear. In such an encounter, skin is the surface that gets rubbed away, and so it makes sense to minimize its exposure to the pavement. Far better to abrade a motorcyclist's clothing material than his own hide. But what differences do materials actually make?

To find out, *Cycle* chose a two-test approach—first an empirical on-the-road "drag" test; second, laboratory analysis to measure the abrasion resistance of common materials used in motorcycling apparel. The road test reproduced an actual encounter with road friction. The laboratory test, known as the Taber Test, is a well-recognized, standardized method for evaluating abrasion resistance. Like *Cycle*'s approach to motorcycle evaluation, our abrasion testing developed numbers from the "real-world" as well as from the "laboratory." Looking at individual elements and then combining information can validate the accuracy of the component parts and generate a broader, more thorough picture of performance.

### DRAG TEST

The object of the drag test (see chart, opposite page) was to create sufficient weight and pressure on the test materials to simulate a fallen motorcyclist's slide at 50 miles per hour, and to measure (in distance) various materials' performance. Since there is no industry standard for drag testing, we devised our own—which we felt could produce reliable, consistent, repeatable results. The reported findings are based on several drags.

The test samples were stitched in as the bottom panel of bags measuring 26.5 in. x 14.5 in. The bags were stuffed with cloth and filled with chalk which, upon rupture, would leave a visible streak on the road. A 75-pound sandbag inside a milk crate provided the weight; a hinged-steel test rack mounted to the rear bumper of *Cycle*'s pickup truck allowed the samples to be lowered gently onto the pavement. (We wanted to test for material abrasion—tossing the bags would have introduced "impact" issues.) The "test site" was an aging, two-lane road in Ventura County, officially classified as B3—"B" for a medium-travel load, "3" to designate the thickest layer of asphalt and concrete.

On a dry and breezy morning, with an air temperature reading of 75 degrees Fahrenheit, we began our drags.

*Leather, Competition Weight, 3 oz./sq. ft.*

Initial contact instantly wiped the leather's shiny surface away, leaving a "flower-petal" imprint. With a constant "shushing" sound, the sample settled into a continuous, steady slide, exhibiting no abrupt, jerky movements typical of the extreme adhesion and snagging of destructive abrasion. Still, a chalk streak soon appeared. Inspection revealed three degrees of abrasion damage: first the partial rubbing away of the shiny surface finish; then the light brown tan of the leather; and finally the white, furry abraded natural hide beneath. In measuring and retracing the leather's route along the road, we found tiny dyed fibers in the asphalt crevices between the rock aggregates.
*Distance: 86 ft., 0 in.*

*Leather, Lightweight, Nude Finish, 2.25 oz./sq.ft.*

Rather than test 2.25 oz. competition leather against the 3.0 oz. sample (later data suggested that results would have been similar), we wanted to see what difference surface finish might make. Nude-finish leather lacks the polished or slick surface coating that motorcycle jackets normally have. It has a simple vegetable tan surface that looks like suede.

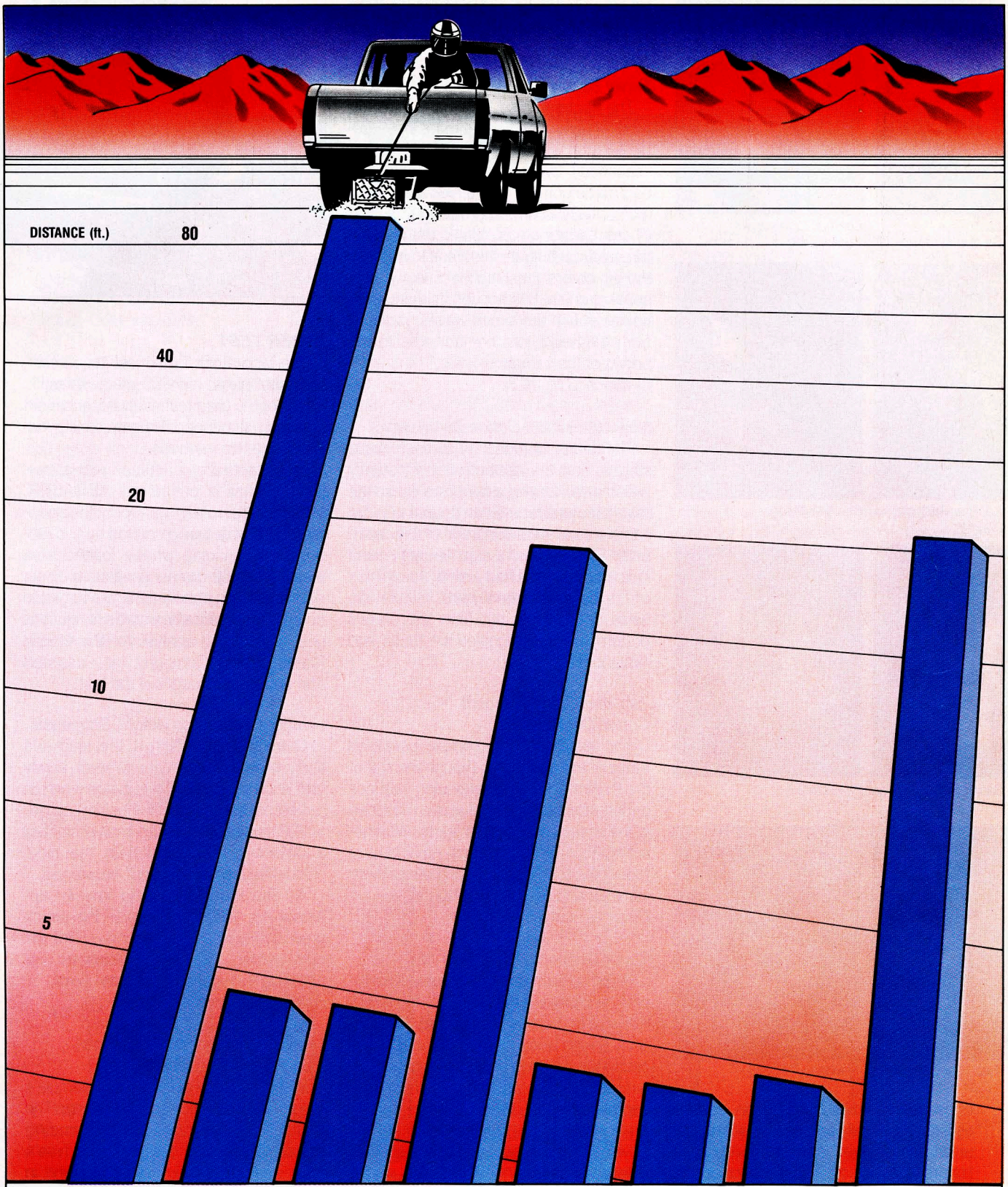
Our sample of nude leather ruptured almost instantly. Pieces flapped from the bag's bottom in long, loose ribbons, and there were other indications of severe ripping and tearing action: left behind on the roadway, snagged on the point of one particularly tall aggregate, was a 1.5-inch gouge, ripped right out of the leather, only four feet after our sample hit the road.
*Distance: 4 ft., 3 in.*

*Leather, Fashion Weight, 1.75 oz./sq. ft.*

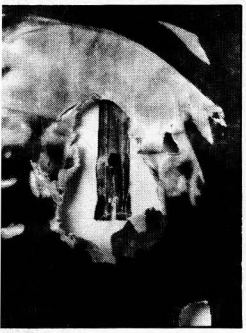
On contact, the acrylic-finished, lime-green leather eased into a clean, smooth-sounding slide—a promising sign reminiscent of the finished competition-weight leather. But shortly after touchdown, a cloud of bright lime-green specks—like flakes of cracked paint—appeared in the sample's wake, followed instantly by a thick chalk streak. The road had ground its way through the fashion sample.
*Distance: 4 ft., 4 in.*

*Cordura Nylon, Type 440*

Much like the finished-leather samples, the Cordura made smooth contact with the road surface. Except for a rusty-red streak of torn nylon fibers left on the road, the Cordura didn't suffer a dramatic loss

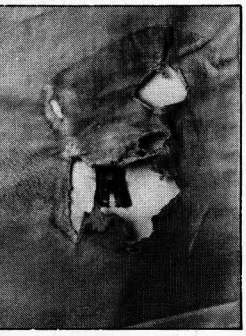



*Cordura and Kevlar are registered trademarks of the DuPont Company.*



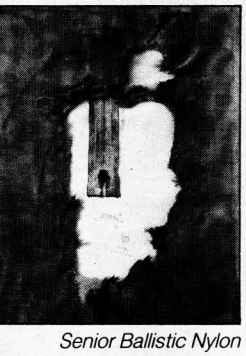
*Leather, Competition Weight*

*Leather, Lightweight, Nude Finish*

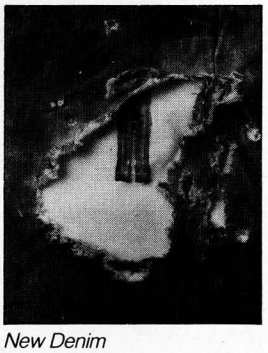


*Leather, Fashion Weight*

*Cordura Nylon*



*Senior Ballistic Nylon*



*New Denim*

*Two-Year-Old Denim*

*Kevlar*

of material. Instead the nylon sample abraded gradually and evenly, somewhat resembling the competition-weight leather in its sound and behavior on the road—no dramatic gripping, no sounds of ripping and tearing.

Despite the very encouraging start, in a little over 18 feet the chalk streak leaked onto the drag path. The nylon sample's light weight and thinness caused it to behave something like the fashion-weight leather, though the consequences were less dramatic.
*Distance: 18 ft., 3 in.*

*Senior Ballistic Nylon*

The contrast in sound on the road between the finished leathers and this sample of nylon was striking: while the leather "shushed" evenly along the road, this bag made contact with a loud slap, went momentarily silent, then caught a grip of great adhesion. Suddenly, the material tore free, causing the test rack to hop into the air before crashing back down in a spray of chalk. This hop left its mark: dark ripples, much like shock waves, radiated from the bag's torn contact area to the edges of the sample.
*Distance: 3 ft., 10 in.*

*New 100-Percent Cotton Denim Jeans*

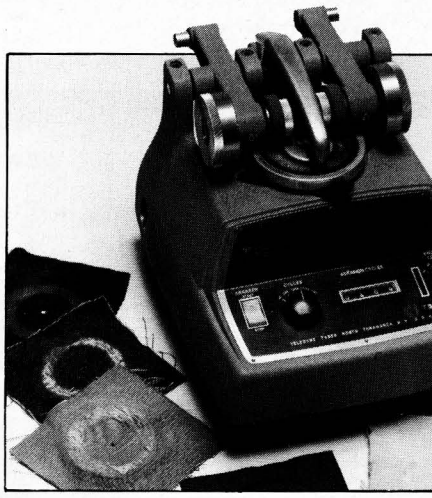
The jeans abraded in distinct, rapid stages: first the cotton's finish instantly wiped away, leaving a faint blue tint on the road's gray surface. Seen bouncing in the sample's trail were hundreds of tiny denim balls. By this time, a loud tearing sound indicated the road had already taken hold of the denim's cotton yarns. Before this white debris blew out from the crate's bottom, the chalk signaled the test's end
*Distance: 3 ft., 10 in.*

*Two-Year-Old 100-Percent Cotton Denim Jeans*

The results for this sample paralleled those of the new jeans, though the first of the three stages of deterioration was less apparent because little blue dye remained in the faded two-year-old jeans. Whether acting on new or old jeans, navy blue or faded, the road easily ground away these samples and left them in ribbons.
*Distance: 4 ft., .5 in.*

*Kevlar 29 Aramid Fiber, Style 713*

Initial contact caused a dull-yellow imprint, yet, beyond this stain, the Kevlar left little visible material on the road. A heavy, gritty sound accompanied the drag, indicating the scruffing was more a grind than a slide. Despite the sound, the Kevlar sample left little debris behind—and no chalk until the bag had traveled 22 feet down the road. A post-test check showed extensive unraveling where the aggregates had penetrated and pulled the yarns of Kevlar out of their weave. Still, these aramid strands, heavily scuffed and abraded, had strongly resisted the road grinder.
*Distance: 22 ft., 1 in.*



### *TABER TEST*

The laboratory Taber Test (see chart, opposite page) served as a scientific check of the drag test's results, and it did establish a bridge of compatibility between the two methods.

Taber tests are conducted with a four-inch turntable called an ABRASER. Mounted on a rotating platform, the specimen turns while being scuffed by two rubber-emery grinding wheels loaded at a maximum 2000 grams. A vacuum clears debris from the specimen, and a turntable counter automatically records revolutions until rupture. An analyst for the United States Testing Company, Inc., assisted and observed throughout the test.

*Leather, Competition Weight, 3 oz./sq. ft.*

Quickly scrubbing off the leather's shiny brown surface, the wheels slowly tore and ripped the fibers below—which puffed off the surface like baking bread. At 700 revolutions, the lab analyst sighted a defect—a tiny scratch in the hide. "Could be a problem later," he warned.

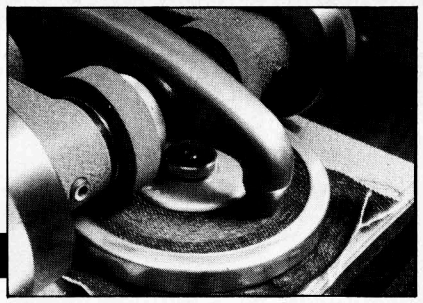
As the wheels ground lower—approaching 1500 revolutions—the crack grew darker and more ominous. But the hide resisted 1100 more revolutions until breaking through at its weakest point.
*Result: 2600 revolutions*

*Leather, Lightweight, Nude Finish, 2.25 oz./sq. ft.*

Within 100 revolutions this sample's beige surface had scuffed away. The sharp, interior edges of the grinding wheels then sliced deep into the hide's furry interior—a dark incision growing in the white fluff.
*Result: 564 revolutions*

*Leather, Fashion Weight, 1.75 oz./sq. ft.*

Surprisingly, this lighter fashion-weight leather outlasted the heavier nude sample



## ABRASION TESTING: TABER TEST

(2.25 oz/sq. ft. versus 1.75 oz./sq. ft.) At 200 revolutions, the lime color had peeled off the acrylic coating and the wheels quickly tunneled below the surface, probing the hide's thickness and weight. Only 550 revolutions later the sample failed.
*Result: 750 revolutions*

*Cordura Nylon, Type 440*

By revolution 200, the Cordura had sustained serious damage: its Zepel-waterproof coating provided no defense for the red nylon fibers on the surface—which were easily teased out of their yarns. By 300 revolutions, the ABRASER had churned up torn chunks of red nylon, and the white, polyurethane backing appeared.

"That backing won't help," said the lab analyst, as the wheels quickly broke through the polyurethane.
*Result: 559 revolutions*

*Senior Ballistic Nylon*

Like Cordura Nylon, the filaments of Senior Ballistic immediately frothed as the wheels teased them out of their yarns. But this woven nylon's strength and density (measured at 1050 *denier,* a unit expressing fiber mass) allowed the test sample to resist the wheel with good success.
*Result: 817 revolutions*

*New 100-Percent Cotton Denim Jeans*

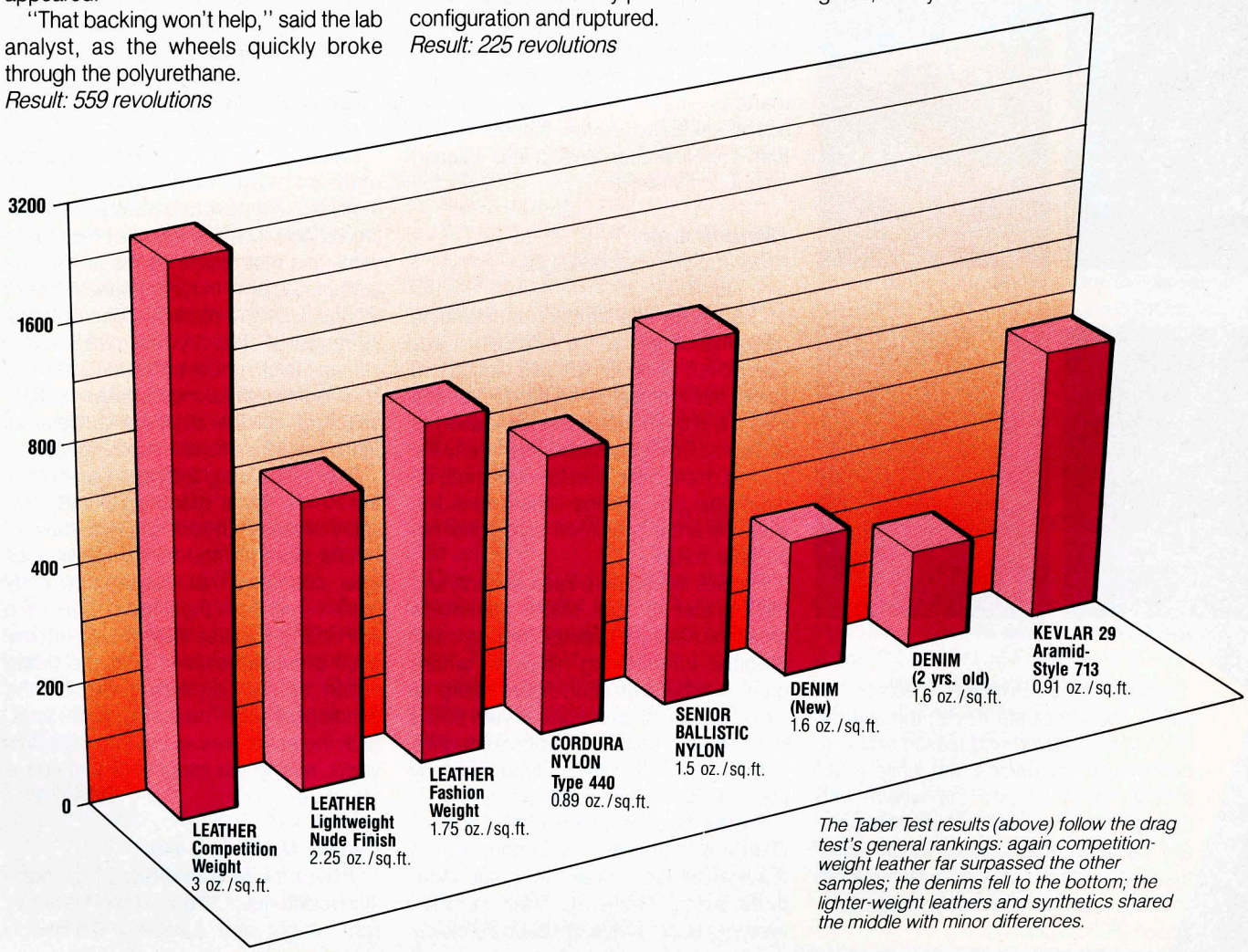
As the wheels hit the jeans, the blue dye lifted and a ring of damage flashed white. The cotton twills lasted longer than the dye, but, unlike the yarns of Senior Ballistic, Cordura or Kevlar—whose filaments were simply cut or frayed—the denim's twills were immediately pulled out of their configuration and ruptured.
*Result: 225 revolutions*

*Two-Year-Old 100-Percent Cotton Denim Jeans*

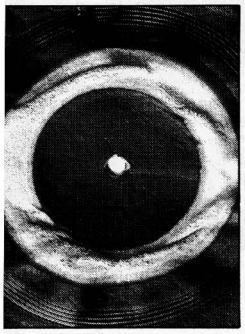
These old jeans deteriorated much like the new ones: the wheels tore a white ring into the fabric by gnawing through the faded-denim finish. Breakthrough came early as the faded denim—perhaps the fabric most commonly worn by motorcyclists—failed faster than any other material tested.
*Result: 168 revolutions*

*Kevlar 29 Aramid, Style 713*

"This stuff might take us weeks," said the lab analyst as he struggled with heavy scissors to cut the Kevlar sample. "My supervisor and I guessed this sample would go 30,000 cycles."

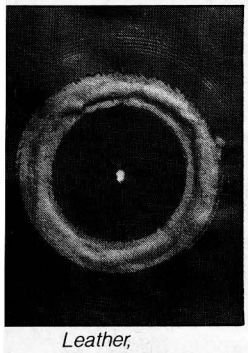



*The Taber Test results (above) follow the drag test's general rankings: again competition-weight leather far surpassed the other samples; the denims fell to the bottom; the lighter-weight leathers and synthetics shared the middle with minor differences.*

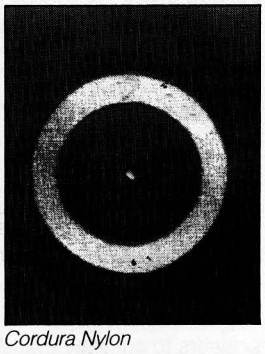


*Leather, Competition Weight*

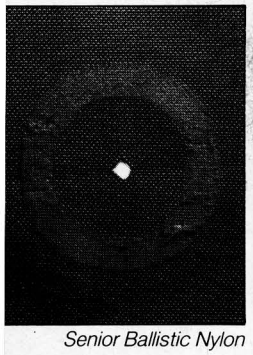
*Leather, Lightweight, Nude Finish*



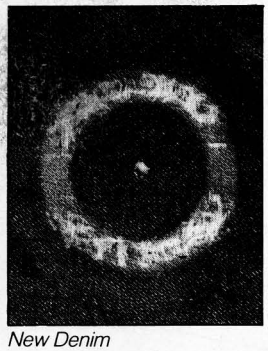
*Leather, Fashion Weight*



*Cordura Nylon*

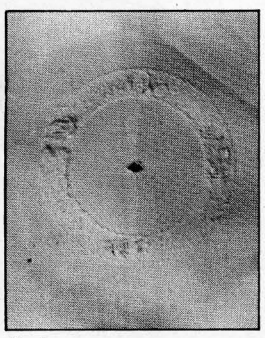


*Senior Ballistic Nylon*



*New Denim*

*Two-Year-Old Denim*



*Kevlar*

But when the ABRASER wheels hit the yellow surface of the Kevlar, the surface foamed with frayed and teased yellow fiber. By 200 revolutions, the wheels had steadily churned into the weave and through the yarns without resistance or any period of stabilization. Much earlier than expected, the strong Kevlar fell victim to the grinding wheels' tiny aggregates.
*Result: 506 revolutions*


# ABRASION TESTING: RESULTS

### *Results*

The eight materials tested can be separated into three broad categories according to abrasion resistance: "Natural Armor," "Strong Synthetics" and "Light Duty." Except for Kevlar, Nude Leather, and Senior Ballistic Nylon (for reasons explained below), the results of the drag and Taber tests are highly compatible. Minor differences between samples in the individual drag/Taber performances—such as the Two-Year-Old Jeans dragging seven inches farther than the New Jeans—had little bearing on our conclusions.

### *"Natural Armor"*

*Leather, Competition Weight, 3 oz./sq. ft.*

The key to this leather's outstanding performance lies at the molecular level. Composed of short, tangled clusters of fibers, this material is the product of collagen, a protein that is the foundation of all hides. Collagen molecules intertwine in long, triple-helix spirals—like three-dimensional coil springs—that cross link with one another to form a complex net called a fibrule.

Fibrules continue to interconnect, and they cluster to form fibers. Man-made creations have yet to match this intricate, irregular interlocking network, where great numbers of short fibers share all stresses from all directions. A yarn pulled from a weave can ruin a fabric's integrity; one broken leather fiber's load is merely passed onto countless others.

Protecting this network on the competition-weight leather is a smooth, plated finish which reduces adhesion and facilitates sliding. Once the finish abraded away, its fibers broke up relatively slowly and in tiny pieces. The fibers' ability to elongate and stretch with the pull of the road aggregates (while anchored in the collagen-bonded networks) resulted in a gradual wearing away termed "ablation." This means there's a predictable erosion of material rather than a catastrophic failure. Only the competition leather demonstrated this ablation quality in the drag test.

### *"Strong Synthetics"*

*Kevlar 29 Aramid, Style 713*

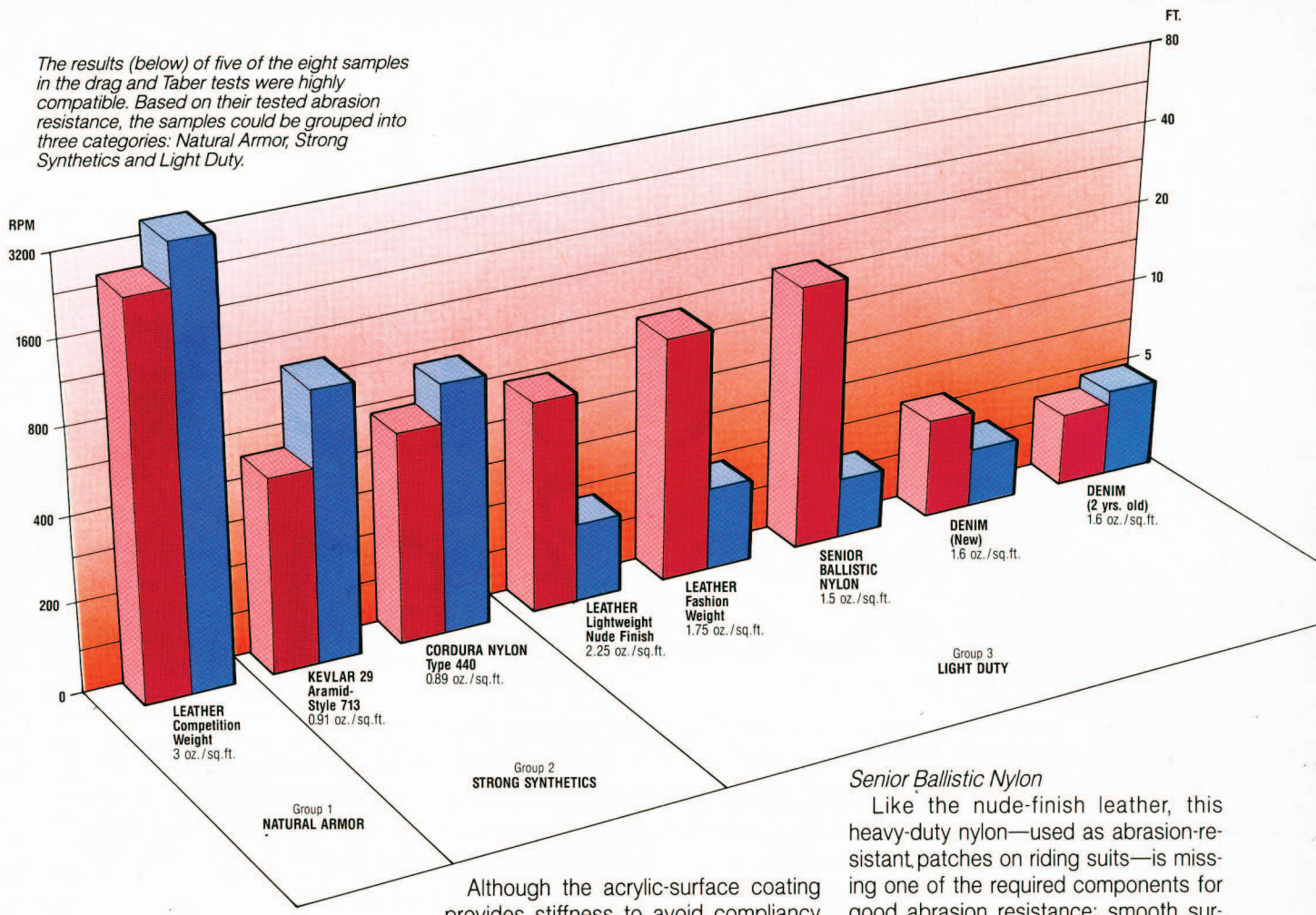
Discovered in 1965, Kevlar is a state-of-the-art ballistic fabric. It has outstanding slash and puncture resistance, making it a logical choice for bullet-resistance vests and motorcycle garments. But the aramid filaments in Kevlar cannot flex or elongate so the material doesn't bend; its range of elasticity resembles a very stiff and thick rubber band that stretches little before breaking. Leather's fiber structure, on the other hand, behaves more like a thin, flexible rubber band.

During the drag test, the filaments in the Kevlar yarns stood rigid and inevitably broke—but with a fierce show of tensile strength and tension resistance after snagging that caused the gritty noise heard from the flatbed. Under the ABRASER, the less impressive performance of Kevlar resulted from the slicing action of the tiny aggregates on the grinding wheels. The teeth, unable to attack the entire weave, cut into individual yarns, ruining the integrity of the weave structure.

*Cordura Nylon, Type 440*

Touted for its comfort and high abrasion resistance, Cordura nicely balances light weight and durability. Commonly

*The results (below) of five of the eight samples in the drag and Taber tests were highly compatible. Based on their tested abrasion resistance, the samples could be grouped into three categories: Natural Armor, Strong Synthetics and Light Duty.*




used in outdoor wear and luggage, Cordura is the textile scientist's answer to cotton and leather. Woven in a dense and compact plain weave (one yarn travels under another intersecting and perpendicular yarn, then over the next, then under, etc.), its fibers are flexible, slippery, and elongate well.

Three factors explain the weakness of Cordura in the drag test: lack of weight, insufficient thickness and an air-treatment process used to soften the fibers. While making the fibers feel like spun yarn, this treatment also weakens them, decreasing their original 1000 denier mass measurement to 500 denier.

The comparable results of Cordura and Kevlar illustrate their key advantages: the strength of Kevlar counterbalances its lack of flexibility; the flexibility of Cordura makes up for its lack of strength.

### *"Light Duty"*

*Leather, Fashion Weight, 1.75 oz./sq.ft.*

As the thinnest and lightest of the leathers, the fashion weight performed equally with the heavier nude leather for one reason: finish.

Although the acrylic-surface coating provides stiffness to avoid compliancy and adhesion, the surface coating also contains a rubbery shield of polymers—a regular, long-chained chemical molecule giving elasticity—that stretched with the aggregates in both tests. Eventually, especially in the drag test, the stretchy and tough polymer coating broke down, allowing the aggregates to tear the low-tensile-strength hide apart. This destruction occurred in the nude-finish leather as well, but the fashion weight's acrylic coating forestalled the attack.

*Leather, Lightweight, Nude Finish, 2.25 oz./sq.ft.*

Only 0.75 oz./sq.ft. lighter than the competition-weight leather, this sample was soundly trounced because it has no finish. With only a vegetable tan, there was nothing to deflect aggregates, avoid adhesion, or promote sliding. The aggregates had easy entrance to another weakness: an interior softened during the dying process by tumbling. Furthermore, the nude leather's compliancy created a larger contact area with the road, producing even greater adhesion, followed by even more powerful tearing and shredding by aggregates.

*Senior Ballistic Nylon*

Like the nude-finish leather, this heavy-duty nylon—used as abrasion-resistant patches on riding suits—is missing one of the required components for good abrasion resistance: smooth surface texture. Its tight, compact plain weave squeezes and floats yarns high off the surface in patterned knobs. In the drag test, these knobs provided handles for the the road's aggregates. The dramatic tearing suddenly freed the knobby surface from the road and caused the crate's explosive jump.

Although this nylon's thickness, weight and tensile strength produced superior results in the ABRASER, its grippy surface doomed it in the drag test.

*New and Two-Year-Old 100-Percent Cotton Jeans*

With no finish coating, the soft and compliant denims adhered to the road much like nude leather. But the resulting shredding by road aggregates was more exaggerated. The denim (which gets its name from twill configuration not color) has a less dense and compact weave pattern than Kevlar, Cordura and Senior Ballistic Nylon. With a pattern of one under, one over, then one under, two over, one under, two over, etc., many yarns "float" on the jeans' surface, making them susceptible to immediate snagging and tearing.

## ABRASION TESTING

### *Conclusion*

The lackluster performance of most samples in the drag test indicates more than specific weaknesses. It shows how much motorcyclists expect of clothing. It demonstrates how little protection the most universal item in our wardrobe—blue jeans—actually gives. The test suggests the hazards of buying non-specialized clothing for a very specialized purpose. It should remind us again that apparel manufacturers are only beginning to use a scientific approach to develop materials for motorcycle gear.

If they think much about it at all, motorcyclists want clothing with great abrasion resistance. But, since their lives include more than motorcycling, most riders also want apparel with a broad versatility. Many riders don't want to look like they've just stepped out of a 1950s motorcycle movie or descended from a space vehicle. Motorcyclists recognize that specialized riding gear is expensive, yet the very expense becomes an argument for versatility. Everyone wants motorcycle clothing to be highly abrasion resistant, universally stylish, broadly accepted, as comfortable as an old sweatshirt—and as inexpensive as a garage-sale clock radio.

Within the boundaries of our testing, the essential elements for good road-abrasion resistance are: a smooth surface texture and thick coating to promote sliding; some rigidity to discourage compliance and adhesion; a flexible internal structure to elongate under abrasion; and sufficient thickness to promote ablation and buy time before rupturing.

These elements are all essential for optimum protection. The absence of just one element—nude leather's lack of a smooth, tough surface to promote sliding, for example—severely compromises performance.

Finally, protection from road abrasion


# Road Rash: Only Skin Deep?

☐ For many riders, road rash is merely a badge of good luck—proof of a fortunate escape from greater injury. Skin heals as if by magic, and once a rider gets beyond the scab stage, all is forgotten.

Because it usually takes care of itself, skin is easy to ignore; most people don't even know what the body's largest organ does beyond its role as a package wrapper for their insides. Among other functions, skin cells monitor body temperature, break down hostile carcinogens, and execute trespassing bacteria.

No matter how versatile it is, your hide cannot protect itself from a slide down the road. Without an effective covering, the skin is vulnerable to three degrees of burns and you run the risk of bone grinding, substantial blood loss and trauma complications. Severely abraded skin also leaves an inroad for bacteria. Harry Hurt—of the University of Southern California's Traffic Safety Center, and America's eye on motorcycle safety—recalls a tragic and extreme case:

"A guy wearing only his bathing suit jumped on his 350 and headed for a swim at his girlfriend's house just down the street. He dumped it at only 37 mph, fell on his right hip, and then rolled onto his left shoulder, forehead and left scalp. He suffered one large abrasion 20 inches long and eight inches wide. Twenty-eight percent of his integument [skin and scalp] suffered from bleeding abrasion.

"They brought him to the emergency room, and then later put him in intensive care. He died a week later of staphylococcus and sepsis infection.

"This is the extreme, but it was a fall at only 37 miles per hour. Without body covering you expose yourself to spectacular danger with a capital 'D.' "

In Australia in 1982, The Royal Brisbane Hospital Burn Unit completed a thirteen-and-a-half-year study of motorcycle burn injuries under the direction of researchers Dr. Stuart P. Pegg and Dr. T.D. Mayze. Here is a sample of their findings:

—In the major-burn unit, injuries associated with road friction comprised 29 percent of the sample (45 percent had hot-metal burns);

—The median inpatient stay for all burn victims was eight days, with a range from one to 186 days. The size of the friction burns presented a particular challenge for speedy rehabilitation;

—Forty-six percent of the friction burn patients had injuries to both upper and lower limbs, and a further 27 percent had injuries to either upper or lower limbs. The most severely abraded riders were wearing minimal clothing—usually shorts, light footwear and a cotton T-shirt—at the time of injury;

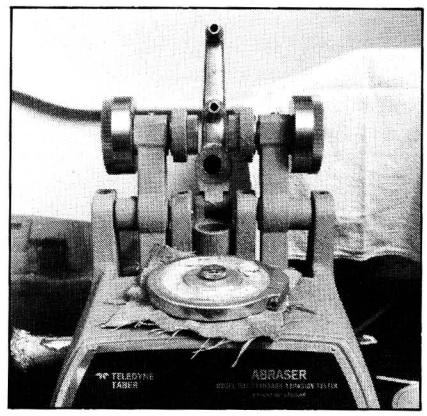
—Most common were second-degree (friction) burns, with deep partial loss of the top layer of skin (the epidermis), and the creation of "tattoos"—dirt and rock ground deep into the skin;

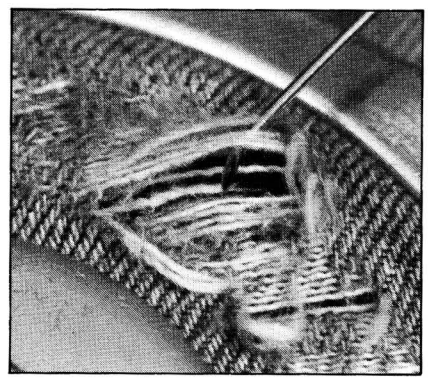
—Analysis of data from accident sites led the researchers to conclude that "suitable clothing would have prevented most of the injuries."

For these people, road rash was not a badge of good luck at all.

*—Peter Halesworth*

cannot be guaranteed by a material's abrasion resistance alone. A jacket may have panels of highly abrasion-resistant materials; yet if low-quality stitching joins those panels and the seams come apart on impact or during a slide, then the abrasion resistance of the panels could count for nothing. Furthermore, an ill-fitting garment may ride up in a slide, contorting the rider's body and exposing his skin. And the best jacket in the world, left unzipped and unsnapped, won't give the rider the protection he paid for. Bear in mind, when it comes to safety, the issues are more complex than just the abrasion resistance of materials.



At *Cycle* the results of our testing have led various staffers to rethink their motorcycling wardrobe. Consider please: experienced riders love to ridicule the kid riding with a helmet, jams, sneakers and a medium-bronze tan. The next laugh is on those of us tooting around in T-shirts, blue jeans, and street shoes. Because, when push comes to slide, we're not much better off. ■

*Note on graphs: Because space limitations required non-linear scales for distance and rpm, the charts used in this article compress the actual differences between the samples.*