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The most raucous cars in all of drag racing are Nitro Flops (partially due to the header configuration, which differs from a Top Fuel car). The sounds and the fury are unmistakable. All photos: Wayne Scraba

New rules, new pipe

The face of fuel Funny Car racing is changing rapidly as a result of shorter tracks and new regulations which have inspired improvements in chassis construction, tire design, safety equipment, and driver protection. But, as **Wayne Scraba** reports, the spectacular heritage of the fuel altered class hasn't disappeared quite yet

The most dangerous, and perhaps the most spectacular, of all drag race cars have to be the 'fuel altered' cars during their 1960s heyday. Those cars had short wheel bases, high engine locations in an effort to promote weight transfer, volatile supercharged nitromethane fueled engine combinations and, of course, a driver in the most vulnerable location possible – directly behind the power plant. They regularly careered all over the racetrack, sometimes on fire, and were a handful at the best of times. And today's ancestral descendant of the fuel altered? The fuel Funny Car.

To be fair, the specifications differ from a fuel altered, but make no mistake, these are still volatile race cars that take considerable skill to drive and maintain. And recent history has shown that no matter how well prepared a car may be, and how much preparation a racetrack may have, accidents can and will happen. Because of those recent events, a number of changes have taken place within fuel car racing. From an NHRA perspective, the track length has been shortened to 1,000 feet (in an effort to slow the cars and to provide more shut down room) and a very large number of vehicle safety regulations have changed. Many of those changes (particularly to the fuel Funny Car chassis) are dramatic.

For the uninitiated, Funny Cars are front engine, rear wheel drive, tube frame race cars with a composite one-piece body draped over the

top. Bodies are hinged at the rear to allow for service access. Power is provided by a supercharged 500 cubic inch Hemi engine (loosely based upon the 1964 Chrysler race hemi), burning 90% nitro methane, 10% alcohol. Engine power is somewhere in excess of 7,000 or even 8,000 horsepower. The driver sits directly behind this powerhouse, sandwiched over the driveshaft and ahead of the massive Goodyear slicks. All of this in a race car that can cover a quarter mile (from a standing start) in little more than 4.6 seconds at almost 334 MPH. In 1,000 feet, it's not uncommon for a fuel powered Funny Car to reach the finish stripe in 4 seconds flat at 300+ MPH.

Sweeping New Specifications

Shortly after the tragic racing accident that claimed the life of Funny Car driver Eric Medlen in March 2007, the NHRA, the motorsport standard-setting body the SFI, and the SFI's Funny Car Chassis committee, along with technical consultants from Ford Motor Company, a representative from Lincoln Electric and several professional engineers, met to discuss the state of the Funny Car chassis. As Arnie Kuhns, President and Chief Executive Officer of the SFI, is quick to point out, the existing Funny Car spec at that time (2007) was already more than two decades old. It was antiquated. The SFI, led by Kuhns, had recently revised the Top Fuel specification. His position was to take what they had learned from the Top Fuel spec revision and apply it to the new Funny Car specification (which would eventually become SFI 10.5).

The meetings led to a series of tests performed by Ford Motor Company. Using data taken from the car driven by the late Eric Medlen, a group of Ford Engineers used computer modeling to simulate the stresses created within a Funny Car chassis. Using "FEA" or finite element analysis, the committee was able to examine and then beef up each piece within the Funny Car chassis to determine the specific weaknesses.

Eventually, they were able to test a complete car. What they found was startling: There was a series of harmonics set up within the chassis, that in Kuhn's words "could create the perfect storm", provided the conditions were right. In fact that perfect storm is what likely caused Medlen's catastrophic accident. Once the vibrations started, there was nothing that could be done to stop them.

As the committee went along, they would fix one tube at a time (typically by increasing the size of the tubing) and then re-test the model. Kuhns notes that when one weak spot was fixed, another would appear. It turned out to be a question of fixing each problem until there were no others left on the plate. The chassis with the new SFI 10.5 spec has a safety margin of 25%. Kuhns knows that performances will eventually surpass this spec, but for the time being, it is a rather significant accomplishment. Ultimately, the new SFI Funny Car specification includes thicker tubing in critical stress areas as well as the option of constructing a three-rail frame design (more on the three-rail design later).

In real world terms, how much improvement did finite element analysis (FEA) reveal for the new specification? In an interview with the NHRA's National DRAGSTER, John Medlen (of John Force Racing) described the significant progress that had been made. He was quoted: "The cross sections where Eric's car failed and where John Force's car failed last year in Dallas were subject to 35,000 PSI in those areas… New cars are measuring under 10,000 PSI, and in most tests, they're under 5,000." On 11 January 2008 a draft of the new specification was presented to the committee for review and subsequently approved. A week later, the SFI Board of Directors approved the final spec, and a day later it was released to the general public. Today, that new SFI specification for funny cars (a 3D, 22-page long document) is mandatory in all fuel Funny Cars.

Chassis Builders, Small & Large

Chassis builder, Brad Hadman (Progressive Metalcraft) is quick to point out that something had needed to be done for a long time: "The NHRA worried about Top Fuel, but fundamentally, Funny Cars haven't changed much since the Seventies. Today, the area of the car from the firewall back must be 1½-inch diameter, 0.095-inch gauge tubing. The front of the car is pretty much open to our creativity. We work with the upper and lower frame rails to plant the tire. I believe that engineering a car that flexes at this point is the answer. To get there, we can tune the way the chassis behaves by either spreading or tightening the distance between the front frame rails: By moving the rails closer ▶

Are these cars sophisticated? You be the judge, but there is considerable technology required to propel a full bodied car to elapsed times in the 4.00-second zone. Today, companies such as Ford Motor Company, (and perhaps to a lesser degree, General Motors and Chrysler) have provided teams with far reaching technology. See the text for more insight

THREE RAIL CHASSIS DESIGN

What is the advantage of the three-rail design? The new SFI two-rail spec calls for a pair of rails that measure 1.50-inches in diameter and with a wall thickness of 0.095-inches. The three-rail configuration uses the same 1.50-inch main rail tubing diameter, but the wall thickness is less, at 0.083-inches. Three-rails simply means that from the firewall back, a Funny Car can have two round tube main frame rails -- upper and lower, one on top of each other, each round tube frame rail separated by a series of tubular uprights (more or less like a ladder placed on end). If three main rails are used, they're smaller diameter, but fit within the same space and still maintain the use of tubular uprights to join the respective rails.

together, we get more flex. Moving them apart tightens up the chassis.

"Motor position is also tunable. Each crew chief has his own idea about where the motor should be. Sixty-five to sixty-seven inches out (ahead of the back axle) is the norm. One of the big problems with Funny Cars is the driveshaft. It used to be that a driver could tell how good the run in a Funny Car was by the way the driveshaft rubbed the seat(!).

"In many of the high profile accidents – Medlen's death and Force's big accident – the driveshaft is likely what started the chain of events. Because of this, teams such as JFR are using a special carbon fiber tub inside the car. This tub pretty much stretches from the motor to the seat upright. It effectively places a tunnel over the driveshaft so that it can't get to the driver. In other accidents, we're sure they were first caused by the driveshaft coming out of the car.

"Is technology going to move ahead more? I don't think so. We've made big and rapid changes in the past year. It will level out."

Hadman builds four complete fuel Funny Cars annually (along with a virtual plethora of dragsters). Typically, it takes four weeks, working full time, to build a car (with three fabricators working full time on the car). Without the body, a complete Funny Car chassis costs in the range of $80,000 to $100,000.

A major player in the fuel Funny Car chassis builder ranks is Murph McKinney (McKinney Corp). McKinney (along with Hadman) is on the SFI Funny Car committee. He was not only front row centre when the new chassis regulations were created; he had sizeable input as well. Now what many people don't know is McKinney has, for a considerable period of time, been using FEA modelling to layout his race car chassis (Murf primarily builds Funny Cars and dragsters for both nitro and alcohol fuelled applications). McKinney points out: "There are people out there who don't buy into computer modeling, but it is used for all sorts of engineering, world-wide. It is only a tool, not an end-all design program. You have to consider the inputs – if you put garbage in you'll get garbage out. Good input data will provide you with valuable, useable design information. Used and interpreted correctly, FEA can be a huge benefit. We tend to catch flak over it. It's unfortunate that some people make it out for what it isn't."

McKinney notes that he began using FEA early on – Murph's company has been involved with the technology for over two decades. He admits he even modeled competitor's cars. The modeling system could show him where his competitors' cars could fail. Surely enough, they did.

It's interesting to note that while the SFI was developing the new Funny Car specification, John Force Racing, Force's sponsor Ford Motor Company and McKinney were involved in the design of a three-rail chassis (see box). As it turns out, a large amount of time and money was spent developing the three-rail chassis, and Murph notes that it was John Force who literally gave the technology away for free in the interest of promoting Funny Car safety (hence the acceptance as an alterative configuration within SFI Spec 10.5).

McKinney states that all of the John Force Racing team cars incorporate the three-rail design and so does the Tasca racing operation. He has others under construction too. Although the three-rail design is more or less unproven over the long haul (it's very new this season), Murf notes that the chassis is stiffer. It is also slightly heavier, but McKinney is quick to point out that when the new NHRA rules came out, the accepted minimum weight of the entire car was increased as well – up to 2,555 pounds, from the 2007 minimum weight of 2,425 pounds.

The new cars are more costly to build and to purchase, and McKinney is well aware of that fact. But the reality is the cars will last longer with the new specification. What does it cost for a basic chassis? McKinney Corp. publishes a price list, but Murph figures it's really only a guideline. For the very basics in a chassis, less body, less rear, less wheels and tires and so on, the cost is just under $30,000. Then there's a list of options or extras that one pretty much needs

Part and parcel of the funny car has almost always been the easy to access, lift up body. If you look closely at the body, you'll note the considerable amount of bracing required to keep the carbon fiber composite body intact (particularly at speed). NHRA regulations spell out how the specific latch mechanism is laid out. In case you're wondering, it takes just as long to fit a bare body with all of the hardware as it does to build the chassis

John Force Racing (JFR) is taking a leading role when it comes to Fuel Funny Car safety. It's no secret that a series of recent tragic events have scarred the face of Funny Car competition, however safety improvements are now manyfold

For the 2008 racing season, the complete Funny Car chassis rules structure was overhauled. A new SFI spec (SFI 10.5) was introduced. This meant that all chassis would have to meet the new specification, which was light-years away from the old spec. It was the first time FEA modeling and testing was performed on a SFI F/C chassis specification

before the car can be put together. Those extras can ring up the cash register by another $5,000 to $10,000, and you're far from done. It's not hard to have six figures invested in a modern Funny Car chassis. There's more too: To trim out the basic body, you can easily add another $20,000 and change (not counting many basic options).

Cost is a very big issue with Murph. He spends an inordinate amount of time fretting over the price factor of professional drag racing. A shift to 1,000-foot long track has helped to reduce racing costs, and so has the new Goodyear tire (described below). McKinney notes that even in tough economic times, he's pushing to bring new technology and equipment into the manufacturing area so that he can make the cars less costly to produce and simultaneously, last longer. It may seem like a wee bit of an oxymoron – if a racer wears out a car sooner, then they'll be back for another sooner. Murph doesn't see it that way. He'd rather see more and more new racers enter the picture. That way, his company can still sell more cars and in turn, the sanctioning bodies would see bigger fields.

Just how many chassis does someone like McKinney build? Murph notes that in the nine-month span from November 2007 to the end of July 2008, his company was completing 1½ cars per week. In order to accomplish this, McKinney Corp. employs 32 people and runs two fabrication shifts. In the drag racing world, it's big business, and he even has a full time engineer on staff.

From The Racer's Perspective

When it comes to the new chassis specifications, racer Tim Wilkerson (a major contender for the 2008 NHRA championship) notes that the new chassis rules have definitely made an impact upon racing. They have also changed the way teams set up their cars. Due to the new tubing sizes mandated by the new SFI specification, the car is far stiffer

Rules from the sanctioning bodies mandate an on-board fire extinguishing system (no surprise). Typically, two ten pound bottles are incorporated, along with half a dozen nozzles. Most often, DuPont FE-36 is the extinguishing agent of choice

from the motor plate back. From a setup standpoint, it is more difficult to get wheel speed with the new chassis, and as Tim points out, once it "goes over the top" (from the wheel speed perspective), the car has a tendency to smoke the tires. Wilkerson figures it just took them some time to get the car sorted out. After that, the new chassis rules actually made for an easier car to work on. The chassis stays square and because of this, things like the rear end are now easy to remove and replace for service.

What about the advantages of "fresh pipe" (something many fuel racers discuss)? Wilkerson's team has two complete cars in its arsenal. Tim figures after fifteen to twenty passes, the chassis take a rest. At that point, they can get a true baseline for data. Wilkerson claims he runs a car for a year, although some teams will try three or more chassis in a given season. It's interesting to note that Wilkerson's team will regularly purchase a bare chassis from McKinney Corp. and build it in their shop from that point (adding a-arms, rear end, plumbing, wiring and so on themselves). Occasionally though, they'll purchase a car with more hardware installed (more or less a "roller").

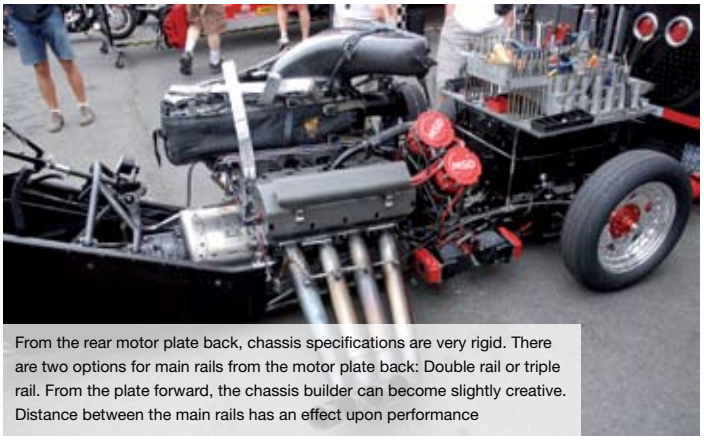
What's the horizon? Wilkerson is working on a new chassis concept from McKinney. While there are some layout changes (with the number of tubes in the main rail – for all intents and purposes, the three-rail chassis we spoke of above), what he wants to do is to mount the chute packs on the chassis (instead of the body). The idea here is if the body disintegrates, the parachutes will always stay with the chassis.

Safety First

Stroud Safety's Bob Stroud has a keen eye on Funny Car safety. It is, after all, his business. He thinks there are some mistaken concepts out there regarding safety. One is the rush toward Kevlar-based parachutes. Stroud notes that while he builds drag chutes from Kevlar, it isn't the best material for drag racing: "Kevlar is really used where abrasion is an issue – case-in-point, Bonneville. The salt quickly wears out a nylon chute. That isn't the case with asphalt or concrete. The problem with Kevlar is that unlike ballistic nylon materials, Kevlar will look good upon inspection, but it can fail catastrophically in use. A Kevlar chute might only last five runs before it should be replaced. Another misguided notion is the fire capability of parachutes. A nylon chute is good for 450° Fahrenheit. A Kevlar chute is good for 900° F. Unfortunately, a fire in a fuel car might easily exceed 1,500° to 2,000° F. ▶

WHAT CONSTITUTES A FUEL FUNNY CAR CHASSIS?

Today's Funny Car must weigh at least 2,555 pounds, with the driver included, and have a wheelbase of 124 to 125 inches. Wheelbase variation, from left to right is 2 inches. The minimum ground clearance from the front of the car to a point 12 inches behind the centerline of the front axle is regulated to 3 inches. The balance of the car has a minimum two-inch clearance with the exception of the oil pan and exhaust headers. The front overhang may not exceed 40 inches, measured from the centerline of the front axle. Front tread width must be no more than 6 inches inside the body while the rear tread width must be no more than 3 inches inside the body. The underside of body, including any roof area and all the composite components (for example, timer boxes) must be covered with flame-retardant covering or coating. Dual parachutes are mandatory, as are four-wheel disc brakes (most often carbon-carbon at the rear) and a special escape hatch must be located in the roof of the body. Specific interior body panels ("tin" for a lack of a better term) must be steel or aluminum and a full seven-point driver restraint system is mandatory, as is a head and neck restraint system. The driver must wear a special SFI-approved fire suit and a fresh air system (where compressed fresh air is provided to the driver) must be used. There are a number of other strict regulations, but perhaps the most compelling has been the change in the roll cage system.



From the rear motor plate back, chassis specifications are very rigid. There are two options for main rails from the motor plate back: Double rail or triple rail. From the plate forward, the chassis builder can become slightly creative. Distance between the main rails has an effect upon performance

Goodyear introduced a new tire for both Top Fuel and Funny Car in 2008. Crewchiefs love it, as it lasts almost twice as long, they balance well and they don't chunk. That tire, by the way, measures 36-inches tall, with a tread width of 17.3-inches along with a section width of 21.6-inches

Under those conditions, how much longer will a Kevlar chute last?"

Stroud thinks the answer is a launcher chute – something all Pro Stock racers and most Alcohol Funny Car racers use. The launcher either uses mechanics (springs) or pneumatics (compressed air) to fire the parachutes into the air stream away from the car. As Bob points out, this helps keep the chute away from the flames as it is deployed. In practice, the chute launcher completely does away with pilot chutes and their inherent problems. The chute launcher is especially effective on the 1/8-mile courses, as it is not speed dependent like a pilot chute system. The mechanical system is spring deployed using a regular pull handle. For those cars that have onboard air, a pneumatic system is preferred. It is lighter and easier to use than the spring launcher. Both systems work equally well and as Bob points out, the parachute does not know the difference.

Stroud also has a new 9-point restraint system that has found acceptance in Pro Stock. He thinks it is ideal for Funny Car applications. This design is based upon a lap belt, with a three-piece crotch strap and multiple shoulder harness assemblies. The idea behind it was to make the system easier to use (even with the multiple straps) and easier to cinch. As Stroud notes: "The idea here is to keep the driver tightly wrapped in the car – you really don't want to become the clapper in a bell, which is what often happens as the driver rattles around inside the roll cage tubing."

NHRA mandates an on-board fire suppression system on all Funny Cars. These systems must meet SFI Spec 17.1. In this case, that means the system must be based upon two ten-pound bottles of fire suppressant. There are different types of suppressant on the market, but the most common for this application is DuPont's FE-36 material.

Steve Baker of Safecraft points out that his company is one of perhaps four or five that regularly manufactures and sells fire suppression equipment for fuel Funny Cars. It's not a big field either – there might only be 50 fuel Funny Cars on the planet. None-the-less, Steve notes that the SFI spec is the bare minimum. His company feels that to be totally effective, the system must be equipped with six nozzles – four in the engine compartment, one in the driver's compartment and one behind the driver. In operation, the Safecraft system is engaged by a pull cable attached to the first fire bottle (Bottle "A"). When it is engaged, it automatically activates the second bottle (Bottle "B") by way of pressure. This eliminates the need for bulky hardware or the need for the driver to engage two different fire bottle systems.

Baker notes that while DuPont's FE-36 is likely today's best extinguishing agent, it isn't as effective as good old-fashioned Halon. The difference is, FE36 is supposedly less toxic and more environmentally friendly. And believe it or not, the fire extinguishing system found in a Funny Car is likely one of the least expensive components on the car – Safecraft sells them out the door from between $1,200 and $1,500, depending upon the options.

Rear Gears

The rear end assembly found in a typical Fuel Funny Car is a very specialized device. Only two companies regularly supply teams with rear end hardware: Chrisman Components and Strange Engineering.

The Strange Engineering 12-inch Live Axle housing is unique in both design and material. Strange notes the top load design coupled with the live axle provides an excellent structural base that maximizes gear life and significantly reduces rear end distortion. The unit features magnesium tubes, magnesium cover, steel axle, steel spool, 11.50 inch carbon brake kit and internal oil pump. Their standard 12 inch live axle assembly weighs 205 pounds, complete less oil. Fully assembled, the live axle with gear set sells for $15,500.

Strange has another version that incorporates special lightweight components. Here, the axles are manufactured from titanium and the spool is machined from aluminum. The lightweight version has a special pump that reduces the required oil capacity by four quarts.

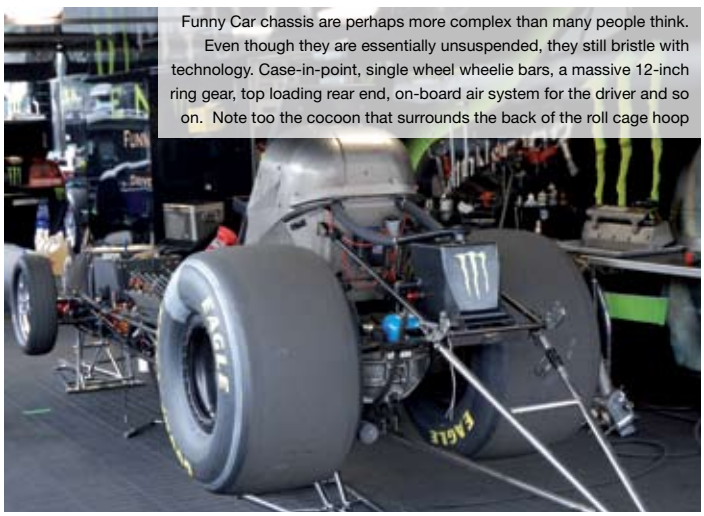
Chrisman Components, on the other hand, offers a specialized rear axle assembly of its own manufacture. This time it is in a 12.50-inch live axle format, based around billet components. The C-12 Live Axle comes standard with the Chrisman drilled steel rotors or a Carbon fiber brake upgrade available provided by Lamb Components (the Lamb setup is based upon a carbon-carbon format, and incorporates titanium rotor adapters). Costs for the rear are similar to those of the Strange Engineering setup.

Rolling Stock

In mid 2008, Goodyear released their new fuel-racing tire, the D2550 -- a replacement for their D2420 slick (a tire that was first introduced in 2006). These drag slicks measure 36 inches tall x 17.5 inches wide and use a 16 inch diameter wheel. Tire weight is 48.5 pounds and they're designed for use with a rim flange bead lock device. In a Funny Car, Goodyear recommends a cold tire pressure of 6.0 pounds.

According to Goodyear, the new slick differs from its predecessors in the methodology used to build it. The tire carcass is still manufactured by hand, however the tread is continuously wound (using machinery).

Unlike Top Fuel Dragsters, a Funny Car must be equipped with front brakes. The sanctioning bodies mandate four-wheel disc setups. Carbon-Carbon assemblies are often the brake of choice



Funny Car chassis are perhaps more complex than many people think. Even though they are essentially unsuspended, they still bristle with technology. Case-in-point, single wheel wheelie bars, a massive 12-inch ring gear, top loading rear end, on-board air system for the driver and so on. Note too the cocoon that surrounds the back of the roll cage hoop

FUNNY CAR CHASSIS SOURCES

Chrisman Driveline Components
1321 Lewis Street, Anaheim, CA 92805, USA
Tel: +1 714-776-2501
Website: www.chrismans.com

Goodyear Tire Company
1144 East Market Street, Akron, OH 44316, USA
Website: www.racegoodyear.com/

McKinney Corp.
4710 Fastline Drive, Lafayette, IN 47905, USA
Tel: +1 765-448-4800
Website: www.mckinneycorp.com

Progressive Metalcraft
2219 112th St E, Tacoma, WA , 98446-3731, USA
Tel: +1 253-539-3339

Safecraft
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Website: www.safecraft.com/

SFI Foundation, Inc.
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Website: www.sfifoundation.com

Strange Engineering
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Stroud Safety
4101 South May, Oklahoma City, OK 73119, USA
Tel: +1 405-632-2022
Website: www.stroudsaftey.com

The result is the tire is more uniform than the old design. In theory, the process should make tires more consistent. Compounding changed (actually a bit harder than the old D2420) and given the new construction practice so did the sidewall layout.

In use, tire wear has eased considerably with the new tires and many teams are now experiencing as much as three times the life from a set of slicks. In the past, the old D2420 tire was good for two runs (!). The new tire life span seems to range from two runs to as many as twelve. As far as "hook" is concerned, most teams are reporting the tires aren't short of it. Even with a bit harder compound, the new tires exhibit excellent traction capability.

The world of the Funny Car chassis has changed dramatically over the past twelve months. To be sure, unfortunate tragedies prompted many of the revisions, however the ensuing regulatory changes have made fuel Funny Cars a much safer place to race than they were a few short months before. The truth is, the face of Funny Car racing has changed forever. And that's a good thing. ■

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