

**BELOW** Pack's back: the Daytona meeting proved that NASCAR's modifications had restored the art of pack racing to the sport's Superspeedway (Photo: autostock/Brian Czobat for Toyota Racing)

# ALL CHANGE

The 2012 Daytona 500 saw two major changes to NASCAR's Sprint Cup – one short-term, the other far-reaching. **Andrew Charman** ushers in NASCAR's new era

**T**HE DAYTONA 500, the race that is both the season-opener to the NASCAR Sprint Cup and paradoxically its biggest event, has never been short of headlines. And in 2012 the potential headlines were being written long before the haulers arrived at the 2.5-mile superspeedway in Florida.

For the cars unloaded at Daytona boasted two major changes from what had gone before. In one area NASCAR was seeking a quick fix to a problem that it hoped would only last through four specific races of the 2012 season. But in another the series was entering a new era, leaving behind one of its core features in the quest for a closer relationship to 21st century motoring.

NASCAR had finally said goodbye to the carburettor – the 2012 Daytona 500, scheduled for 26th February, would mark the first Sprint Cup round for electronic fuel-injected (EFI) stock cars. As we will learn later in this feature, the change appeared, initially, to go very smoothly, although potential issues with the new systems are now surfacing – not earth-shattering problems, but enough to make teams take notice.

Part of the reason that fuel injection appeared to have such a smooth entry into competition was that nobody was talking about it. The system had been a year in development so no real surprises were expected, particularly as the nature of

Daytona was unlikely to seriously test its capabilities. The track is a superspeedway with horsepower curbed by air inlet restrictor plates, where the throttle is pressed hard to the floor for the entire lap – unlike on most tracks which demand acceleration and braking up to four times a lap.

## FINAL TANGO?

However silence over EFI at Daytona was mainly due to the headlines focusing elsewhere, initially on aerodynamics. Previous issues of Race Tech have documented NASCAR's battle to break up the two-car pushing that in the past year has replaced pack racing at the two





Superspeedway tracks of Daytona and Talladega, and which neither the drivers or the fans like.

Using a combination of aerodynamic modifications and restrictions to the cars' cooling systems, series officials hoped to arrive at a situation where it was no longer advantageous to join up with one other car and push it for lap after lap. And at a pre-season test at Daytona in January, they thought they had found an answer.

NASCAR duly mandated rule changes that resulted in the cars that arrived for the season-opener looking significantly different to the last time they were in Florida – a much smaller rear spoiler significantly cutting rear-end downforce, and the front radiator



**BELOW** Carnage: the return of pack racing also brought a return of the big accidents. This one early in the 500 took out media focus Danica Patrick (10) and five-time champion Jimmie Johnson (Photo: Tom Pennington for NASCAR)

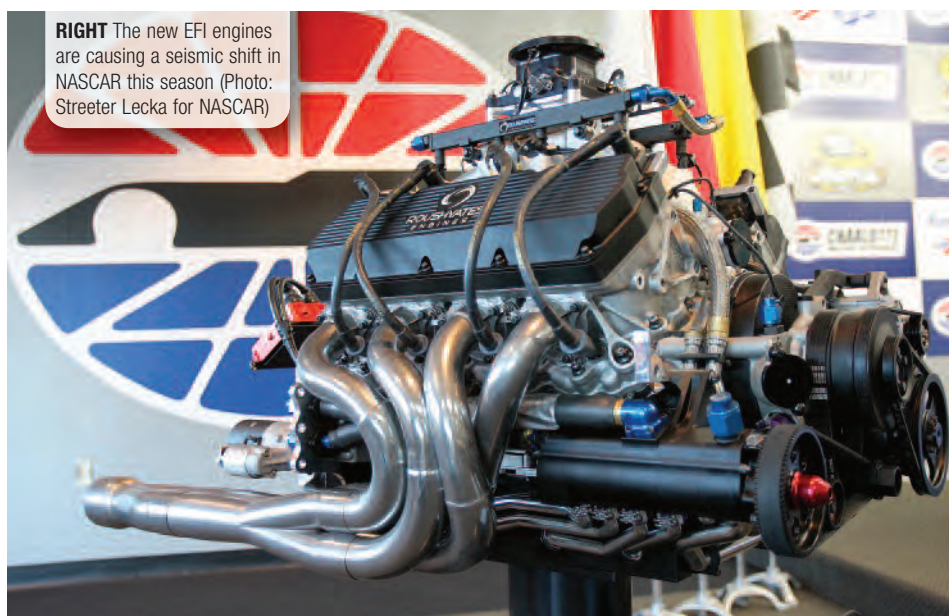
**“Teams will suffer problems as they become more familiar with the system and explore its boundaries”**

inlet moved up onto the bumper. If one car pushed another it would block its own inlet and send engine water temperatures climbing. In the Budweiser Shootout exhibition race, held a week before the 500, drivers discovered that they could not push for long at all before tell-tale plumes of steam warned them that an overheated engine was throwing out its water.

So pack racing – everyone running together inches apart – again became the best way to circulate the speedway, with perhaps the option of a two-car push for victory on the last lap. But the cut in rear-end downforce also made cars highly

susceptible to breaking into a spin if touched even lightly on the left rear corner: the Shootout was characterized by wild accidents in the pack. “NASCAR will have to change that,” some shouted after the race. NASCAR, however, held its nerve, refused to make any changes, and the two traditional 150-mile qualifying races on the Thursday saw much better behaved action as drivers curbed their aggressive tendencies in the interest of making the finish without wrecking.

How this would translate into Sunday's 500, where all 43 cars would be on the track together over a much longer distance, ►



**RIGHT** The new EFI engines are causing a seismic shift in NASCAR this season (Photo: Streeter Lecka for NASCAR)



was heavily speculated upon in the hours leading up to the race, particularly as many drivers had remarked at how hot their cars had run during the qualifying races.

In the event the 500 wrote a whole new set of headlines, ranging from the first-ever rain-out on the Sunday, to the eventual running of the race on Monday evening with prime-time TV coverage, to Indycar transferee Danica Patrick running her first Sprint Cup event and being crashed out of

it early on, to bizarrely, a red flag of more than two hours after Juan Montoya contrived to hit a track drier. These use redundant helicopter engines mounted on trailers, and when hit by Montoya's Chevrolet the 200 gallons of jet fuel carried ignited and sent a fireball across the track.

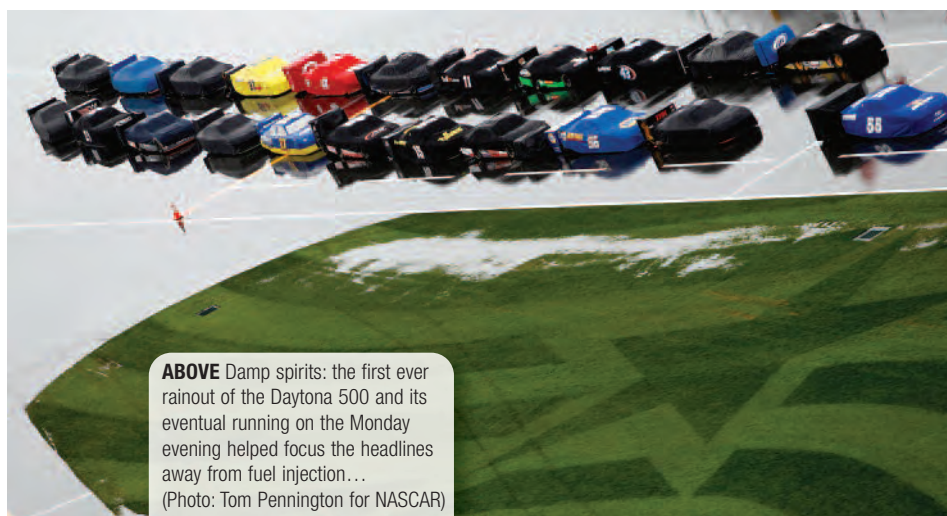
Even during the red flag driver Brad Keselowski created another big story, using his mobile phone, which he had secured in its own pouch in his race car, to take

photos and post them on social network site Twitter. His followers jumped from 80,000 to more than 200,000 in the space of two hours.

When the final 40 laps were eventually completed the cars ran in packs, and Matt Kenseth's Roush-Fenway Ford won without significant evidence of the field splitting into two-car drafts, as many had predicted. However no-one was talking about pushing after this strangest of Daytona 500s; while on the face of it NASCAR's changes appeared to have worked, many feel the true test will come at the next Superspeedway track, Talladega, on May 6.

In any case, NASCAR won't have this problem for long, as one can be certain that the all-new car shapes set for introduction at next year's Daytona 500 will only be approved in a form where they do not react well to the two-car draft technique.

And fuel injection? Its Daytona debut appeared almost to have been forgotten – but not for long. The next fortnight saw the 'true' season begin with races at the 1-mile Phoenix and 1.5-mile Las Vegas speedways. Incidents at both races brought EFI back ▶



**ABOVE** Damp spirits: the first ever rainout of the Daytona 500 and its eventual running on the Monday evening helped focus the headlines away from fuel injection... (Photo: Tom Pennington for NASCAR)



**BELOW** ...as did Juan Montoya's bizarre crash into a jet track drier, causing a fireball and stopping the race for two hours (Photo: Levitt/LAT USA)

**ABOVE & BELOW**

Sparking change: the Daytona race was the climax of several months of work for NASCAR's technical head John Darby, seen here holding one of the McLaren ECUs (Photo: Streeter Lecka for NASCAR)



into the spotlight.

Like all forms of motorsport NASCAR races see engine failures. Generally they are due to faulty batches of parts; when one car has a problem, crew chiefs of other cars in the same team start worrying. Failures early in the season are less common, yet already there have been a few in the opening three races – EFI not surprisingly being mentioned in the inevitable speculation.

But it was a very visible incident to reigning champion Tony Stewart in the Phoenix race that brought EFI back into

sharp focus. Fuel mileage is a major part of NASCAR strategy, drivers hoping that by saving fuel they can miss out a pit stop and if the race runs out in the correct fashion (ie with no late cautions producing extra pit stops), they can win as rivals are forced into a 'splash and go' stop.

A prime fuel saving technique occurs under caution when the field is lined up behind the pace car, drivers switching off their engines, coasting round the lap and then refiring them as cars start to slow. Stewart did this under caution at Phoenix, but when he tried to refire the engine, it refused to start. The Chevrolet had to be pushed to the pits where before getting it going again the team lost a lap, a sure top five and potential win.

**CIRCUIT BREAKER TRIPPED**

It transpired that at some point in the race a circuit breaker in the engine management system's relay box had tripped. It wasn't the first such incident this season, and it was also clear that no-one really knew why it had happened. "Not my department, electronics," Stewart commented, while his crew chief Steve Addington admitted to not knowing the purpose of the breaker. "I really don't understand why it's there," he said after the race. "I'm talking to the engine guys, and it's something that we've all just got to put our heads together and figure it out before (the race at) Vegas."

Toyota's NASCAR racing head Ed White, who also saw circuit breaker issues in the car of Mark Martin, thought that vibration might have led to parts breaking, the steel of a stock car being more vibration prone than the carbon-composite surroundings of the pure racecars that EFI systems have traditionally been designed around.

Doug Yates, CEO of main Ford power

**EFI AT A GLANCE**

**THE EFI** system adopted for the V8 pushrod engines of NASCAR's Sprint Cup is a simple setup, centring on an ECU supplied by the Electronic Systems department of UK-based McLaren International, with processors from US electronics supplier Freescale Semiconductor. A single Holley throttle body is employed with four air inlets, allowing NASCAR to continue to use its horsepower-curbing restrictor plates at the Superspeedways of Daytona and Talladega. Bosch O2 sensors are employed with one injector per cylinder. Further UK input comes from Essex-based DCE Motorsports, which supplies the wiring harnesses for the systems.

Teams are not allowed to modify the systems in any way. NASCAR intends to ensure both transparency in the systems and guard against any attempt by teams to alter the parameters by being able to download individual teams' data at any time, and to make all data downloaded available to every team competing. **RT**



**ABOVE** Goodbye to carbs! (Photo: Jerry Markland/Getty Images for NASCAR)

unit supplier Roush-Yates Engines, also pointed fingers in the direction of durability, but added that the circuit breaker issue was surprising as they had been more fearful of failures higher up the system, for example in the fuel sensors themselves. "Now that we're getting some races on this, there's a lot to learn," Yates said, and White agreed, saying that while the circuit breaker issue was a simple fix, the fuel injection learning curve would continue at least until the end of May.

So where are we with fuel injection? To find out Race Tech talked with long-time friend of the magazine, Andy Randolph, engine technical director of Earnhardt-Childress Racing Engines (ECR). And overall Randolph believes the switch to EFI has gone extremely well, the issues mainly ►



caused by teams unfamiliar with the systems making errors in their calibration.

"NASCAR and [EFI supplier] McLaren have done a good job of creating plenty of testing opportunities and facilitating communication between teams, and between teams and the sanctioning body, to address issues as they arose – we came a long way in a very short period," Randolph says.

"It's all new – as you know in Europe with EFI systems if there is an issue with a sensor it goes to a backup calibration strategy, and to varying degrees different teams are better equipped to deal with it. There were a couple of occasions where issues happened and put the systems in backup mode and the team's calibration was not mature enough to deal with that."

Some of the early-season engine failures can also be laid at the door of EFI. Three ECR engines, in the cars of Jamie McMurray, Jeff Burton and David Reutimann, failed at Phoenix and Randolph says these could be blamed on the extra flexibility in strategy

allowed by EFI. "You have a lot of options regarding rev limiter strategies that you didn't have before and we are finding that fuel-injected engines can accelerate a lot faster and you have to be a little more conscientious on how you evoke your rev limit strategies. We didn't have any failures at Daytona; we did at Phoenix, all those issues have been addressed and there will not be any future failures from that aspect."

Randolph believes more teams will suffer problems as they become more familiar with the system and explore its boundaries, while an unanswered question is the working life of the components. "None of us really know what the lifecycle expectations are of all the sensors and harnesses, injectors and coils – all these parts, we don't really know how many miles they are supposed to last and we are probably going to learn from the school of hard knocks unfortunately. Lifecycle management will start to become an issue as we get four or five races into the season."

Despite this, he believes the systems are a major advance, opening up several new strategy options particularly regarding fuel economy. However such strategies are no longer in the hands of the driver, because they involve choosing between leaner, more economical or thirstier, more powerful fuel mixtures.

#### ROLL THE DICE

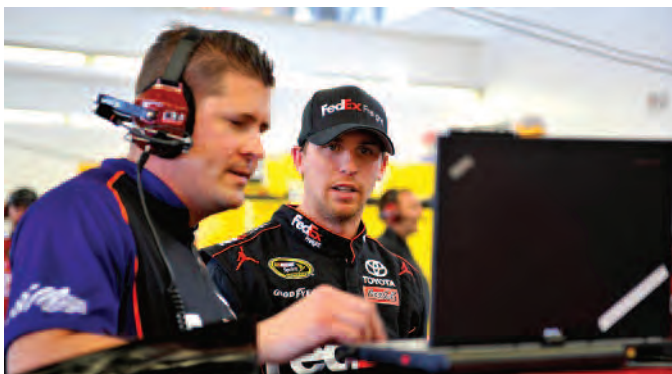
"The options now are in the hands of the teams and engineers before the race even starts, deciding what calibration philosophy they are going to follow. If you want to roll the dice and play a fuel economy game, then you'll go for a leaner calibration, more aggressive on part throttle, your engine braking. Whereas if you just want to go with full power on everything you can do that – it adds another element of strategy that we just didn't have before."

Randolph foresees crew chiefs choosing to run with less power in the hope the race turns into a fuel-mileage event – which

**“You have to be more conscientious on your rev limit strategies”**

**ABOVE** Travis Kvapil's Toyota Camry detonates its engine at Las Vegas. Engine failures have always been a part of NASCAR but the learning curve for fuel injection is a prime subject for the current ones (Photo: Todd Warshaw/Getty Images for NASCAR)





**ABOVE** Data crunching: Toyota driver Denny Hamlin studies the data. The arrival of EFI has made the laptop a more familiar tool in the garage, and put new strategy options in the hands of the crew chief (Photo: autostock/Brian Czobor for Toyota Racing)

**BELOW** Need a push: the futile efforts of current champion Tony Stewart to restart his car after he switched off to save fuel under caution at Phoenix focused attention on potential fuel injection issues (Photo: Todd Warshaw/Getty Images for NASCAR)



## THE SUPPLIER'S VIEW

**BRITISH** specialist DC Electronics, based in Maldon, Essex, is heavily involved in NASCAR's electronic fuel injection programme, supplying wiring harnesses, ignition coils and sensors for the systems. As a result in time for the 2012 Sprint Cup season the company has established a US factory in NASCAR's 'race town' of Mooresville.

According to DC Electronics managing director David Cunliffe, the introduction of EFI has been a case of "so far so good," the teething problems that have emerged being mainly concerned with the fuel system side rather than the electronics.

Such minor issues should be expected, Cunliffe tells Race Tech, because despite thousands of miles of testing the race environment puts the new systems under different stresses, especially at Daytona where the measures to try and break up two-car drafting have resulted in extreme temperatures in the engine bay.

Some teams have been seeing what they thought were high temperatures but discovered, according to Cunliffe, that the accuracy of the gauges used do not

measure up to that of the EFI hardware. NASCAR is thought to be considering permitting the use of digital displays in the cockpit for the 2013 season.

Cunliffe concurs with Andy Randolph's comment that the expected lifecycle of the system componentry remains unknown. The current practice is to play safe and change out items after three to five races, however DC Electronics is making available its Cirris tester, which it uses to check the electronic performance of newly-completed components. The company has these testers at both its UK and US facilities and the idea is that race teams have their systems retested after each race, DC then overlaying the data to analyse and check for any changes in electrical data, indicating system fatigue.

Generally, however, Cunliffe believes that the minor EFI issues experienced so far are "as bad as it is likely to get", even as teams become more familiar with the systems. "They are pretty limited in what they are allowed to do after all – they have laptops now but they can't do much with them during the race weekend." **RT**

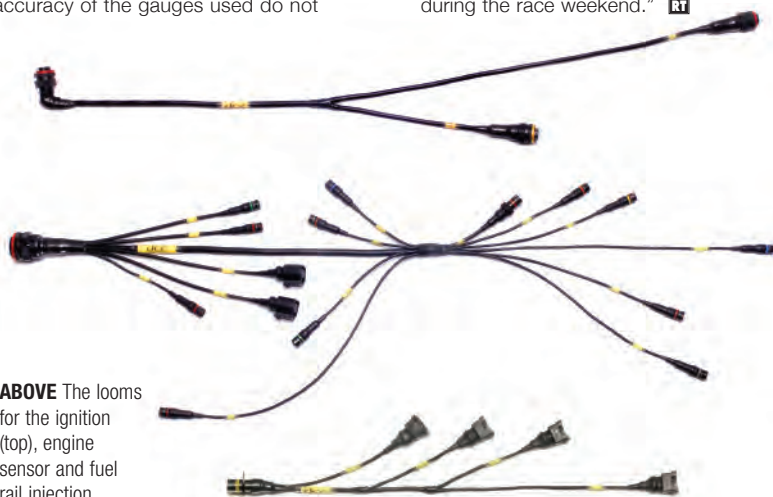
some tracks are known for. "If you (the crew chief) are going into Sunday and you realise you have a top-15 car but not one to compete for a win, you might think okay, let's give up another tenth or two a lap, get five or 10 per cent more fuel economy and see if we can steal a win that way. That's a viable approach that I am sure some people will take."

### HAVE-NOTS FACE STRUGGLE

What EFI has done, Randolph believes, is widen the gap between the Sprint Cup's haves and have-nots. "You need resource, and not just people resource but instrumentation resource – some of the instrumentation is very expensive and not everybody has it."

As a result the back of the grid teams have turned into two types – those that lease their engine package, calibration ECU and tuner from one of the main suppliers will be in a stronger position. "But then you have the other kind who are trying to lease an engine package and the rest from what is not a major Cup supplier, they are really struggling and they will continue to struggle."

It's clear that there will be more issues concerning EFI, and Race Tech will report further on the systems later in the season. Despite the seemingly smooth introduction, fuel injection is still a very new game in NASCAR and one that many prominent team members do not yet fully understand. However they will learn to understand it, and it's a safe bet that by the time NASCAR begins another era at next year's Daytona 500 with its all-new car body shapes, EFI will be an established part of the technical makeup and carburettors a distant memory... **RT**



**ABOVE** The looms for the ignition (top), engine sensor and fuel rail injection