

# *Emergency* engineering

They're machines that deal with life and death situations. As a result, both the engineering and detail of fit-for-purpose construction are key to emergency vehicles. Keith Read reports



Whether you're a hardened truck man with 'HGV' running through your veins like the 'Brighton' in Brighton rock, or a small boy in short trousers, the sight and sound of a fire engine answering a shout is evocative of heroes. But what about that big red machine with two-tone sirens and blue-flashing lights? What's it like under the panels and paintwork, compared to the fire engines of just a couple of decades ago, let alone those from our boyhoods?

The simple answer is that the latest machines on the fire station floor are as different to machines even from the 1980s as chalk is to cheese. Brian Wiggins, sales director of Worcester-based AMDAC-Carmichael, has seen big changes in the design, particularly of aircraft fire and rescue vehicles, to meet changing requirements of operators. And he sees more to come in the future.

"One of the most significant trends we are currently seeing from customers is a demand for reduced emissions," he comments. "Although these vehicles are exempt from many [Road Vehicles] Construction and Use and Emissions Regulations, customers are increasingly conscious of the need to reduce unnecessary environmental damage."

And it's not just engine tailpipe emissions that have come under the microscope. Some extinguishing materials, such as BCF (bromochlorodifluoromethane) – which is ozone-depleting and all but outlawed these days – have been replaced. Even the foam used to fight real fires is of concern. As a result, less toxic substitutes are frequently used, especially for training purposes.

Looking at Carmichael's Cobra 2 family of aircraft fire and rescue vehicles – which serve both civil and military applications – emissions reduction is about cleaner, more efficient propulsion engines, which are also used to drive PTOs (power take offs) linked to pumps and other on-board equipment. Here, the desired move is the step up from Euro 3 to Euro 5 – and the same is true for its conventional fire engines, which are mainly for export.

For Carmichael, that is posing a challenge, since Caterpillar, which supplies the company with its C18 propulsion unit, has not yet confirmed a Euro 5



version of what is essentially an off-road-vehicle engine. "We are currently looking at alternatives," comments Wiggins.

"We're log-jammed in a position where a Euro 5 engine presents a serious problem, in that, to avoid exceeding set pollution levels, these engines will go to reduced power or shut down, if dirty exhaust is detected," he explains. "In our view, that is nonsensical in an emergency service vehicle. Issues, such as automatic reduction of power output by the engine ECU, fly in the face of one of the key requirements of any emergency vehicle – 100% maximum power available all of the time. Fortunately, we're not obliged to provide a certified engine. So, if the industry is moving towards cleaner engines, we believe that Euro 5 compliant will be adequate."

Here, Euro 5 compliant means an engine that does not pose a potential threat of automatic shutdown, yet meets the emissions standards customers are demanding. What Carmichael is now seeking is an engine manufacturer that can provide such a unit – and the proof that it meets the emission standards, thereby avoiding having to do its own costly chemical analysis.

He also adds that some newer, cleaner engines can experience problems with red diesel, the fuel many airport operators use for fire and rescue fleets. "I am sure these things can be overcome," says Wiggins, who also believes that current exemptions from Construction and Use Regulations may yet be eroded, except where they conflict with the fundamental operation of the vehicle in its role.

That aside, with Cobra 2 water-carrying capacity now up to 14,000 litres, and more onboard equipment adding to its overall weight, chassis construction has also had to come under the microscope. "The chassis carrying capacity has had to be increased, so we've looked at our supply base



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## Transformed transmission

Allison Transmission used Interschutz (held every five years in Hannover, Germany, for the fire and rescue community) to launch its M6620 transmission, designed for airfield crash trucks. The new gearbox builds on the record for performance and reliability of its existing M6610.

Manlio Alvaro, Allison's European marketing manager, confirms that vehicle manufacturers worldwide – including Daimler, Renault, Iveco, DAF, Scania, MAN and Volvo – offer Allison automatics for a variety of fire and emergency applications. This new box has software and hardware upgrades aimed at improving durability, while also resulting in lower operating costs and simplified maintenance," he says.

In addition, Allison has made transmission tuning a reality – to match different operators' specific requirements. "For ultra high performance applications, Allison can increase the shift points to keep the engine at peak torque and so maximise acceleration," explains Alvaro.



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**Ian Mawhinney**

to determine where we can get the componentry from, because we’re an assembler of proprietary items,” he explains.

This, in turn, means that axles and suspensions are having to be re-verified for their suitability and matched to individual vehicles' operational demands by Carmichael's CAD teams. Incidentally, in common with other manufacturers, Carmichael is also seeing ESP (electronic stability programme) and similar safety systems increasingly appearing in emergency vehicle specifications – again, in part, to help handle the requirements of increasingly demanding vehicles.

On the other side of the coin, reducing weight to compensate for larger water tanks and additional heavy on-board equipment is another continuous process, although opportunities are increasingly limited. One area under consideration, though, is the crew cab. “We have a cab frame at the moment that’s made in high-grade stainless steel and it’s a very heavy box section, designed to meet ECE 29 crash impact standards,” states Wiggins.

And, for the time when emergency vehicles finally come to the end of their life, recycling versus reusing is presenting manufacturers such as Carmichael with different concerns. “A percentage of the bodywork is GRP [glass reinforced plastic]. But what we can see happening, as legislation tightens, is ‘reuseable’ will become unacceptable.”

### The space race

For the design and development teams at Browns Coachworks – another long established fire and rescue vehicles specialist – membership of the Magic Circle, rather than the IRTE, might be useful, according to Ian Mawhinney, director and general manager. Almost without exception, every new order for an emergency vehicle brings the same request from fire authorities: give us more storage space.

“We’re being asked to provide more space within the envelope of the vehicle for the equipment fire

authorities want to carry,” he says. Also, almost every vehicle is bespoke, with no two brigades specifying the same combination of lockers, racks, shelving or even water tanks and pumps.

“We have seen an increased use of foam, and the pumps have become more complex and much more highly automated,” comments Mawhinney. And he adds: “One of the biggest changes we’ve seen over the past three or four years has been the increased use of CAFS [compressed-air foam systems], although there’s not a clear consensus among the brigades as to whether it is so wonderful.”

However, the switch by many to CAFS means Browns now has to install pump units that incorporate different technology. “These tend to come as integrated units from pump manufacturers such as Godiva in Warwick,” he says. What about the consequent requirement for more foam tanks, more plumbing and more controls? Mawhinney says that is an issue, but adds that the key assemblies do come as part of the pump systems.

More importantly, he points to a noticeable trend towards getting away from pure fire-fighting appliances to what a lot of the brigades are now calling ‘rescue-pumps’. These retain their extensive fire-fighting capabilities – and the specifications that underpin them – but also include other equipment on board for dealing with the 50% or more of emergency services shouts that are not fire-related.

While cab safety remains a clear priority, Mawhinney explains that, with the vast majority of brigades now using factory-built cabs, some of the demand for coach-built cab specials has diminished. And with it has gone the need for coachmakers to undertake specialist design and development work.

However, the need for coachbuilders and equipment suppliers to talk to chassis-cab manufacturers has never been greater. Mawhinney: “Every new order is a new project. Our customers say: ‘Here’s our last vehicle. We now want to add x, y and z: can you find a way of stowing that for us,

## Pumping up the pressure

Andy Roe is director of sales for pump systems manufacturer Godiva (part of the IDEX Fire Suppression Group). “We offer CAFS [compressed-air foam systems] equipment in a number of different configurations, ranging from the Mini-CAFS – a self-contained retro-fit unit for the compartment of an existing vehicle – to our Prima vehicle pump, with an integrated SmartCAFS module,” he says. “We can also offer a range of engineered packages that emergency service vehicle builders can integrate into their designs, according to customer requirements.”

All Godiva compressed air foam systems feature so-called ‘smart switch’ technology that allows for pre-

either by clever stowage of the existing equipment or using every nook and cranny on the vehicle?' Those challenges mean we must communicate."

And the same applies to the relatively new breed of smaller, lighter weight fire appliances being developed for restricted access areas. These require creative thinking, but also a lot of co-operation between different parties. The machine set to replace Cornwall Fire Brigade's existing 'micro fire engine' (based at Looe and one of the first in the country) provides an excellent example. That vehicle, a Kawasaki Mule fire engine, was specified to negotiate the narrow streets of fishing villages such as Polperro and, after almost 20 years' sterling service, is about to be replaced by an even more flexible and powerful machine.

### Revolution or evolution

Jon Norris, founder of FireTech Special Vehicles, says the new unit will have 4WD, not 2WD. It will carry a similar two-man crew, but more equipment, such as a portable pump, two breathing apparatus sets, extinguishers, suction and delivery hoses, a hose reel branch and a 3m ladder. It will also be faster than the current 20mph machine.

Norris' company focuses on the US-made Polaris Ranger ATV, which carries a four-man crew and can reach 45mph. "It has the ability to enter areas with restricted access that would prevent a conventional fire engine attending and it can carry more than the Mule," he points out. "However, if brigades want even more carrying capacity, then we base a range of designs based on Land Rovers, both 4x4 and 4x6. Six years ago, we launched our Challenger range, based on the Land Rover 110 and 130 chassis, with the option of a crew cab."

None of the above should leave you with the impression that fire and rescue vehicle technology equipment is revolutionary. Station tutor Mark Gilbert, from the Fire Services College at Moreton in Marsh, Gloucestershire, says developments are part of a

programmed foam positions and discreet control of wet-to-dry foam composition. "We incorporate FoamLogix electronic foam proportioning for accurate and reliable foam injection into the water stream," explains Roe.

"An appliance equipped with CAFS equipment contains a high-volume air compressor (1,400 to 5,800 litres per minute) integrated with a foam-proportioning system and the normal centrifugal fire pump," he adds. "Typically, a Class A CAFS foam application will consume 20% of the water used in a conventional water attack. So a fire truck equipped with CAFS has a much greater fire fighting capability."

## Colour blind

Red has not always been the colour usually associated with fire and rescue vehicles. 45 years ago, when Coventry ran its own fire service, the fire chief discovered that, at night, bright red engines appeared black under sodium street lighting. After working with the then Transport & Road Research Laboratory (now TRL), he painted all his machines lime-green-yellow – a colour now known as Coventry Fire Brigade Yellow.


In 1974 the West Midlands authority took over Coventry's fire service, and its machines were repainted red. However, the added conspicuity that Coventry Fire Brigade Yellow offers is not lost on airport fire services.

Former assistant divisional officer Alan Gilbert, now a consultant to Birmingham airport fire service, says yellow – and white – are easier to see than red. Some airports, such as Newcastle, prefer white fire appliances, but add their corporate colour – purple in Newcastle's case. Carmichael, which makes many of the fire engines seen at airports, says demand from its customers for yellow paintwork runs at 50-50, with red.



process of evolution. "If you take something like an aerial platform, we always want bigger, higher and further reach. But I believe the biggest development over the past 10 to 20 years has been that of our hydraulic cutting equipment," he says.

"With structures such as boron tubes in modern motor vehicles, the manufacturers of cutting equipment have had to develop robust, heavier-duty tools. At the same time, we've had to work with other services – such as crane and recovery firms – when we're dealing with accidents involving HGVs."

Gilbert also says that, at the other end of the scale, fire-fighters themselves often identify small hand tools able to tackle some of the difficult jobs when undertaking rescue from road-traffic accidents. He gives the example of cutting away plastic trim components and says that tools to handle such everyday items are increasingly being incorporated into the vehicles' range of equipment – hence the mushrooming storage requirements. 

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