# The evolution of the American fire apparatus

**The US fire vehicle has come a long way since the first fire apparatus was tested in Cincinnati in 1853. So what does the future hold for truck design? Three experts came up with some surprising insights, writes Ann-Marie Knegt.**

*Bob Barraclough.*

The American fire truck has evolved into an iconic image during the last century. Not only is it larger than fire apparatus elsewhere in the world, it also stands out because of its looks – European and Asian fire apparatus tend to look plainer and more functional. The US fire truck also represents a department's pride and individuality.

At the basis of the US fire truck stands the NFPA 1901 standard for automotive fire apparatus, which determines which basics and safety features should be onboard every single fire truck in the US.

Bob Barraclough, consultant for vehicle manufacturer Rosenbauer and owner of company The Best Fire Apparatus, is a 20-year member of the NFPA 1901 committee. He explains that the committee is set up with one third fire service personnel, one third of manufacturers and one third independent experts, in order to maintain a balance. He explains that the members meet twice a year, and review the standards continually. They are also responsible for standards 1906 (wildland unit), 1911 (in service testing) and 1912 (refurbishment). "In Europe, all departments have a standard truck, but our standards are probably more basic than those they are accustomed to on the other side of the pond. The NFPA standards do not specify all the equipment that a fire service might need, because that might vary according to local requirements."

*The Pierce Contender Responder is engineered for both the US and overseas markets.*

Bob Meyer, from vehicle manufacturer American LaFrance, agrees with Barraclough that local needs determine what fire apparatus will end up looking like. The main factors are geography and demography. "Cities that incorporate large industry and concentrated populations will require apparatus that has the capability to combat basically all types of fires on a grand scale, and this also includes rescue and medical capabilities, as well as foam systems. These cities will have a large tax base to finance the added costs of the expensive custom-built fire apparatus required."

Small rural communities on the other hand, will require tankers and water tenders with large diameter hoses to carry water to the fire scene. A small population limits the local department to volunteer firefighters and relies on fundraisers to finance its apparatus, and according to Meyer, these people typically specify a commercial business class chassis.

### *Increased compartmentation*

Mike Moore, Director for Strategic Business Development for vehicle manufacturer Pierce, explains that the streets in the US are larger than in other areas in the world and therefore the vehicles are too. In addition, many US Fire departments now increasingly handle non-firefighting calls that require the vehicles to carry additional equipment and personnel, such as EMS and

ALS (Advanced Life Support) "At the same time we have been able to repackage components like the pump and water systems allowing for a smaller overall vehicle size. So, actually, we are seeing reduced vehicle sizes, and at the same time increased compartmentation and cab sizes."

When asked what the most significant developments have been in the history of the American apparatus, both Meyer and Barraclough indicate that the increase in electronics in vehicle applications has reduced workload and simplified firefighting operations, such as computerised pump operations as well as the electronic control of aerial devices.

Meyer mentions that the first step towards modern firefighting was made when the New Stutz Fire Engine Company introduced the diesel engine on fire trucks in 1939. "It would take another 25 to 30 years before diesel engines would show up in every fire truck in the US. The two-cycle diesel engine reigned supreme on just about all apparatus until improvements in the four-cycle Diesel engine made its way into the industry over the past 20 years."

Safety improvements have played a leading role, and as a main driver NFPA 1901 was amended in 1991, making it obligatory for firefighters to be seated and belted in the enclosed area of the cab. This also meant that riding on the back of the cab had become illegal.

## *Ladder failures*

Barraclough adds that prior to 1991, aerial ladders where breaking and failing by an average of once a month. "We increased the requirements for the strength of aerial ladders, and we specified a more stringent testing procedure. Aerial ladders were much safer by the time the 1991 regulations hit the fire departments. I know that this regulation was successful as we have had less than five ladder failures in the US since."

The introduction of class A foam and the relevant foam systems (CAFS) for municipal fire brigades have resulted in a reduction in property damage and more importantly a decrease in the loss of civilian and firefighter lives. "Class A foam puts the fire out quicker, provides less exposure to heat, and allows the truck to get back in service faster. Everybody wins with class A foam. Around 15 years ago, maybe 15 per cent of the vehicles were equipped with foam systems. Today, at least 70 per cent of the trucks are leaving the factory equipped with foam systems," Barraclough explains.

## *Current trends*

At the recent FDIC (Fire Department Instructors Conference) it became very clear that efficient compartmentation and multipurpose solutions are very much in vogue at the moment. Ferrara launched the new Multi Vocational Pumper (MVP) and Pierce launched its PUC (Pierce Ultimate Configuration), a smaller

*Increased safety with the Pierce frontal air bag system.*

*Vehicles are becoming safer. Aerial ladders are made of toughened materials and are tested extensively for safety.*

vehicle in which the bulky pump house is removed, to offer more efficient compartment space. The company reconfigured the water pump, and at the same time brought pre-connects lower to the ground, improving safety for firefighters as they no longer have to jump on and off the truck.

Vehicles are still becoming safer. For instance, more trucks are now required to have Antilock brakes (ABS) and some have Roll Stability Control (RSC) and Automatic Traction Control (ATC). All of these features assist the driver by controlling braking and throttle to prevent loss of control and rollovers. However, according to Meyer there is still room for improvement. He explains that water pump designs have essentially remained unchanged for the last 50 years. "There is no manufacturer, that I am aware of, that is actively pursuing new designs. Personally, I would like to see a manufacturer come up with an efficient, compact axial flow water pump, perhaps even run by a small turbine engine."

### The future

Barraclough points out that fire trucks have to become more in tune with the "green" wave, and that the engines in fire apparatus are not economic enough on fuel. He illustrates this with an example from his own department. "The town that I live in consists of 250,000 inhabitants – a medium-sized city. Six months into last year's fuel budget, we were a quarter of a million dollars over our anticipated payments. Partly this was caused by a raise in oil prices, but for the other part we had paid no attention to our fuel consumption. We have to do a better job at fuel conservation, and we can do that by reducing engine size,

## Slide and tilt systems with a focus on safety

Clients of US vehicle manufacturer KME can now be assured of even higher quality drawer and slide systems onboard their vehicles, as the company recently started working with UK drawer manufacturer, GSF Slides. Known for its safety and high quality, these systems already had a strong reputation in the UK, and now the company has jumped across the pond and has received great acclaim for its products. KME produces over 600 fire trucks a year, and according to International Sales Director for GSF Slides, Alec Don, it was impressed by the quality of GSF's products and the ability to use the product to achieve a large number of different drawer combinations.

GSF's slides and tilt systems were on show on the KME vehicles at the recent FDIC in Indianapolis. "The feedback was great and visitors really liked the way motion of the system and the easy grip that the handle in the middle of the drawer provided. They could see that the quality of the system was good, and all reactions were extremely positive."

When designing drawer systems it is extremely important to keep safety factors and the potential treatment of the drawer in mind. Don warns that often manufacturers use systems that are not suitable for the heavy-duty use of the fire service, causing an array of problems. For instance, the wrong placement of the latches can cause fingers to be pinched, and with a heavy-duty load placed on the drawer, this is no laughing matter.

Don explains that there has been a long established safety culture in the UK, and this is now also establishing itself in the USA and Canada. "We have a culture of designing and selecting products for their safety with an equal weight to function. Engineers for US fire truck manufacturers are extremely well trained and knowledgeable people who know a good product when they see it. The fact that KME's customers have all endorsed the GSF's slide and tilt system means a great deal to us, their exact standards have needed to be met and GSF's slides have managed achieve this.

"In the current climate, there has to be a degree of differentiation to make sure you stand out from others as a vehicle builder, and quality is of prime importance. We have had interest from other parties as well, but conditions are generally quite tough at the moment. However, we're not complacent and GSF are currently developing new product ranges that work alongside our traditional lines and fit with our experience and industry knowledge. By listening and responding to our customers we continue to move forward, which in these tough times is of paramount importance," explained Don.

Indeed GSF's new product ranges have been eagerly adopted by new and existing clients. The new Promount range of fast lock instant release tool mounts are highly innovative and they have proved popular beyond the companies' expectations. A new workbench balance box has recently been launched and GSF is unveiling a new mobile hydraulic power unit which will revolutionise the way emergency personnel can access and respond to emergency situations. The Interfron range consists of battery run power packs that operate hydraulic tools such as cutters and spreaders without any need for further hydraulic extensions, meaning no emissions and no entanglements, which in low visibility high risk environments reduce accidents and increase access to enclosed and otherwise inaccessible spaces.

*The Pierce 100-foot aluminum aerial platform features a small overall footprint that includes an 11-foot nine-inch overall height and a compact 15-foot six-inch stabiliser spread with 18 inches of ground penetration.*

adjusting the gearing in our transmissions and lowering vehicle weight. This brings us to smaller vehicles, which are more movable, and that can carry four or five firefighters, as well as a class A foam system and a sufficient amount of water."

He reasons that if you have a more manoeuvrable fire vehicle, it should get through traffic quicker than a large heavy truck. This means the firefighters get to the incident faster, and can extinguish the fire rapidly with class A foam, before it gets too overwhelming. He believes that in the long run it will save the eco-system as well, because fewer chemicals will end up down the drain with the firewater.

## Potential solutions

Meyer believes that the most significant change coming up will be the 2009 edition of NFPA 1901. However, he does not expect any major changes within the industry for the next five to 10 years because of the current downturn in the US economy. He does see a more gradual change in that 12-volt electrical systems onboard vehicles will move towards higher voltages of 24-volt and over, as has already been seen in speciality vehicle applications such as ARFF, and the European vehicle industry has been developing 48-volt systems for some time now.

Truck batteries could become ultra capacitators. The ability to

## VEHICLE PROFILE: THE SUTPHEN RESCUE PUMPER
### Battalion Chief Tom Grow, Fort Meyers Beach Control District

*What are the main challenges you face?*

We operate very similar to any other fire department in the US. We mainly face car accidents, and our fair share of structural fires. Many of our call outs are of a medical nature, and being near the beach in Florida, we naturally respond to many beach related incidents and technical rescue operations.

*What type of vehicle did you purchase and why?*

We recently bought a Sutphen rescue pumper, with a dual stage pump that has a capacity of 1.500 gallons per minute. We like Sutphen, because this company has been in business producing custom-built vehicles since 1890, and in our opinion its vehicles are of a superior quality, and have been designed to meet the needs of the ever changing American fire service. We feel that we can depend on these trucks, because they perform when we require them to.

The service level that Sutphen delivers is excellent and the gentleman who takes care of us in this part of Florida, always bends over backwards to resolve any issues we have, and this was an important reason for acquiring this truck.

*What was your main requirement for this vehicle?*

The truck that we have just bought has got a large amount of storage onboard to hold the equipment that we require on a daily basis. When you show up at a job, people expect you to take care of them. This means the truck has to carry quite a lot of equipment, so we can cover any of the multitude of disciplines we face.

We really put much thought in this vehicle and tried to cover all the basics. During our committee meetings we looked at issues we didn't like on trucks we worked in over the years, and tried to correct them in this one. In my opinion we have been very successful, for example, firefighters like a lot of room in the cab. Our department tends to get dressed in our bunker gear in there, with our airpack on and our tools in our hand, so we designed the cab to fit that need.


*What makes this truck special?*

The most special thing about this truck is that we have set it up for car accidents, as its main purpose. We have mounted a large capacity winch in such a manner that it can swivel to all four sides of the vehicle, which enables us to use it for vehicle stabilisation. The light tower on top of the vehicle lights up the scene like daytime, and we have included an onboard generator to power our equipment. In addition, we have installed the Hale pump in the back of the vehicle so that the engineer can easily reach it for maintenance.

*What kind of equipment did you specify?*

The vehicle carries 1,000 feet of five-inch supply line, and 600 feet of 2.5-inch hose for fire attacks. The Hearst Simo power unit enables us to run two rescue tools simultaneously, and eliminates the need for crew members to switch over on the tools. This aspect of the power unit is rather remarkable, and we can get people out of wrecks a lot faster, enabling us to carry out a much smoother response.

store energy quickly will make them particularly suitable for regenerative braking applications, as opposed to batteries which have slow charging rates. "The stringent engine emission regulations that will be introduced in 2010 and 2012 by the Environmental Protection Agency (EPA) will have significant impact on air quality standards. However, the new engine enclosures having to be designed by apparatus manufacturers will require more space and deal with additional heat rejection while accommodating the firefighting equipment required for the truck," Meyer explains.

Moore thinks that the current trend for better use of compartment space and vehicle design will continue over the next couple of years. Pierce is currently incorporating environmental awareness in its truck design and manufacturing. The company uses an environmentally sensitive paint process and reclamation of paint. "Recycling and utilisation of materials is high on our agenda in addition to our apparatus refurbishment programme, in which older vehicles can be completely rebuilt to incorporate all the latest safety storage and firefighting technologies in a brand new vehicle. It is as though the entire vehicle is being recycled and re-used."

*Rosenbauer's Bob Barraclough is an advocate of smaller more manoeuvrable vehicles to cut fuel costs down and to spare the environment.*

### Stringent regulations

The emission regulations that will be introduced by the EPA in 2010 and 2012 will force apparatus manufacturers to integrate new engines in their production lines, and Meyer expects that even hybrids might find their way into the industry as more efficient motors are developed. He can also see bio fuel replacing conventional fossil fuel, and there is potential for the development of electro mechanical wheel drives.

Barraclough adds that there are many aspects of the "green truck" that have not even been explored, yet. "We were never worried about fuel consumption, and never worried about weight, but I think we are awfully close to the limit. The main issues are manoeuvrability and cost. For many the trend to combine as many disciplines on one truck sounds like the answer, but it really isn't. I challenge people, when I carry out my presentations, to do an inventory of all the equipment they carry on a truck, and keep track of what they use for a year. Most firefighters will find that they will never use certain tools, but they keep them on the truck just in case. We have to get away from that mentality, because every bit of extra weight has to be carried around, and stored on the truck, and this makes the truck heavier and therefore costs money through increased fuel usage and wear and tear. We have to take advantage of modern technology, downsize where we can, and just be reasonable."