

Topic 12 Pump Systems Shelters, installation, fuel cans

Chair: Malcolm Hackett OAM

Presenter: Dr Justin Leonard



Chair

Should a pump be enclosed or open to the air? And what about a petrol pump vapour lock? And should a pump have its own sprinkler?

Justin Leonard

Petrol pumps do have that problem, and did prolifically conk out during conditions of, say, Black Saturday. So, despite them being a fire fighter supply pump, the engine side of that actually isn't that adequate to work at the 40°+ conditions running flat out under those fire conditions. Let alone handle the ember attack, the radiant heat, and whatever other heat loads are applied on it. So, they do prolifically cut out, and in a lot of cases won't be able to restart.

So, they do need to be put in quite a special protected place to be much cooler than the ambient conditions, and must be protected from embers and all those other things to have any chance of operating. And you can understand that that can be quite tricky. A steel enclosure can be quite hot. You really actually need thermal inertia around it like a masonry enclosure to really get to a point where you could get a petrol pump through one of these events.

Justin Leonard

Let's move on to pressure and how we get a system to work. A typical system I find when I'm doing these post bushfire surveys or having a look at people's houses is we've got a tank or a dam, we've got a fire fighter pump and a system that gets it to the house. This is a really typical system. Obvious major problems that we've already covered is the fuel tank is quite problematic, there's inadequate protection of the actual pump itself, it's going to operate flat out for x amount of time, might be half an hour to an hour and need refuelling, and they typically cut out under the worst of the fire conditions that present.

So, lots of issues, and I guess the functional nature of these types of pumps is you've got to ideally put them next to the tank to make them work. They don't like having to try and suck water from a long pipe network, so they're recommended to put near the tanks. And unfortunately, out near a tank is out in the open and exposed. And those tanks are an example of one of those pumping systems that's ingested embers during the fire and it suffered a flaming failure of the inlet air filter that's shut the pump down, and that won't be functioning ever again.

The actual ember screening of the inlet area is important, as is trying to get these pumps to operate under the really high temperature conditions. And here's a really good example of an attempt to prevent the heat transfer between the exhaust outlet and the inlet, and also the exhaust outlet and the petrol tank here. So, this is going to mean that this pump's going to push through to a much higher level of ambient exposure before it shuts down, so this might get up into the mid 40°C before it shuts down.

But obviously, we've still got an issue about embers. So, how are we going to solve the embers? Well, we could think about putting the entire thing in an ember-proof cabinet. In doing so, you have to put a lot of effort into having enough airflow so that the exhaust can leave that enclosure and enough fresh air can get to the enclosure, and the enclosure itself doesn't get too hot as an internal air temperature because it's not able to evacuate that heat.

The degree that you need to ember-proof a pump enclosure like this is that you have to be as fastidious as you would with your house itself. So, absolutely down to the 2mm gaps and entrance, and I'd probably give this enclosure about 6/10 for detail because there's still gaps and areas where embers can be drawn into this approach. So, it's still quite possible that pump could shut down in an ember storm by sucking embers into the inlet.

And I guess the other approach is, well, you can even try to cool the enclosure or provide some cooling to the surrounding area, and you can do that by putting a spray system on the enclosure itself. So, like that evaporative cooling effect you get by using evaporative coolers in and around your house, you get a similar effect by spraying water around your environment. So, this pump might now start enjoying a 10° temperature drop in what it feels the ambient conditions are, so that could also extend the performance of that particular pump.

What the spray systems won't do though is prevent embers getting to and being ingested by that pump. We see time and time again that spraying water around the place just simply doesn't stop the ember storm. The embers don't suddenly go out because there's water around. There's so many embers around, you just cannot rely on spray systems to prevent the embers getting into that enclosure. And, obviously, when you open that enclosure internally, that enclosure will be dry for the same reason that your roof cavity or your wall cavities are dry in your house.

Chair

Some people were interested in is that shielding material. Is that like a thick cement sheet or was it some special material on that pump example that you had?

Justin Leonard

A suitable material to do that would just be any cementitious board, a non-combustible cementitious board would be fine. Even if it's a relatively dry environment and it's protected from the weather. Even some cut pieces of plasterboard would be adequate.

Justin Leonard

There's a few places where you really do have to compromise and potentially consider using a flexible plastic pipe. And one of those is actually the entry and exit to the pump itself. So, because the pump vibrates, if it's an internal combustion engine pump, there's quite a lot of vibration. And to deal with that vibration, you can't really mount a hard metal connection to that pump. It'll eventually fatigue through and break, and it's not recommended in the installation instructions.

So, if you're going to have to use certain sections of plastic piping, like in this example, what we really recommend you do is wrap it in some type of high temperature lagging. This is like an exhaust wrap that you get from an automotive shop, so that's actually a ceramic fibre woven bandage or wrap that'll prevent embers and heat affecting the plastic too much. And the ideal finish is to then wrap that again with a reflective aluminium covering that then repels the radiant heat and gives you a really good protection for those limited areas where you really have to do use plastic.

Chair

What kind of container should fuel be stored in and where should it be stored?

Justin Leonard

You'll notice deliberately that fuel cans have metal, typically metal, with a plastic lid. And the plastic lid is actually what you would call the fusible link. When that gets heated up, the cap itself melts and relieves pressure and lets the fuel vapour out. If it was a metal fuel container with a metal lid and it was heated, it would build up to an extreme pressure and then really catastrophically explode, if it was heated enough.

So, that's the ultimate issue and compromise between what you should store things in. You should store it in a purchased specific fuel can that's designed for that purpose. Where you put the fuel can is another important question. I would in a shed somewhere remote on your property and don't go near it during the bushfire.