Fire and Flame Retardant Conduit

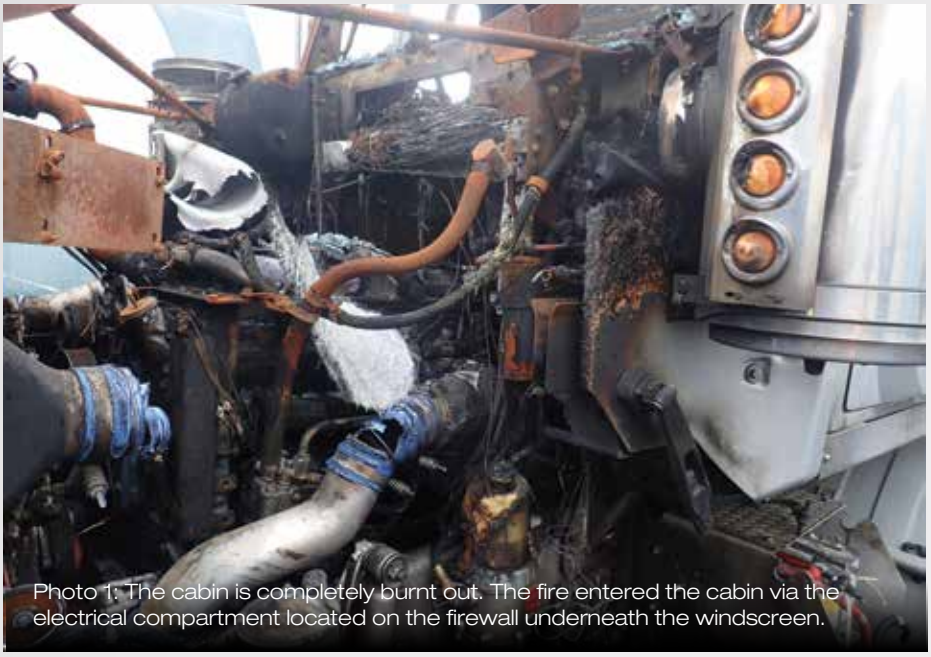

Photo 1: The cabin is completely burnt out. The fire entered the cabin via the electrical compartment located on the firewall underneath the windscreen.

ARTSA recently proposed that polymer conduits that are used to protect main electrical cables should have flame retardant properties. The proposal is to add a requirement into the design rule 42/04 General Safety that, unless electrical wires are protected by a circuit breaker or fuse, polymer conduits used to provide mechanical protection on an electrical wire shall have a continuous circumference and not be split; or have a flame retardancy rating that meets or exceeds the classification V-0 in standard UL 94 or standard EN-ISO 11925-2, V2 30s.

I want to explain why this proposal is important and why it will never happen. Truck and trailer fires occur too frequently in our industry. According to National Transport Insurers (NTI), in 2013 transport fires represented 10.7 per cent of significant incidents that occurred on the NTI insurance book, resulting in 549 major payouts costing $71.7 million. There were 59 incidents due to non-impact fires, with a payout value of $7.8 million. Assuming that the NTI experience accounts for about 40 per cent of serious truck and trailer fires in Australia, the total number in 2013 would be 148. In 2018 terms, this number is probably about 160. NTI also reported that 68.5 per cent of fires that it paid out on were 'cabin/engine compartment fires'. The significance of this is that truck fires dominate over trailer fires. Trailers don't have engines or cabins. While there are more trailers than trucks in Australia, truck fires dominate. My estimate is that 80 per cent start on trucks and 20 per cent start on trailers. The common 20 per cent of causes occur at the wheel ends.

Truck fires occur more frequently than trailer fires because there are more systems in trucks that can start fires than in trailers:

1. Trucks have engines with hot exhausts.
2. Trucks have more electrical wiring than trailers.
3. Trucks have alternators and starter motors.
4. Trucks have batteries and main electrical cables.

The ARTSA proposal is intended to reduce vulnerability to the third and fourth causes. To explain how, consider the photos in this article. Photo 1 shows a burnt-out cabin and its firewall. It's obvious that the fire started either at the electrical box on the top of the firewall or inside the cabin under the console, or did it?

Photo 2 shows that the main return cable was left off the starter motor when the starter was changed about a week before the fire. The starter current had been returning via a minor cable linking it to the chassis rail steel. This cable caught fire when the truck was cranked for a prolonged period because the starter was being starved of battery voltage. The fire reached the cabin because the polymer conduits that run vertically up to the cabin on the firewall caught fire and spread the fire upwards. The green arrow in Photo 4 indicates the fire path – it started at the starter motor and the truck burnt

Photo 2: The return cable was left off the starter motor

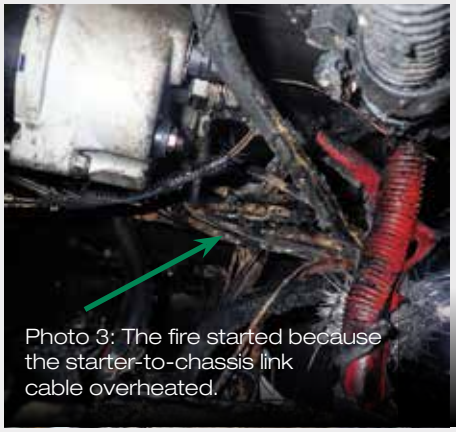

Photo 3: The fire started because the starter-to-chassis link cable overheated.

Photo 5: Many truck polymer conduits burn freely when ignited and this provides the fuel for fires that start at cable rubs.

out because the split polymer conduits burnt freely.

The insulation on main electrical cables usually has flame retardant properties, but the conduit does not. Rubs on main electrical cables are the single most common cause of truck fires. They occur because cables often run against metal features due to the crowded spaces around starter motors, engines and underneath the cabin. Over a long road life the protective polymer conduits rub away, cracks or gapes. Mostly conduits are split and this makes them ineffective at sharp edges or bolt shafts.

The main battery-to-starter electrical motor cables are not protected by a circuit breaker. Such protection would have to cope with the high and peaky starter motor current (~1500A on a 12V truck). The protection offered against a short at a rub point would be ineffective. So the starter motor cables have no electrical protection. Unfortunately some manufacturers go further and fail to provide circuit breaker protection for the alternator, trailer relay box and cabin stud. All these main cables are vulnerable to rubs that could start fires. But it is the conduit that provides the fuel!

Photo 4: The fire moved upwards from the starter motor via the flammable polymer conduit.

The ARTSA conduit proposal is intended to reduce the risk on new trucks that a rub on a main cable will become a full-blown fire. Split polymer conduit should not be used on main cables because the conduit can open up at a sharp intrusion. The polymer conduit should meet a decent flame retardancy standard such as UL94 V0. This requires that the conduit not burn for longer than 10 seconds when it is withdrawn from a flame.

Drips of melted plastic must also not ignite tissue paper held underneath the initially burning polymer. I believe that using flame-retardant unsplit conduit would halve the number of electrical fires on trucks.

If this proposal could be implemented on all trucks it would save $7 million per year in insurance payouts and probably as much again in emergency services and community costs.

This figure assumes that 40 per cent of fires occur due to rubs on the main electrical cables of trucks and that this number could be halved. NTI's average payout per major incident in 2013 was $130,000, say $160,000 for 2018. Truck and trailer fires are usually very significant losses, so assume that the average fire loss is $200,000. It's easy to get to a $7 million p.a. saving. And the cost per truck? $30. The numbers stack up so let's start mandating flame-retardant conduits on major truck cables!

There are three reasons why this proposal will never happen:

1. Truck fires seldom kill people. Therefore, fires are not in the scope of the design rules.
2. Supplier regions (North America and Europe) do not have such a rule. It is too hard for the Australian authorities to go it alone.
3. Truck manufacturers will argue that cab rubs can be dealt with through proper maintenance.

The last point is not true because cable rubs often occur in locations that cannot be inspected. But it is an argument that government can understand.

Owners and operators of trucks in Australia – it is up to you to demand flame-retardant and non-split polymer conduits be used on truck main electrical cables. No one else has the power that you have!

Dr Peter Hart
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