FOR A SAFER ENVIRONMENT OF ELECTRIC AND HYBRID VEHICLES

营造更安全的电动及混合动力车辆运行环境



dafo European Technology | 达弗® 消防

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Dafo Vehicle

is introducing a safer environment for electric and hybrid vehicles

达弗消防为电动及混合动力车辆打造更安全的使用环境。

There is a global transition to renewable fuels and by that an increasing demand for electric and hybrid vehicles (EV and HEV). As more electric vehicles become operational, their involvement in fire incidents is likely to rise.
全球正转向使用可再生燃料，电动及混合动力车辆（EV、HEV）的需求随之不断增长。随着投入使用的电动汽车数量增多，其火灾事故的发生概率也将上升。

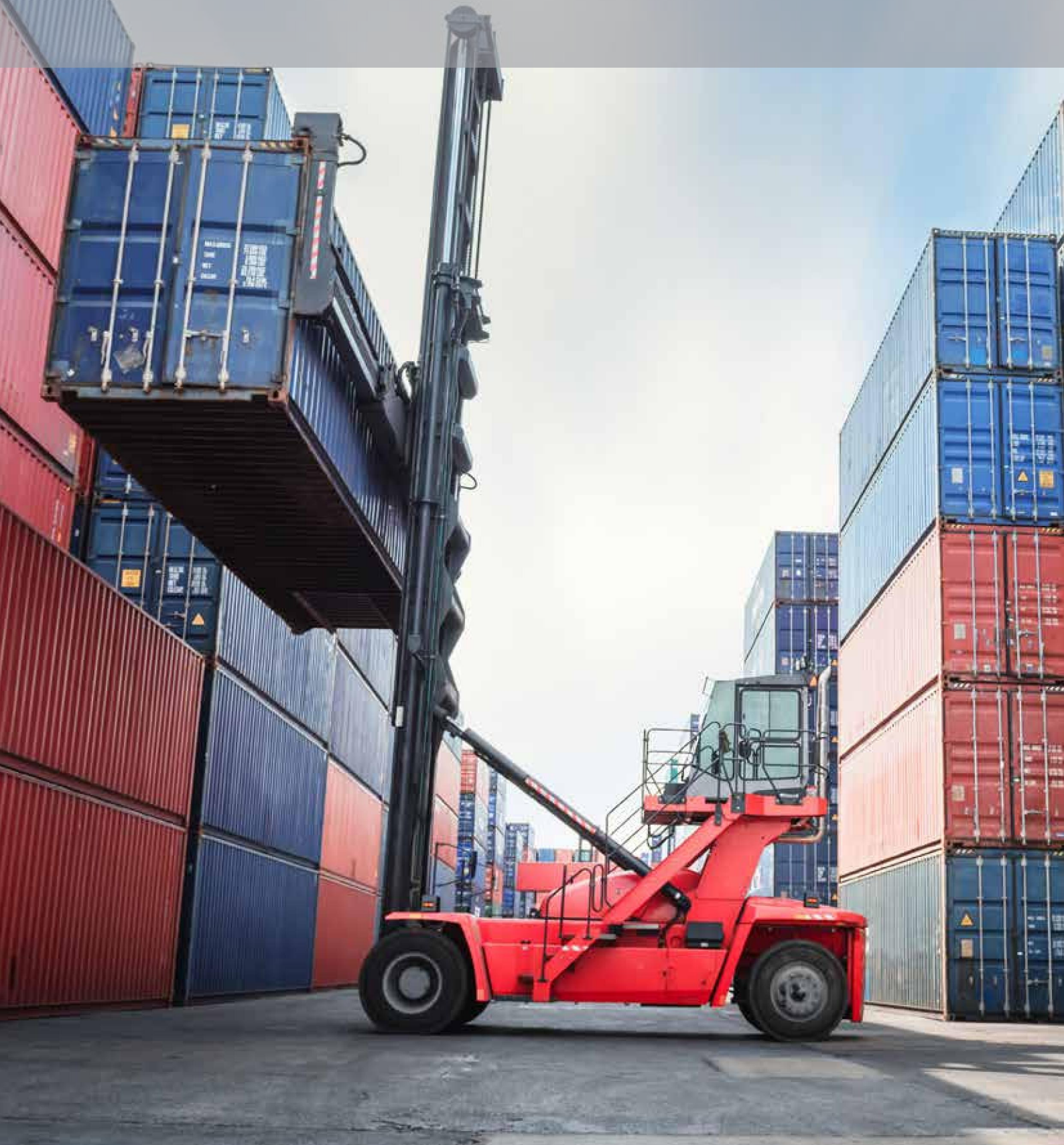
The significant fire risks associated with vehicles being powered by batteries and high-power electric engines/devices are not widely understood. For example, the consequence from a malfunctioning Li-ion battery can be very serious, potentially resulting in a thermal runaway situation with rapid fire and heat propagation as well as emission of toxic gasses, posing a great threat to vehicle drivers, occupants as well as the environment in which the vehicle is operating.
由电池及大功率电机 / 设备驱动的车辆，其所伴随的重大火灾风险尚未得到充分认知。例如，锂离子电池发生故障会造成极其严重的后果，可能引发热失控，造成火势与热量快速蔓延，同时释放有毒气体，对驾驶员、车内乘员以及车辆所处的运行环境构成严重威胁。

From a regulatory standpoint, fire risks in electric and hybrid vehicles are currently being treated as similar to those in traditional combustion engine vehicles. For example, this stance is taken by GRAMKO, the health and safety committee of the Swedish industry organization for mines, mineral and metal producers, stating that fire standards need to be kept/further enhanced when transforming from diesel engines to electrical powertrains.
从监管层面来看，电动汽车及混合动力车辆的火灾风险，现行管控标准与传统内燃机车辆等同。瑞典矿山、矿产与金属生产商行业组织下属健康安全委员会 GRAMKO 即持该观点：在柴油动力向电驱动总成升级转型过程中，防火标准应当予以保留并进一步提高。

You could argue that fire risks are actually increasing when introducing electrical vehicles. As an example, a significant part of the fire risks in a traditional combustion engine vehicle is related to the electrical system of the vehicle. These types of risks are further accentuated in an electric vehicle, having more electrical components, more wiring as well as higher power running through the electrical system. In addition, the Li-ion battery adds a whole new risk element to an electric vehicle.
有观点认为，电动车辆的引入实际上会增大火灾风险。例如，传统内燃机车辆的相当一部分火灾风险来源于车辆电气系统；电动汽车电气部件数量更多、线束更复杂，电气系统工作功率更高，会进一步加剧该类风险。此外，锂离子电池为电动车辆带来了一类全新的风险源。

Through multiple international collaborative research projects in which studies were made of fire risks associated with lithium-ion batteries in vehicles, Dafo Vehicle has developed the fire protection system solution safeEV™ that addresses and mitigates these risks effectively and safely.

达弗车辆参与多项国际联合研究项目，针对车载锂离子电池的火灾风险开展研究，由此研发出 safeEV™ 防火系统解决方案，可安全、有效地应对并降低该类风险。



Differences in risks and additional risks between diesel-powered vehicles and EV and HEV

柴油动力车辆与电动汽车（EV）、混合动力车辆（HEV）的风险差异及新增风险

The difference between diesel-powered vehicles and EV and HEV from a fire risk perspective is related to the location as well as the character of the potential fire sources. In vehicles with combustion engines, the location of most fire sources is concentrated in the area of the engine compartment. In EV and HEV vehicles potential fire sources are often located in different sections of the vehicle. It means that more protection zones will have to be taken into account. Furthermore, a combination of different extinguishing methods will have to be used due to the different types of fires that might occur, as well as the sensitivity of electrical components.

从火灾风险角度看，柴油动力车辆与电动汽车、混合动力车辆的区别，在于潜在起火源的位置与特性。内燃机车辆的绝大多数起火源集中于发动机舱区域；而电动汽车与混合动力车辆的潜在起火源往往分布于车辆多个不同部位，因此必须考虑设置更多防护分区。此外，由于可能发生的火灾类型各不相同，同时电气部件具备高敏感性，需要组合采用多种灭火方式。

Challenging risks related to Li-ion batteries

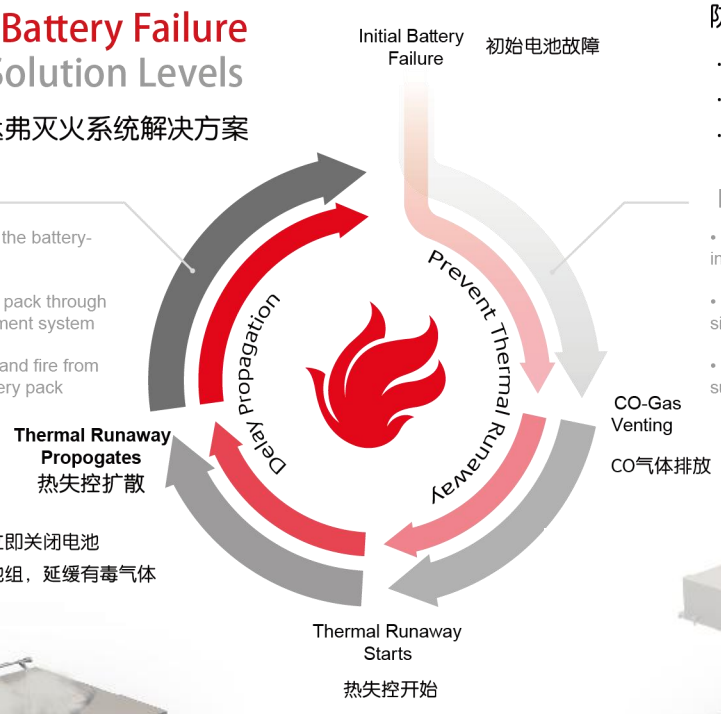
锂离子电池的高危风险

When Li-ion batteries fail through short circuiting, overcharging, high temperatures, mechanical damage and overheating, this might cause thermal runaway. Thermal runaway occurs when a battery cell has reached the temperature at which the temperature will continue to increase on its own and the electrolyte catches fire. Through this it becomes self-sustaining as it creates oxygen which feeds the fire. As the heat source and the fuel are both existing within the battery these fires can develop quickly. The release of flammable electrolyte makes fire extinguishing very difficult and in addition there are a lot of toxic gases being emitted such as hydrogen fluoride, which can cause serious damage to both the skin and the respiratory tract.

当锂离子电池因短路、过充、高温、机械损伤及过热发生失效时，可能引发热失控。当电芯达到临界温度后，温度会自行持续升高并引燃电解液，即发生热失控。该过程会生成氧气助燃，形成自持燃烧。由于热源与可燃物均存在于电池内部，此类火灾会快速发展。可燃电解液的喷出致使灭火难度极大；同时会释放大量有毒气体，例如氟化氢，可对人体皮肤及呼吸道造成严重损伤。

Stages of Li-Ion Battery Failure
& Dafo Vehicle Solution Levels

锂电池失效的阶段 & 达弗灭火系统解决方案



Delay Propagation

- Detection by CO-sensors outside the battery-pack
- Immidate shutdown of the battery pack through alarm signal to the battery management system
- Delay propagation of toxic gases and fire from the battery pack by cooling the battery pack externally with suppression agent

延迟传播

- 通过电池外的CO传感器检测
- 通过向电池管理系统发送信号立即关闭电池
- 通过使用抑制剂从外部冷却电池组，延缓有毒气体的传播和电池组的复燃

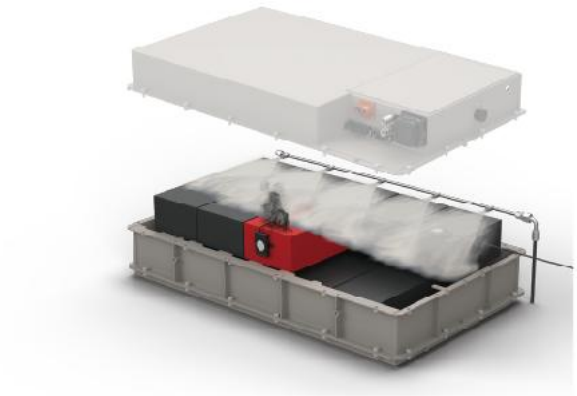


Prevent Thermal Runaway

- Early detection by CO-sensors located inside the battery-pack
- Immidiate shutdown of the battery through signal to the battery managment system
- Rapid cooling of battery modules by suppression agent inside the battery pack

防止热失控

- 通过位于电池组内部的CO传感器进行早期检测
- 通过向电池管理系统发送信号立即关闭电池组
- 通过电池组内部的抑制剂快速冷却电池组



Dafo Vehicle has developed a full coverage multi-zone fire protection solution in response to the urgent need for risk mitigation in EV and HEV vehicles. The suppression agent Forrex EVO ™ is used as one part of the complex system solution and it provides effective cooling capacity to slow the fire development for allowing safe evacuation of machine operators. In order to cover all risk areas in the EV or HEV vehicle, the main risk scenarios are typically divided into four protection zones.

The different protection zones are then protected in various ways by robust detection and suppression systems – both liquid based and gas-based solutions.

达弗消防已开发出全面覆盖多区域消防的的解决方案以应对电动车混合动力车减轻风险的迫切需求。药剂 Forrex EVO 被用作复杂系统解决方案的一部分，能提供有效的冷却能力减缓火势发展，使操作员能安全撤离。为了覆盖电动车和混合动力车所有的风险区域，主要的风险情况分为四个保护区。不同的保护区域由强大的探测和扑灭系统以不同的方式保护着—既有液体基也有气体基方案。



Zone 1 Engine compartment

Protection applied for combustion engine (HEVs) and compartment with electrical components (EVs) based on Dafo Vehicle's well proven liquid based fire suppression system.

- Liquid based FORREX agent.
- Robust detection/suppression technology.
- Prevents re-ignition.

区域 1

发动机舱

经过达弗消防充分验证的液体灭火系统，为内燃机（混合动力汽车）和带有电气元件的舱室（电动汽车）提供保护。

- 液态弗瑞克斯（FORREX）药剂。
- 稳健的检测/抑制技术。
- 具备防复燃能力。

Zone 2 Electrical hazards

Electric systems are a common failure source on conventional vehicles that now increases in risk with the addition of high voltage, high power traction systems.

- Detection using heat or smoke detection or combination of both.
- Clean extinguishment without any residuals through our PFK system with agent gas FK-5-1-12.

区域 2

电气风险区

电气系统是传统车辆常见的故障源，随着高压、大功率牵引系统的加入，其风险也随之增加。

- 使用热探测或烟雾探测，或两者结合进行探测。
- 通过我们的 PFK 系统，使用灭火剂 FK-5-1-12，实现清洁灭火，无任何残留物。

Zone 3 Traditional hazards

Many of the traditional hazards such as flammable liquids, hydraulic fluid, diesel oil, greases, lubricating oil, heaters, AC units and combustible debris still exist and has to be taken into a potential fire hazard.

- General system feature.
- Liquid based Forrex agent.
- Robust detection.

区域 3

传统风险区

许多传统风险仍然存在，必须予以考虑。空调机组、液压系统和高压线缆都存在潜在的火灾风险。

- 通用系统功能。
- 液态弗瑞克斯（FORREX）药剂。
- 稳健的检测/抑制技术。

Zone 4 Batteries

Dafo Vehicle's liquid based fire suppression system is used to protect battery pack from external fires as well as to provide maximum cooling in case of a thermal runaway battery fire in order to create sufficient time for evacuation of machine operators.

- High sensitive gas detection for early warning.
- Robust Dafo Vehicle linear detection.
- Double amount of liquid compared to normal combustion engine application is used.

区域 4

电池区

达弗消防的液态灭火系统用于保护电池组免受外部火灾的影响，并在电池发生热失控起火时提供最大程度的冷却，以便为人员疏散争取足够的时间。

- 高灵敏度气体检测，用于早期预警。
- 强大的达弗线型检测线。
- 与普通内燃机应用相比，使用的液体量是双倍的。

Early warning detection

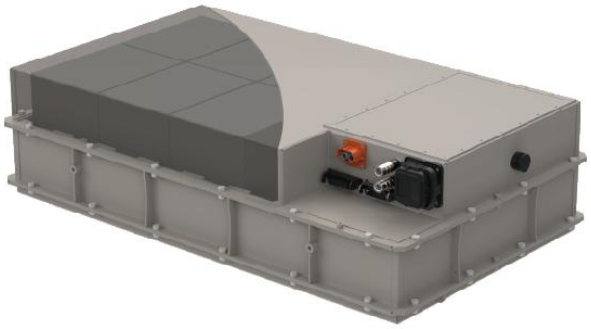
早期预警探测

As a solution to specific risks related to batteries Dafo Vehicle has developed an early warning detection system solution. The system will detect potential battery failure, at the earliest possible stage and take immediate action by cooling, using the suppression agent Forrex EVO ™. This will effectively stop, or delay, a potentially hazardous situation without the fire developing further.

针对电池特有的风险，达弗车辆开发了早期预警探测系统方案。该系统可在最早阶段识别电池潜在故障，并立刻使用 Forrex EVO™灭火剂实施冷却处置。能够有效遏制或延缓危险工况，阻止火情进一步扩大。

Depending on the protection level that needs to be achieved the early warning detection system solution can either be applied outside the battery packs or as an integrated part of the packs. The solution can also be limited to detection only without the suppression application.

依据所需达到的防护等级，该早期预警探测系统方案可外置安装于电池包外部，也可作为电池包内置集成组件。该方案也可配置为仅具备探测功能，不执行灭火喷射。



Battery pack

电池组



High-sensivity CO sensor

高灵敏一氧化碳传感器

Distributed detection and suppression thanks to full bi-directional CANbus communication. The extinguishing agent is only deployed at the detected risk area.

依托全双向 CAN 总线通信，实现分布式探测与灭火。 灭火剂仅向已探测到风险的区域释放。

Easy to customize to the customer-specific needs and type of vehicle.

对客户特定需要和汽车类型易于定制。

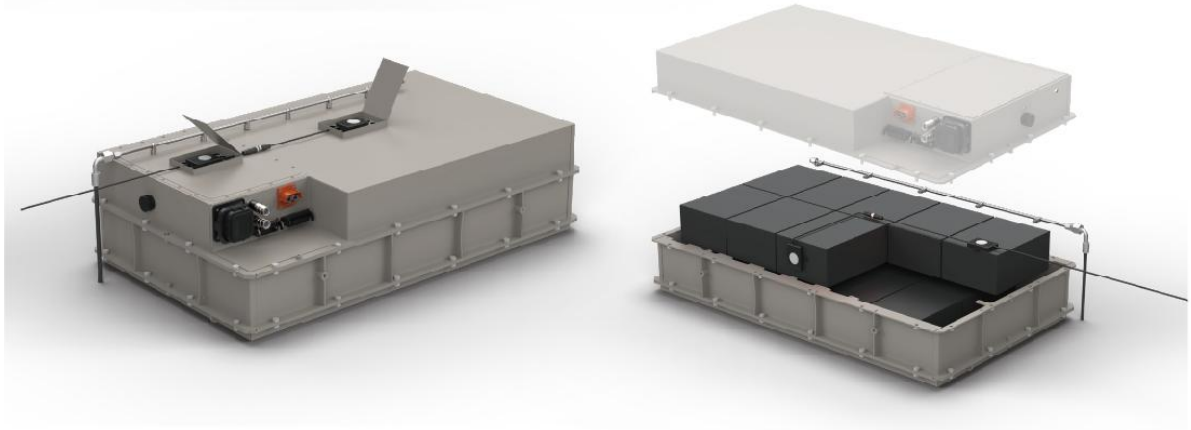
Possibility to set multiple alarm and suppression criterias.

可设置多级报警与灭火触发条件。



CO sensor application together with cooling agent distribution system

一氧化碳传感器配套冷却灭火剂分配系统应用



Examples of integrated applications

集成式应用示例

State-of-the-art graphical user interface.
智能用户界面



Touch Screen
触摸屏



Informative
信息



Alerting
提示



Optional Features
可选功能

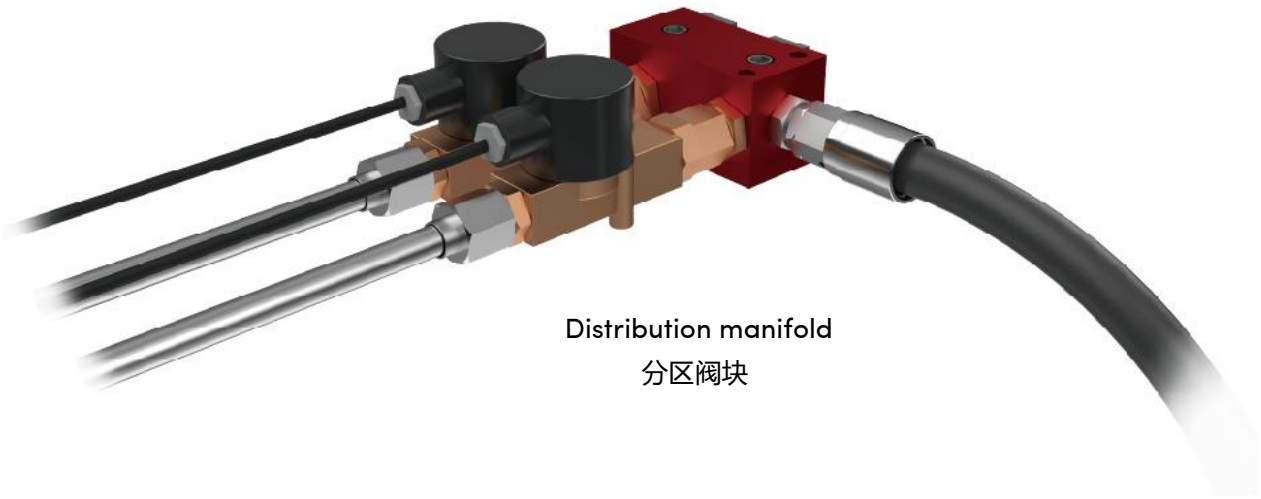


Internal Data logger
内部数据记录



The battery pack should be cut-off upon detection and discharge of the system.
系统探测到火情并启动释放时，应当切断电池组电源。

Other extinguishing agents such as powder, gas and aerosols are unsuitable due to the lack of cooling effect. Furthermore, non-aqueous agents like powder could in some cases make a fire scenario worse by encapsulating the hazard and shielding it from further firefighting actions.
干粉、气体及气溶胶等其他灭火剂因不具备冷却效果而并不适用。此外，干粉这类非水基灭火剂，在部分工况下会包裹住危险源，阻碍后续灭火处置，进而加剧火情。



Distribution manifold
分区阀块

The early warning detection system will dramatically boost the safety of operators having heavy-duty machines in hazardous environments and the actual machine operators by allowing safe evacuation as well as boosting the protection of valuable assets. The new solution is designed to mitigate losses due to fire and reduce the impact on investment, reducing downtime, securing business continuity as well as increasing the productivity of the end users.

该预警探测系统能够保障危险环境下重型设备操作人员安全撤离，大幅提升人员安全等级，同时强化贵重资产防护。这套全新方案旨在降低火灾造成的损失、减小投资受损风险，减少停机时间，保障业务连续性，并提升终端用户的生产效率。



Case study Heavy vehicles　重型车辆案例研究

In the automotive industry, electric and hybrid vehicles are a new standard. The technology is recognized and already used in the Mining, Container Handling, Construction, and Forestry sectors. All vehicle manufacturers are aware of the ecological footprint of their products. They focus on sustainability and set goals to reach zero-emission.
Dafo Vehicle is a key part of this transition participating in several electric and hybrid vehicle projects together with leading heavy-vehicle manufacturers. Their main requirement is that the electric vehicles shall be equipped with an Automatic Detection and Fire Suppression System to further enhance the safety of operation.
The main objective for heavy vehicles in the Mining, Container Handling, Construction, and Forestry sector is to address the traditional risks such as the engine compartment in hybrid vehicles as well as electrical and hydraulic system compartments. In addition, the Li-ionFire battery needs to be protect from external heat. This means everything around the battery pack that could cause it to become overheated, for example, the electrical engine, high-voltage cables, converters, diesel heaters, and hydraulics. In future cases also the battery itself will be protected.
Further on through the system's minimized maintenance needs contribute to a high vehicle uptime and a low total cost of ownership (TCO) which is essential for the profitability of operators.
Dafo Vehicle is committed to minimizing the ecological footprint. By designing the systems and utilize technologies that minimize the need for spare parts, maintenance, and unforeseen service calls this can be realized.

在汽车行业，电动及混合动力车辆已成为新标杆。该技术已得到行业认可，并应用于采矿、集装箱装卸、建筑及林业领域。所有车辆制造商均重视产品的环境影响，聚焦可持续发展，并设定零排放目标。

达弗车辆是此次技术转型的重要参与者，与主流重型车辆厂商合作开展多项电动及混合动力车辆项目。厂商的核心要求是电动车辆必须配置自动探测及灭火系统，进一步提升作业安全性。

采矿、集装箱装卸、建筑、林业领域的重型车辆，核心目标是应对各类传统风险，例如混动车辆的发动机舱、电气舱与液压系统舱。此外，锂离子电池需要防护外部热源。即电池包周边所有可造成其过热的部件，包括电机、高压电缆、变流器、柴油加热器及液压部件。后续方案还将实现对电池本体的防护。

同时，该系统维护工作量极低，保障车辆高可用率，降低总拥有成本（TCO），这对运营方实现盈利至关重要。

达弗车辆致力于降低环境影响，通过系统设计与技术选型，减少备件消耗、维护工作及非计划抢修，以此实现环保目标。

Safe with Dafo Vehicle　安全与达弗相伴



Active fire protection is an integral part of systematic and effective fire prevention. Together with Dafo Vehicle Fire Protection, you'll always get the most effective solution so that you can limit fire damage, reduce downtime and increase productivity.

主动防火是系统化高效火灾预防不可或缺的组成部分。与达弗车辆合作，您将始终获得最优解决方案，以此控制火灾损失、减少停机时间、提升生产效率。

Since the start back in 1919, Dafo has developed into a modern, high-tech company committed to offer the very best solutions to our customers.

达弗车辆自 1919 年创立至今，已发展成为一家现代化高科技企业，致力于为客户提供顶尖解决方案。

Dafo Vehicle has three main business areas: Integration (Fire suppression systems integration into OEM production line, Retrofit (Fire suppression systems installed at final customer) as well as Service & Maintenance.

达弗车辆拥有三大核心业务板块：集成业务（将灭火系统集成至主机厂生产线）、改造业务（为终端客户现场加装灭火系统）以及服务与维保业务。

Dafo group today consist of several subsidiaries, distributors and service providers worldwide.

如今达弗车辆集团在全球拥有多家子公司、分销商及服务合作商。

Do not compromise safety – get in touch!

不要在安全上妥协 —— 请联系我们！

dafo European Technology | 达弗® 消防

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