# Experimental of Water Mist to Put ou<br>Electric Compartment of Utility<br><sup>Zhenpeng Bai, Xiaohan Zhao, Jin Zhang<br>*Abstract*—This paper used full-scale experimental tests to<br>*Mbstract*—This paper used full-scale experimental tes</sup> **Experimental of Water Mist to Put**<br> **Electric Compartment of Utili**<br> *Zhenpeng Bai, Xiaohan Zhao, Jin Zhang*<br> *Abstract*—This paper used full-scale experimental tests to<br>
system. It has the charactury time water mist syst Experimental of Water Mist to Put out Fire in the<br>Electric Compartment of Utility Tunnel<br>Zhenpeng Bai, Xiaohan Zhao, Jin Zhang<br>Affect This paper used full-scale aparimental tests to be a simple and paper in the subscribe o Electric Compartment of Utility Tunnel<br>
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Electric Compartment of Utility Tunnel<br>
Zhenpeng Bai, Xiaohan Zhao, Jin Zhang<br>
is paper used full-scale experimental tests to high efficiency Engineering Letters<br>
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Dimpartment of Utility Tunnel<br>
Zhenpeng Bai, Xiaohan Zhao, Jin Zhang<br>
system. It has the characteristics of environmental protective<br>
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**compartment of utility tunnel after cable fires. It used a 250 kW**<br> **compartment of Utility Tunity Tunity**<br> *compartment of utility* tunnel after cable experimental tests to high efficiency and non-pollution. It is<br>
study **propane burner to ignite the cable. A high-pressure water mist<br>
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study fine water EIECTIC COMPATTMENT OT UTIITY**<br>
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compartment of utility tunnel af Zhenpeng Bai, Xiaohan Zhao, Jin Zhang<br> *system.* It has the characterist<br> *tudy* fine water mist system to extinguish fires in the electrical<br>
or extinguishing system and non-pollu<br>
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study fine water mist system to extinguish fires in the electrical<br>
compartment of utility tunnel after cable fires. It us *system.* **It has the character about the system of the speed of utility tunnel speed on the free extinguishing efficiency and non-pol study fine water mist system was implemented for cable fires. It used a 250 kW extingui** *Abstract***—This paper used full-scale experimental tests to** system. It has the charact study fine water mist system to extinguish fires in the electrical compartment of utility tunnel after cable fires. It used a 250 kW *Abstract***—This paper used full-scale experimental tests to** high efficiency and non-<br>study fine water mist system to extinguish fires in the electrical<br>compartment of utility tunnel after cable fires. It used a 250 kW<br>sy **Abstract—This paper used full-scale experimental tests to** by sisting the study fine water mist system to extinguish fires in the electrical the urban fire contrompartment of utility tunnel after cable fires. It used a 2 **ventilation** was implementate that the urbeat the specific than the diversion of control constrained for calle fire control constrained between the control constrained between the extinguishing system has propane burner t **Examplement to the studied of the studied in the studied of the studied of the studied of the electrical compartment of utility tunnel after cable fire extinguishing tests. The system was implemented for cable fire exting Examplement of that the could at the could at the set of the different water mist of the extinguishing system was implemented for cable fire extinguishing tests. The system was implemented for cable fire extinguishing tes internal temperature of the electrical compartment in utility**<br> **internal temperature of the water spray varied between 7 L/min**<br> **internal radiation and puriand 10 L/min.** The effect of different water mist volume flow **Existival was implementary of the eximplemism curve are eximplement of the water spray varied between 7 L/min** thermal radiation and 10 L/min. The effect of different water mist volume flow equipment, and rates on fire e **Water the system set of the value of the electrical compartment** of the influence of the effect of different water mist volume flow equipment, and good rates on fire extinguishing in the electrical compartment of extingu **preserved in the control of the control of the system in the electrical compartment of** extinguishing. Computility tunnel was investigated. In four cases, the ventilation systems, water mist speed of utility tunnels varie **Practical compartment of the electrical compartment of utility tunnels** significance in the electrical compartment of the electrical compartment of the electrical compartment of utility tunnel were measured. The effect of **tunnel.** *I* INTRODHICTION<br>
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INTERC **Example 12** were measured. The effect of differentiation speeds on the fire extinguishing electrical compartment of utility tunnel versults showed that high-pressure water miss internal temperature of the electrical comp IT and the fire extinguishing efficiency in the halon extinct of utility tunnel were studied. The control of the electrical compartment in utility<br>
In recent y<br>
The of the electrical compartment in utility<br>
I. The water m

previewing re-ignonic Fine water mist system has an important<br>
tunnel,<br> *Index Terms*—Water mist; Put out fire; Utility tunnel;<br> *Index Terms*—Water mist; Put out fire; Utility tunnel;<br> *Electric compartment*<br> *I.* INTRODU Index Terms—Water mist; Put out fire; Utility tunnel; al. [11] conducted<br>
Electric compartment<br>
I. INTRODUCTION<br>
ILECTED machinery casings.<br>
ILECTED machinery casings.<br>
ILECTED machinery casings.<br>
ILECTED machinery casings **A** Then the utility tunnel fire occurs, it is very dangerous spaces. It was recomment control of methane constant rotation of [14] studied the atte threquent excavation of [14] studied the atte threquent conth, the urban W hen the utility tunnel fire occurs, it is very dangerous<br>spaces. It was recommen<br>urban roads, shorten the driving time, and keep the traffic<br>urban roads, shorten the driving time, and keep the traffic<br>simulation of [14] **VV** [1][2]. In order to reduce the frequent excavation of [14] studied the a<br>urban roads, shorten the driving time, and keep the traffic large-scale fires by m<br>smooth, the urban utility tunnel shows an increasing trend i urban roads, shorten the driving time, and keep the traffic <br>
smooth, the urban utility tunnel shows an increasing trend in curtain. A new type<br>
all over the world. However, the fire causes great economic produce a uniform

baiyi1056@126.com).

<span id="page-0-0"></span>(2021BSJJ048). Henan Province Central Leading Local Science and experimental tests by<br>
Technology Development Fund Project (220231811020), Zhengzhou indicator. They found the<br>
Support Program Project (23XNKJTD0305), Henan Technology Development Fund Project (Z20231811020), Zhengzhou indicator. They found<br>
University of Light Industry Science and Technology Innovation Team<br>
Special Project (231111322200).<br>
2henpeng Bai is a lecturer in the D University of Light Industry Science and Technology Innovation Team<br>
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Special Project (23111322200).<br>
Zhenpeng Bai is a lecturer in the Department of Zhengzhou Key<br>
Zhenpeng Bai is a lecture Support Program Project (23XNKJTD0305), Henan Province Key<br>Special Project (231111322200).<br>
Zhenpeng Bai is a lecturer in the Department of Zhengzhou<br>
Laboratory of Electric Power Fire Safety, College of Building Enviro<br>
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Sist to Put out Fire in the<br>mt of Utility Tunnel<br>an Zhao, Jin Zhang<br>system. It has the characteristics of environmental protection,<br>high efficiency and non-pollution. It is gradually promoted in<br>the urban fire control cons Ist to Put out Fire in the<br>int of Utility Tunnel<br>in Zhao, Jin Zhang<br>system. It has the characteristics of environmental protection,<br>high efficiency and non-pollution. It is gradually promoted in<br>the urban fire control cons **ist to Put out Fire in the**<br> **nt of Utility Tunnel**<br> **nn Zhao, Jin Zhang**<br>
system. It has the characteristics of environmental protection,<br>
high efficiency and non-pollution. It is gradually promoted in<br>
the urban fire c Triangleright is the Put out Fire in the<br>introf Utility Tunnel<br>an Zhao, Jin Zhang<br>system. It has the characteristics of environmental protection,<br>high efficiency and non-pollution. It is gradually promoted in<br>the urban fir extinguishing efficiency, wide fire extinguishing range, nt of Utility Tunnel<br>an Zhao, Jin Zhang<br>system. It has the characteristics of environmental protection,<br>high efficiency and non-pollution. It is gradually promoted in<br>the urban fire control construction [5-7]. The water mi **EXECT SET ASSEM CONTROVER CONTROLL COLOGET SET AND SEVERE THE SURVEY CONTROLL SURVEY THE UPS SYSTEM IN A SURVEY THE WATER THE EXTINGUISHING THE EXTINGUISHING SYSTEM THE EXTINGUISHING FOR THE EXTINGUISHING FOR THE EXTINGUI** an Zhao, Jin Zhang<br>system. It has the characteristics of environmental protection,<br>high efficiency and non-pollution. It is gradually promoted in<br>the urban fire control construction [5-7]. The water mist fire<br>extinguishing an Zhao, Jin Zhang<br>system. It has the characteristics of environmental protection,<br>high efficiency and non-pollution. It is gradually promoted in<br>the urban fire control construction [5-7]. The water mist fire<br>extinguishing an Zhao, Jin Zhang<br>system. It has the characteristics of environmental protection,<br>high efficiency and non-pollution. It is gradually promoted in<br>the urban fire control construction [5-7]. The water mist fire<br>extinguishing system. It has the characteristics of environmental protection, high efficiency and non-pollution. It is gradually promoted in the urban fire control construction [5-7]. The water mist fire extinguishing system has the cha system. It has the characteristics of environmental protection, high efficiency and non-pollution. It is gradually promoted in the urban fire control construction [5-7]. The water mist fire extinguishing system has the cha system. It has the characteristics of environmental protection,<br>high efficiency and non-pollution. It is gradually promoted in<br>the urban fire control construction [5-7]. The water mist fire<br>extinguishing system has the cha high efficiency and non-pollution. It is gradually promoted in<br>the urban fire control construction [5-7]. The water mist fire<br>extinguishing system has the characteristics of high fire<br>extinguishing efficiency, wide fire ex Exercise urban fire control construction [5-7]. The water mist fire<br>tinguishing system has the characteristics of high fire<br>tinguishing efficiency, wide fire extinguishing range,<br>ermal radiation and purification of the scr extinguishing system has the characteristics of high fire<br>extinguishing efficiency, wide fire extinguishing range,<br>thermal radiation and purification of the screen, no damage to<br>equipment, and good electrical insulation fo extinguishing efficiency, wide fire extinguishing range,<br>thermal radiation and purification of the screen, no damage to<br>equipment, and good electrical insulation for fire<br>extinguishing. Compared with other fire extinguishi thermal radiation and purification of the screen, no damage to<br>equipment, and good electrical insulation for fire<br>extinguishing. Compared with other fire extinguishing<br>systems, water mist fire extinguishing systems have th

showed that high-pressure water mist could reduce the<br>
the influence of the designed the electrical compartment in utility<br>
the influence of the designed<br>
integration and good effects in reducing temperature and<br>
integral Lemperature of the electrical compartment in utility<br>
in the influence of the design param<br>
in this system had good effects in reducing temperature and<br>
in any and large space water mist on the<br>
ting re-ignition. Fine wat tunnel to below 100 °C within 300 seconds. The high-pressure<br>
metar mist system had good effects in reducing temperature and<br>
preventing re-ignition. Fine water mist system has an important<br>
tunnel. Luo et. al. [9]<br>
pract water mist system had good effects in reducing temperature and<br>
practical significance in the electrical compartment of utility<br>
practical significance in the electrical compartment of utility<br>
tunnel.<br>
In the urban under Finder and significant external compariment of all investigated low ambient processing than the electric compartment<br>
Electric compartment<br>
I. INTRODUCTION and the value of the value of the state in the state in the sum o *Index Terms*—Water mist; Put out fire; Utility tunnel;<br>
al. [11] conducted an indoor<br>
Electric compartment<br>
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CITE TO mean interest of met equipment, and good electrical insulation for fire<br>extinguishing. Compared with other fire extinguishing<br>systems, water mist fire extinguishing systems have the<br>advantages of less water consumption, long-distance<br>transport extinguishing. Compared with other fire extinguishing<br>systems, water mist fire extinguishing systems have the<br>advantages of less water consumption, long-distance<br>transportation, small water supply pipe diameter required by systems, water mist fire extinguishing systems have the advantages of less water consumption, long-distance transportation, small water supply pipe diameter required by the system, and small space occupation. As an alterna advantages of less water consumption, long-distance<br>transportation, small water supply pipe diameter required by<br>the system, and small space occupation. As an alternative to<br>halon extinguishing agents, fine water mist is<br>e transportation, small water supply pipe diameter required by<br>the system, and small space occupation. As an alternative to<br>halon extinguishing agents, fine water mist is<br>environmentally friendly [8].<br>In recent years, previo the system, and small space occupation. As an alternative to<br>halon extinguishing agents, fine water mist is<br>environmentally friendly [8].<br>In recent years, previous studies have extensively studied<br>the influence of the desi halon extinguishing agents, fine water mist is<br>environmentally friendly [8].<br>In recent years, previous studies have extensively studied<br>the influence of the design parameters of tunnel, utility tunnel<br>and large space water environmentally friendly [8].<br>In recent years, previous studies have extensively studied<br>the influence of the design parameters of tunnel, utility tunnel<br>and large space water mist on the fire extinguishing effect of<br>tunne In recent years, previous studies have extensively studied<br>the influence of the design parameters of tunnel, utility tunnel<br>and large space water mist on the fire extinguishing effect of<br>tunnel. Luo et. al. [9] explored th the influence of the design parameters of tunnel, utility tunnel<br>and large space water mist on the fire extinguishing effect of<br>tunnel. Luo et. al. [9] explored the water mist fire<br>extinguishing system in the tunnel model. and large space water mist on the fire extinguishing effect of tunnel. Luo et. al. [9] explored the water mist fire extinguishing system in the tunnel model. Wang et al. [10] investigated low ambient pressure effect on the tunnel. Luo et. al. [9] explored the water mist fire<br>extinguishing system in the tunnel model. Wang et al. [10]<br>investigated low ambient pressure effect on the spray<br>characteristics of sprayer at low pressure (<0.1MPa). Zh extinguishing system in the tunnel model. Wang et al. [10]<br>investigated low ambient pressure effect on the spray<br>characteristics of sprayer at low pressure (<0.1MPa). Zhu et<br>al. [11] conducted an indoor experiment of water investigated low ambient pressure effect on the spray<br>characteristics of sprayer at low pressure (<0.1MPa). Zhu et<br>al. [11] conducted an indoor experiment of water mist<br>suppressing transformer sump fire. Yu et al. [12] con characteristics of sprayer at low pressure (<0.1MPa). Zhu et al. [11] conducted an indoor experiment of water mist suppressing transformer sump fire. Yu et al. [12] conducted a study on fine water mist fire extinguishing f al. [11] conducted an indoor experiment of water mist<br>suppressing transformer sump fire. Yu et al. [12] conducted a<br>study on fine water mist fire extinguishing for industrial<br>machinery casings. Pan [13] studied the prevent suppressing transformer sump fire. Yu et al. [12] conducted a<br>study on fine water mist fire extinguishing for industrial<br>machinery casings. Pan [13] studied the prevention and<br>control of methane combustion in enclosed unde study on fine water mist fire extinguishing for industrial<br>machinery casings. Pan [13] studied the prevention and<br>control of methane combustion in enclosed underground<br>spaces. It was recommended to use fine water mist. Zhu machinery casings. Pan [13] studied the prevention and<br>control of methane combustion in enclosed underground<br>spaces. It was recommended to use fine water mist. Zhu et al.<br>[14] studied the attenuation of thermal radiation i control of methane combustion in enclosed underground<br>spaces. It was recommended to use fine water mist. Zhu et al.<br>[14] studied the attenuation of thermal radiation in<br>large-scale fires by medium and low pressure fine wat spaces. It was recommended to use fine water mist. Zhu et al. [14] studied the attenuation of thermal radiation in large-scale fires by medium and low pressure fine water mist curtain. A new type of multi nozzle has been d [14] studied the attenuation of thermal radiation in large-scale fires by medium and low pressure fine water mist curtain. A new type of multi nozzle has been designed to produce a uniform and low water consumption water large-scale fires by medium and low pressure fine water mist<br>curtain. A new type of multi nozzle has been designed to<br>produce a uniform and low water consumption water mist<br>curtains. The author had conducted extensive rese curtain. A new type of multi nozzle has been designed to produce a uniform and low water consumption water mist curtains. The author had conducted extensive research on fire and ventilation [15-19]. Prasad et al. [20] anal produce a uniform and low water consumption water mist<br>curtains. The author had conducted extensive research on fire<br>and ventilation [15-19]. Prasad et al. [20] analyzed the<br>influence of particle size, spray position and o rtains. The author had conducted extensive research on fire<br>d ventilation [15-19]. Prasad et al. [20] analyzed the<br>fluence of particle size, spray position and other parameters<br>vater mist fire suppression. Research has fou and ventilation [15-19]. Prasad et al. [20] analyzed the influence of particle size, spray position and other parameters on water mist fire suppression. Research has found that in large enclosed spaces, fine water mist spr influence of particle size, spray position and other parameters<br>on water mist fire suppression. Research has found that in<br>large enclosed spaces, fine water mist sprayed from the top<br>has the shortest extinguishing time. Zh on water mist fire suppression. Research has found that in large enclosed spaces, fine water mist sprayed from the top has the shortest extinguishing time. Zhang et al. [21] proposed fine water mist fire to suppress combus large enclosed spaces, fine water mist sprayed from the top<br>has the shortest extinguishing time. Zhang et al. [21]<br>proposed fine water mist fire to suppress combustion<br>experimental tests by using rubber ignition as a flash EXECTION<br>
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EXECTION<br>
Then the utility tunnel fire occurs, it is very dangerous<br>
spaces. It was recommended to use fine water mist. Zhu et al.<br>
[14] studied the attenuation of thermal radiation in<br>
urban roads, sho

has the shortest extinguishing time. Zhang et al. [21] proposed fine water mist fire to suppress combustion experimental tests by using rubber ignition as a flashover indicator. They found that as the pressure and flow rat proposed fine water mist fire to suppress combustion experimental tests by using rubber ignition as a flashover indicator. They found that as the pressure and flow rate of the fine water mist increased, the flashover and f experimental tests by using rubber ignition as a flashover indicator. They found that as the pressure and flow rate of the fine water mist increased, the flashover and fire extinguishing effects improved. However, there is

mooth, the urban utility tunnel shows an increasing trend in early and curtain. A new type of<br>all over the world. However, the fire causes great economic damage and casualties to the utility tunnel [3][4]. The fine curtain Smooth, the urban utility tunnel shows an increasing trend in<br>
all over the world. However, the fire causes great economic<br>
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damage and casualties to the utility tunnel [3][4]. The fine<br>
curtains. The aut all over the world. However, the fire causes great economic<br>
damage and casualties to the utility tunnel [3][4]. The fine<br>
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and ventilation [15-19].<br>
gas fire exti damage and casualties to the utility tunnel [3][4]. The fine curtains. The author had<br>water mist fire extinguishing system has two advantages of and ventilation [15-19<br>gas fire extinguishing system and water fire extinguis and the extinguishing system has two water mist fire extinguishing system has twater mist fire extinguishing system and water f<br>Specifical Project (242 Scientific Research) in Henan Province (242 Scientific Research) in He Iter mist inve extinguishing system nas two advantages of and ventilation [15-19]<br>
Solive extinguishing system and water fire extinguishing on water mist fire supported by Key R&D and Pronotion Special Project (Science and gas fire extinguishing system and water fire extinguishing influence of parti<br>
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Encombed by Key R&D and Pronotion Special Project (Science and<br>
chaology Research Fund of Zhengzhou University of Light Industry<br>
21 supported by Key R&D and Promotion Special Project (Science and<br>
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inductor. They found the<br>
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Engineering Letters<br>factor. The temperature distribution of the electrical<br>compartment was investigated when the fine water mist flow<br>rates were 7 L/min, 8 L/min, 9 L/min, and 10 L/min. This<br>paper investigated the effect o Engineering Letters<br>
factor. The temperature distribution of the electrical<br>
compartment was investigated when the fine water mist flow<br>
rates were 7 L/min, 8 L/min, 9 L/min, and 10 L/min. This<br>
paper investigated the effe Engineering Letters<br>
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compartment was investigated when the fine water mist flow<br>
rates were 7 L/min, 8 L/min, 9 L/min, and 10 L/min. This<br>
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paper investigated the effe Externe Externe Externe Extinguishing in the electrical<br>compartment was investigated when the fine water mist flow<br>rates were 7 L/min, 8 L/min, 9 L/min, and 10 L/min. This<br>paper investigated the effect of longitudinal vent Example 110kV<br>
Example 110kV<br>
compartment was investigated when the fine water mist flow<br>
rates were 7 L/min, 8 L/min, 9 L/min, and 10 L/min. This<br>
paper investigated the effect of longitudinal ventilation speed<br>
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compartment was investigated when the fine water mist flow<br>
paper investigated the effect of longitudinal ventilation speed<br>
on fine water mist f compartment. g and distribution of the electrical<br>tigated when the fine water mist flow<br>L/min, 9 L/min, and 10 L/min. This<br>ffect of longitudinal ventilation speed<br>ire extinguishing in the electrical<br>tunnel with wind speed. This articl From the temperature distribution of the electrical<br> *A. Physical Model and Fire Scenario*<br> *A. Physical Model and Fire Scenario*<br> **A.** Physical Model and Fire Scenario<br> **A.** Physical Model and Fire Scenario<br> **A.** Physical

paper investigated the effect of longitudinal ventilation speed<br>on fine water mist fire extinguishing in the electrical<br>compartment of utility tunnel with wind speed. This article<br>provides guidance for the use of water mis The water mist fire extinguishing in the electrical<br>
compartment of utility tunnel with wind speed. This article<br>
provides guidance for the use of water mist in the electric<br>
compartment.<br>
The length, height, and width of cable width was 750 mm. The distance between adjacent provides guidance for the use of water mist in the electric<br>
compartment.<br>
Compartment.<br>
The length, height, and width of the electrical<br>
Compartment in utility tunnel were 25 m, 2.9 m, and 3.4 m,<br>
respectively. In this t Examplement and the ground. The top cable was 500 mm away from the top.<br>
Fig. 10. METHOD<br>
The length, height, and width of the electrical<br>
compartment in utility tunnel were 25 m, 2.9 m, and 3.4 m,<br>
respectively. In this The cable types were the same. The cable diameter was 100<br>
The cable types were the same. The cable diameter was a function of the same of the same of the same of the cable width was 750 mm. The distance between adjacent<br> The state of the model and Fire Scenario<br>
The length, height, and width of the electrical<br>
compartment in utility tunnel were 25 m, 2.9 m, and 3.4 m,<br>
respectively. In this testing scenario, the right side (ignition<br>
side 11. METHOD<br>
The length, height, and width of the electrical<br>
compartment in utility tunnel were 25 m, 2.9 m, and 3.4 m,<br>
respectively. In this testing scenario, the right side (ignition<br>
side) of the ventilation speed inl *A. Physical Model and Fire Scenario*<br>
The length, height, and width of the electrical<br>
compartment in uility tunnel were 25 m, 2.9 m, and 3.4 m,<br>
respectively. In this testing scenario, the right side (ignition<br>
side) of A. Physical Model and Fire Scenario<br>
The length, height, and width of the electrical<br>
compartment in utility tunnel were 25 m, 2.9 m, and 3.4 m,<br>
respectively. In this testing scenario, the right side (ignition<br>
side) of The length, height, and width of the electrical<br>
compartment in utility tunnel were 25 m, 2.9 m, and 3.4 m,<br>
respectively. In this testing scenario, the right side (ignition<br>
side) of the ventilation speed inlet was a 7-l compartment in utility tunnel were 25 m, 2.9 m, and 3.4 m,<br>
respectively. In this testing scenario, the right side (ignition<br>
side) of the ventilation speed inlet was a 7-layer cable. The<br>
cable layers was 750 mm. The bis respectively. In this testing scenario, the right side (ignition<br>side) of the ventilation speed inlet was a 7-layer cable. The<br>cable width was 750 mm. The distance between adjacent<br>the ground. The toy cable in the bottom side) of the ventilation speed inlet was a 7-layer cable. The<br>
cable width was 750 mm. The distance between adjacent<br>
cable layers was 350 mm. The bottom cable is 300 mm above<br>
the ground. The top cable was 500 mm away fr cable width was 750 mm. The distance between adjacent<br>cable layers was 350 mm. The bottom cable is 300 mm above<br>the ground. The top cable was 500 mm away from the top.<br>The cable types were the same. The cable diameter was



Fig. 1. Physical model of electric compartment<br> **and** the nozzle was arranged in the middle of the the normal intervalses. The nozzle was arranged in the middle of the unit intervalses of the nozzle were mist system activ 5.0 2.5 2.5 2.5 2.5 1.6 1 The experimental process wa<br>
belonged to local applications in the middle of the propagation in the comparison of the propagation in the middle of the entity tunnel,<br>
The nozzle was arranged in t **Experimental** conditions of high-pressure water mist conditions the matter site water in the mist system of the propane burner of the propane burner water and the high pressure water The nozzle was arranged in the middle ignition time. Pre-ignition<br>
and the nozzle time states are the nost time of the propane<br>
Fig. 1. Physical model of electric compartment<br>
Fig. 1. Physical model of electric compartment<br>
The nozzle was arranged in the middl outlet **a**<br> **Example 10** MPa. As shown in Table 1, it is parameters are the shown in the mozzle was arranged in the middle of the utility tunnel,<br>
The mozzle was arranged in the middle of the utility tunnel,<br>
The mozzle wa Fig. 1. Physical model of electric compartment<br>
Fig. 1. Physical model of electric compartment<br>
(2) The mist start time of the<br>
which was located below the ceiling of the electrical<br>
which was located below the ceiling of The fine water mist system active<br>
Fig. 1. Physical model of electric compartment<br>
(2) The mist started to spray are<br>
cocorded the start time of the mislon which was located below the ceiling of the electrical<br>
when the te Fig. 1. Physical model of electric compartment (2) The mist started to spray are<br>
which was located below the ceiling of the utility tunnel, (3) The temperature was reco<br>
which was located below the ceiling of the electric Fine nozzle was arranged in the middle of the utility tunnel,<br>
which was located below the ceiling of the electrical<br>
compartment. The nozzle spacing was 3 m. The installation<br>
angle and levelness of the nozzle were 45 deg The nozzle was arranged in the middle of the utility tunnel, (3) The temperature was<br>which was located below the ceiling of the electrical When the temperature rema<br>compartment. The nozzle spacing was 3 m. The installatio which was located below the ceiling of the electrical When the temperature remained<br>compartment. The nozzle spacing was 3 m. The installation that the fire had been extinguisl<br>angle and levelness of the nozzle were 45 degr compartment. The nozzle spacing was 3 m. The installation that the fire had b angle and levelness of the nozzle were 45 degrees. It to release the pre-<br>belonged to local applications of fine water mist. Under the closed.<br>e



<b>CHARACTERISTICS</b>				
Pressure (MPa)	Nozzle volume flow rate (L/min)	Atomizatio n cone angle	Droplet size $(\mu m)$	Initial droplet velocity $(m/s)$
10	7/10	140	80	50



 $\begin{array}{ccc} 5 & 7 & 0 & 250 \\ 6 & 7 & 0.4 & 250 \\ 7 & 7 & 0.8 & 250 \\ \hline \end{array}$ <br>
The experimental process was performed as follows:<br>
(1) The propane burner was ignited. It recorded the ignition time. Pre-ignition time lasted for 2 minute (3) The temperature remained constant, the staff confirmed the first one of the respective monitor of the propane burner was ignited. It recorded the mition time. Pre-ignition time lasted for 2 minutes. Then, it med off th

 $\frac{8}{12}$   $\frac{7}{12}$   $\frac{0.8}{250}$ <br>The experimental process was performed as follows:<br>(1) The propane burner was ignited. It recorded the<br>ignition time. Pre-ignition time lasted for 2 minutes. Then, it<br>turned off the pro  $\frac{8}{12}$  and  $\frac{1.2}{12}$  and  $\frac{250}{120}$ <br>The experimental process was performed as follows:<br>(1) The propane burner was ignited. It recorded the<br>ignition time. Pre-ignition time lasted for 2 minutes. Then, it<br>turned o The experimental process was performed as follows:<br>
(1) The propane burner was ignited. It recorded the<br>
ignition time. Pre-ignition time lasted for 2 minutes. Then, it<br>
turned off the propane burner. Meanwhile, it manual closed. (1) The propane burner was ignited. It recorded the intion time. Pre-ignition time lasted for 2 minutes. Then, it med off the propane burner. Meanwhile, it manually ened the high pressure water mist area control valve grou ignition time. Pre-ignition time lasted for 2 minutes.<br>
turned off the propane burner. Meanwhile, it i<br>
opened the high pressure water mist area control valy<br>
The fine water mist system activated the correspond<br>
(2) The mi The more is the propane burner. Meanwhile, it manually<br>
ened the high pressure water mist area control valve group.<br>
e fine water mist system activated the corresponding area.<br>
(2) The mist started to spray and extinguish opened the high pressure water mist area control valve group.<br>The fine water mist system activated the corresponding area.<br>(2) The mist started to spray and extinguish the fire. And it<br>recorded the start time of the mist s The fine water mist system activated the corresponding area.<br>
(2) The mist started to spray and extinguish the fire. And it<br>
recorded the start time of the mist spray.<br>
(3) The temperature was recorded on the monitor scree (2) The mist started to spray and extinguish the fire. And it<br>corded the start time of the mist spray.<br>(3) The temperature was recorded on the monitor screen.<br>hen the temperature remained constant, the staff confirmed<br>at t recorded the start time of the mist spray.<br>
(3) The temperature was recorded on the monitor scree<br>
When the temperature remained constant, the staff confirme<br>
that the fire had been extinguished and shut down the pun<br>
to r (3) The temperature was recorded on the monitor screen.<br>
then the temperature remained constant, the staff confirmed<br>
at the fire had been extinguished and shut down the pump<br>
release the pressure. The regional control ma When the temperature remained constant, the staff confirmed<br>that the fire had been extinguished and shut down the pump<br>to release the pressure. The regional control manifold was<br>closed.<br>(4) The temperature curve of the fi

that the fire had been extinguished and shut down the pump<br>to release the pressure. The regional control manifold was<br>closed.<br>(4) The temperature curve of the fire scene over time was<br>recorded and saved.<br>(5) If the water to release the pressure. The regional control manifold was closed.<br>
(4) The temperature curve of the fire scene over time was recorded and saved.<br>
(5) If the water mist system did not extinguish after 15 minutes of operat

**Engineering Le**<br>III. RESULTS AND DISCUSSIONS temport<br>of water mist flow rate<br>inst flow rate<br>inst flow rate is one of the important factors<br>extinguishing efficiency. This paper tested and inacc **Engineering Lette**<br>
III. RESULTS AND DISCUSSIONS tempera<br> *A. Effect of water mist flow rate*<br>
Fine water mist *flow rate*<br>
Fine water mist flow rate is one of the important factors<br>
Tecting fire extinguishing efficiency. **Engineering Letters**<br>
III. RESULTS AND DISCUSSIONS<br>
4. *Effect of water mist flow rate*<br>
Fine water mist *flow rate*<br>
Fine water mist *flow rate*<br>
Fine water mist flow rate is one of the important factors<br>
Fecting fire ex **En Example 18 EVALUATE:**<br>III. RESULTS AND DISCUSSIONS<br>A. Effect of water mist flow rate<br>Fine water mist flow rate is one of the important<br>affecting fire extinguishing efficiency. This paper tes<br>analyzed the temperature o





200  $y = 2.50 \text{ m}$ <br>
can be seen that the temperature distribution in Figs. 3 ~ 6, when the flow rates were 7 L/min,<br>
Fig. 4. Temperature above the fire source position when flow rate was<br>
E 400  $y = 2.50 \text{ m}$ <br>
As shown in 100<br>  $V = 2.50 \text{ m}$ <br>  $V = 2.50 \text{ m}$ <br>  $V = 1.80 \text{ m}$ <br>  $V = 2.50 \text{ m}$ <br>  $V = 2.50 \text{ m}$ <br>
As shown in Figs. 3 ~ 6, when the flow rates were 7 L/min,<br>
8 L/min, 9 L/min, and 10 L/m Fig. 4. Temperature above the first summarize of the bottom<br>
Time (s)<br>
Fig. 4. Temperature above the first summer position when flow rate was<br>  $\frac{8 \text{ L/min}}{200 \text{ A}} = \frac{100 \text{ V}}{200 \text{ A}} = \frac{100 \text{ V}}{200 \text{ A}} = \frac{100 \text{ V}}{200$ Fig. 4. Temperature above the fire source position when flow rate was<br>
Fig. 4. Temperature above the fire source position when flow rate was<br>
8 L/min (s)<br>
As shown in Figs. 3 ~ 6, when the flow rates were 7 L/min,<br>
8 L/mi Fig. 4. Temperature above the fire source position when flow rate was<br>
8 L/min<br>
As shown in Figs. 3 ~ 6, when the flow rates were 7 L/min,<br>
8 L/min, 9 L/min, and 10 L/min, the temperature of the<br>
thermocouples above the Fig. 4. Temperature above the fire source position when flow rate was<br>
8 L/min<br>
As shown in Figs. 3 ~ 6, when the flow rates were 7 L/min,<br>
8 L/min, 9 L/min, and 10 L/min, the temperature of the<br>
thermocouples above the f s L/min<br>
8 L/min, 9 L/min, and 10 L/min, the temperature of the<br>
thermocouples above the fire source position was affected.<br>
Fig. 6. Temperature above the fire source position was affected.<br>
Fig. 6. Temperature above the As shown in Figs. 3 ~ 6, when the flow rates were 7 L/min,<br>
8 L/min, 9 L/min, and 10 L/min, the temperature of the<br>
thermocouples above the fire source position was affected.<br>
From the analysis of temperature fluctuations As shown in Figs. 3 ~ 6, when the flow rates were 7 L/min,<br>
8 L/min, 8 L/min, and 10 L/min, the temperature of the<br>
thermocouples above the fire source position was affected.<br>
From the analysis of temperature fluctuations 8 L/min, 9 L/min, and 10 L/min, the temperature of the thermocouples above the fire source position was affected. Fig. 6. Temperature abord temperature fluctuations in Figs. 3 -6, it from the analysis of temperature fluct thermocouples above the fire source position was affected.<br>
From the analysis of temperature fluctuations in Figs. 3-6, it<br>
can be seen that the temperatures in the bottom, middle, and<br>
upper spaces remained relatively st

**Engineering Letters**<br>
III. RESULTS AND DISCUSSIONS<br>
A. Effect of water mist flow rate<br>
Fine water mist flow rate<br>
Fine water mist flow rate<br>
Fine water mist was within 40 s,<br>
the previous groups. Due to term<br>
affecting fi **Engineering Letters**<br>
III. RESULTS AND DISCUSSIONS<br>
A. Effect of water mist flow rate<br>
Fine water mist flow rate<br>
Fine water mist flow rate<br>
Fine water mist was under<br>
analyzed the temperature of the electric compartment **Example 18 Exercise 19 Exercise 19 Exercise 19 Exercise 19 Exercise 10 E/min, the temperature fluctuation of the fine water mist was within 40 s, which was more intense than the previous groups. Due to temperature fluctua** g Letters<br>temperature fluctuation was further weakened. When the<br>flow rate was 10 L/min, the temperature fluctuation of the<br>fine water mist was within 40 s, which was more intense than<br>the previous groups. Due to temperatu **g Letters**<br>temperature fluctuation was further weakened. When the<br>flow rate was 10 L/min, the temperature fluctuation of the<br>fine water mist was within 40 s, which was more intense than<br>the previous groups. Due to tempera **Example 19 Letters**<br>temperature fluctuation was further weakened. When the<br>flow rate was 10 L/min, the temperature fluctuation of the<br>fine water mist was within 40 s, which was more intense than<br>the previous groups. Due t **g Letters**<br>temperature fluctuation was further weakened. When the<br>flow rate was 10 L/min, the temperature fluctuation of the<br>fine water mist was within 40 s, which was more intense than<br>the previous groups. Due to temper **g Letters**<br>temperature fluctuation was further weakened. When the<br>flow rate was 10 L/min, the temperature fluctuation of the<br>fine water mist was within 40 s, which was more intense than<br>the previous groups. Due to temper **Exercise 10 Solution 10** state the flow rate was 10 L/min, the temperature fluctuation of the fine water mist was within 40 s, which was more intense than the previous groups. Due to temperature fluctuations, it was inac **Exercise 15 Exercise 10** Energy temperature fluctuation was further weakened. When the flow rate was 10 L/min, the temperature fluctuation of the fine water mist was within 40 s, which was more intense than the previous **g Letters**<br>temperature fluctuation was further weakened. When the<br>flow rate was 10 L/min, the temperature fluctuation of the<br>fine water mist was within 40 s, which was more intense than<br>the previous groups. Due to temper funder the mistrical model of the space of the space of the space of the space of the mist was within 40 s, which was more intense than the previous groups. Due to temperature fluctuations, it was inaccurate to use certai temperature fluctuation was further weakened<br>flow rate was 10 L/min, the temperature fluctu<br>fine water mist was within 40 s, which was more<br>the previous groups. Due to temperature fluctua<br>inaccurate to use certain tempera





200<br>  $\begin{bmatrix}\n100 \\
0 \\
0\n\end{bmatrix}\n\begin{bmatrix}\n100 \\
Y=2.50m\n\end{bmatrix}$ <br>  $\begin{bmatrix}\n100\n\end{bmatrix}\n\begin{bmatrix}\nY=1.80m \\
Y=1.80m\n\end{bmatrix}$ <br>  $\begin{bmatrix}\nY=1.80m \\
Y=1.80m\n\end{bmatrix}$ <br>  $\begin{bmatrix}\nY=1.80m \\
Y=1.80m\n\end{bmatrix}$ <br>  $\begin{bmatrix}\nY=1.80m \\
Y=1.80m\n\end{bmatrix}$ <br>  $\begin{bmatrix}\nY=1.80m$ 100  $Y=2.50m$ <br>  $Y=2.50m$ <br>  $V=2.50m$ <br>  $V=2.50m$ <br>  $T=6$   $V=1.80m$ <br>  $V$ Fig. 6. Temperature above the fire source position when flow rate was<br>
Fig. 6. Temperature above the fire source position when flow rate was<br>
10 L/min<br>
The flame retardant cable was ignited that it used a<br>
propane burner.







g Letters<br>in the electrical compartment of the utility tunnel rapidly<br>decreased after 20 s. At a distance of 2.5 m from the ignition<br>source, the temperature dropped below 45 °C. With the<br>continuous spraying of fine water m g Letters<br>in the electrical compartment of the utility tunnel rapidly<br>decreased after 20 s. At a distance of 2.5 m from the ignition<br>source, the temperature dropped below 45 °C. With the<br>continuous spraying of fine water m g Letters<br>in the electrical compartment of the utility tunnel rapidly<br>decreased after 20 s. At a distance of 2.5 m from the ignition<br>source, the temperature dropped below 45 ℃ . With the<br>continuous spraying of fine water g Letters<br>in the electrical compartment of the utility tunnel rapidly<br>decreased after 20 s. At a distance of 2.5 m from the ignition<br>source, the temperature dropped below 45 °C. With the<br>continuous spraying of fine water g Letters<br>in the electrical compartment of the utility tunnel rapidly<br>decreased after 20 s. At a distance of 2.5 m from the ignition<br>source, the temperature dropped below 45 °C. With the<br>continuous spraying of fine water **Exercise 12 The Exercise of the exercise of 2.5 m from the ignition** decreased after 20 s. At a distance of 2.5 m from the ignition source, the temperature dropped below 45 ℃. With the continuous spraying of fine water **Exercise 15 Exercise 10 Continuos** in the electrical compartment of the utility tunnel rapidly decreased after 20 s. At a distance of 2.5 m from the ignition source, the temperature dropped below 45 ℃. With the cont g Letters<br>in the electrical compartment of the utility tunnel rapidly<br>decreased after 20 s. At a distance of 2.5 m from the ignition<br>source, the temperature dropped below 45 °C. With the<br>continuous spraying of fine water **g Letters**<br>in the electrical compartment of the utility tunnel rapidly<br>decreased after 20 s. At a distance of 2.5 m from the ignition<br>source, the temperature dropped below 45 °C. With the<br>continuous spraying of fine wate in the electrical compartment of the utility tunnel rapidly decreased after 20 s. At a distance of 2.5 m from the ignition source, the temperature dropped below 45 °C. With the continuous spraying of fine water mist, afte in the electrical compartment of the utility tunnel rapidly decreased after 20 s. At a distance of 2.5 m from the ignition source, the temperature dropped below 45 °C. With the continuous spraying of fine water mist, afte in the electrical compartment of the utility tunnel rapidly<br>decreased after 20 s. At a distance of 2.5 m from the ignition<br>source, the temperature dropped below 45 °C. With the<br>continuous spraying of fine water mist, afte decreased after 20 s. At a distance of 2.5 m from the ignition<br>source, the temperature dropped below 45 ℃. With the<br>continuous spraying of fine water mist, after 240 s, the<br>temperature around the fire source gradually dro





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**Engineering Letters**<br>temperature fluctuations at three locations were significant, As shown in Fig. 13,<br>which caused by the buoyancy of unstable smoke movement. electrical compartment<br>Meanwhile, when the water mist was op Engineering Letters<br>temperature fluctuations at three locations were significant, As shown in Fig. 13,<br>which caused by the buoyancy of unstable smoke movement. electrical compartment<br>Meanwhile, when the water mist was open **Engineering Letters**<br>temperature fluctuations at three locations were significant, As shown in Fig. 13, when t<br>which caused by the buoyancy of unstable smoke movement. electrical compartment of the u<br>Meanwhile, when the **Engineering Letters**<br>temperature fluctuations at three locations were significant, As shown in Fig. 13<br>which caused by the buoyancy of unstable smoke movement. electrical compartment<br>Meanwhile, when the water mist was op **Engineering Letters**<br>temperature fluctuations at three locations were significant, As shown in Fig. 13, w<br>which caused by the buoyancy of unstable smoke movement. After detertical compartment of<br>Meanwhile, when the water **Engineering Letters**<br>
temperature fluctuations at three locations were significant, As shown in Fig. 13, when the which caused by the buoyancy of unstable smoke movement. electrical compartment of the undermementarie dat **Engineering Letters**<br>
temperature fluctuations at three locations were significant, As shown in Fig. 13, which caused by the buoyancy of unstable smoke movement. electrical compartment of Meanwhile, when the water mist w **Engineering Letters**<br>temperature fluctuations at three locations were significant, As shown in Fig. 13, when ti<br>which caused by the buoyancy of unstable smoke movement. electrical compartment of the u<br>Meanwhile, when the **Engineering Letters**<br>
temperature fluctuations at three locations were significant, As shown in Fig. 13, when<br>
which caused by the buoyancy of unstable smoke movement. electrical compartment of the<br>
Meanwhile, when the w **Engineering Letters**<br>
temperature fluctuations at three locations were significant, As shown in Fig. 13, when<br>
which caused by the buoyancy of unstable smoke movement. <br>
lectrical compartment of the underawitie, when the temperature fluctuations at three locations were significant,<br>which caused by the buoyancy of unstable smoke movement. electrical compartment of the u<br>Meanwhile, when the water mist was opened for 60 s and the temperature temperature fluctuations at three locations were significant, As shown in Fig. 13, when<br>which caused by the buoyancy of unstable smoke movement. electrical compartment of the<br>Meanwhile, when the water mist was opened for temperature fluctuations at three locations were significant, As shown in Fig. 13, when the which caused by the buoyancy of unstable smoke movement. Meanwhile, when the water mist was opened for 60 s and the temperature ab which caused by the buoyancy of unstable smoke movement. electrical compartment of the Meanwhile, when the water mist was opened for 60 s and the temperature above the ignitice temperature data was stable, the entire spac Meanwhile, when the water mist was opened for 60 s and the<br>
temperature above the ignit<br>
temperature data was stable, the entire space temperature combustion. The electrical<br>
reached a stable state after 30 s. After water temperature data was stable, the entire space temperature combustion. The electrical con-<br>reached a stable state after 30 s. After water mist was sprayed, exceeded 70 °C. The temp<br>the water mist acted on the flame surface reached a stable state after 30 s. After water mist was sprayed, exceeded 70 °C. The<br>the water mist acted on the flame surface along the<br>tatomization cone angle and longitudinal ventilation direction.<br>Even the remoccuple the water mist acted on the flame surface along the thermocouple showed that the matomization cone angle and longitudinal ventilation direction.<br>
Fine water mist relied on the amount of mist to suppress the constant in th atomization cone angle and longitudinal ventilation direction.<br>
Fine water mist relied on the amount of mist to suppress the<br>
constant in the middle position<br>
buoyancy rise of flames and smoke, as well as the heat<br>
exchan Fine water mist relied on the amount of mist to suppress the<br>
buoyancy rise of flames and smoke, as well as the heat<br>
exchange between fine water droplets and flames. The<br>
diffusion process of fine water droplets started





Letters<br>As shown in Fig. 13, when the ventilation velocity in the<br>ectrical compartment of the utility tunnel was 0.8 m/s, the<br>mperature above the ignition source decreased after stable<br>mbustion. The electrical compartment **Example 18 Except**<br>As shown in Fig. 13, when the ventilation velocity in the<br>electrical compartment of the utility tunnel was 0.8 m/s, the<br>temperature above the ignition source decreased after stable<br>combustion. The elec **Example 18 Except**<br>As shown in Fig. 13, when the ventilation velocity in the<br>electrical compartment of the utility tunnel was 0.8 m/s, the<br>temperature above the ignition source decreased after stable<br>combustion. The elec **Example 18 Exters**<br>As shown in Fig. 13, when the ventilation velocity in the<br>electrical compartment of the utility tunnel was 0.8 m/s, the<br>temperature above the ignition source decreased after stable<br>combustion. The elec **Example 18 Exceeded** 70 °C . The temperature data of the ventilation velocity in the electrical compartment of the utility tunnel was 0.8 m/s, the temperature above the ignition source decreased after stable combustion. **Example 15**<br>As shown in Fig. 13, when the ventilation velocity in the<br>electrical compartment of the utility tunnel was 0.8 m/s, the<br>temperature above the ignition source decreased after stable<br>combustion. The electrical **Example 10**<br>As shown in Fig. 13, when the ventilation velocity in the<br>electrical compartment of the utility tunnel was 0.8 m/s, the<br>temperature above the ignition source decreased after stable<br>combustion. The electrical **g Letters**<br>As shown in Fig. 13, when the ventilation velocity in the electrical compartment of the utility tunnel was 0.8 m/s, the temperature above the ignition source decreased after stable combustion. The electrical c **Exercise 15 Exercise 15 All Startingtherol** As shown in Fig. 13, when the ventilation velocity in the electrical compartment of the utility tunnel was 0.8 m/s, the temperature above the ignition source decreased after st As shown in Fig. 13, when the ventilation velocity in the electrical compartment of the utility tunnel was 0.8 m/s, the temperature above the ignition source decreased after stable combustion. The electrical compartment c As shown in Fig. 13, when the ventilation velocity in the electrical compartment of the utility tunnel was 0.8 m/s, the temperature above the ignition source decreased after stable combustion. The electrical compartment c As shown in Fig. 13, when the ventilation velocity in the electrical compartment of the utility tunnel was 0.8 m/s, the temperature above the ignition source decreased after stable combustion. The electrical compartment c As shown in Fig. 15, when the ventua<br>electrical compartment of the utility tunn<br>temperature above the ignition source de<br>combustion. The electrical compartment<br>exceeded 70 °C. The temperature d<br>thermocouple showed that th cerrical compartment of the utility tunnel was 0.8 m/s, the<br>mperature above the ignition source decreased after stable<br>mbustion. The electrical compartment ceiling temperature<br>ceeded 70 °C. The temperature data of the low temperature above the ignition source decreased after stable<br>combustion. The electrical compartment ceiling temperature<br>exceeded 70 °C. The temperature data of the lower<br>thermocouple showed that the maximum temperature di combustion. The electrical compartment celling temperature<br>exceeded 70 °C. The temperature data of the lower<br>thermocouple showed that the maximum temperature did not<br>exceed 40 °C. And the ambient temperature remained<br>cons exceeded 70 °C. The temperature data of the lower<br>thermocouple showed that the maximum temperature did not<br>exceed 40 °C. And the ambient temperature remained<br>constant in the middle position. After the water mist was<br>turne

thermocouple showed that the maximum temperature du not exceed 40 °C. And the ambient temperature remained constant in the middle position. After the water mist was turned on, the temperature of the bottom thermocouple dr exceed 40 ∪. And the ambient temperature remained constant in the middle position. After the water mist was turned on, the temperature of the bottom thermocouple droped to near the simulated ambient temperature within 10 constant in the middle position. After the water mist was<br>turned on, the temperature of the bottom thermocouple<br>droped to near the simulated ambient temperature within 10 s<br>and remained stable. The temperature of the uppe durned on, the temperature of the bottom thermocoupted droped to near the simulated ambient temperature within 10 s and remained stable. The temperature of the upper thermocouple droped to around 40 °C and remained stable droped to near the simulated ambient temperature within 10 s<br>and remained stable. The temperature of the upper<br>thermocouple droped to around 40 °C and remained stable for<br>80 s.<br>As shown in Fig. 14, when the ventilation ve and remained stable. The temperature of the upper<br>thermocouple droped to around 40 °C and remained stable for<br>80 s.<br>As shown in Fig. 14, when the ventilation velocity in the<br>electrical compartment increased to 1.2 m/s, th thermocouple aropea to around 40 ∪ and remained stable for<br>80 s.<br>
As shown in Fig. 14, when the ventilation velocity in the<br>
electrical compartment increased to 1.2 m/s, the temperature<br>
above the fire source further decr



200<br>  $\begin{bmatrix}\n\sqrt{Y=1.80 \text{ m}}\n\end{bmatrix}\n\begin{bmatrix}\n\sqrt{Y=1.80 \text{ m}}\n\end{bmatrix}\n\begin{bmatrix}\n\sqrt{Y=1.80 \text{ m}}\n\end{bmatrix}\n\begin{bmatrix}\n\sin(95) & \sin(950) & \sin(950) & \sin(950) & \sin(950) & \sin(950) & \sin(950) \\
\sin(950) & \sin(950) & \sin(950) & \sin(950) & \sin(950) & \sin(950) & \sin(950) \\
\cos(950)$ 100<br>  $\frac{1}{2}$   $\frac{1}{$ 100<br>
units of 100 150 200 250 300 350 400 450 500 550 600<br>
Fig. 14. Temperature above fire source position when ventilation velocity was<br>
1.2 m/s<br>
As shown in Figs. 15 ~ 18, the temperature changes in the<br>
upstream direct and 2.5 m from the fire source location. High-pressure water<br>metal and 2.5 m/s and 2.5 m from the fire source location. The temperature changes in the upstream d 0 50 100 150 200 250 300 350 400 450 500 550 600<br>
Fig. 14. Temperature above fire source position when ventilation velocity was<br>
1.2 m/s<br>
As shown in Figs.  $15 \sim 18$ , the temperature changes in the<br>
upstream direction in Time (s)<br>
Fig. 14. Temperature above fire source position when ventilation velocity was<br>
1.2 m/s<br>
As shown in Figs. 15 ~ 18, the temperature changes in the<br>
upstream direction in the electrical compartment were<br>
represent Fig. 14. Temperature above fire source position when ventilation velocity was<br>1.2 m/s<br>1.2 m/s<br>45 s, the temperature changes in the<br>upstream direction in the electrical compartment were<br>represented at distances of -10.0 m, 1.2 m/s<br>
As shown in Figs.  $15 \sim 18$ , the temperature changes in the<br>
upstream direction in the electrical compartment were<br>
represented at distances of -10.0 m, -5.0 m, and -2.5 m from<br>
the fire source location. The temp As shown in Figs.  $15 \sim 18$ , the temperature changes in the upstream direction in the electrical compartment were represented at distances of -10.0 m, -5.0 m, and -2.5 m from the fire source location. The temperature chan As shown in Figs.  $15 \sim 18$ , the temperature c<br>upstream direction in the electrical compa<br>represented at distances of -10.0 m, -5.0 m, and<br>the fire source location. The temperature ch<br>downstream direction of the electrica









 $\begin{array}{r|l}\n \text{Z0} & \text{X=2.5m}\n & \text{X=2.5m}\n & \text{X=10.0m}\n\end{array}$ <br>  $\begin{array}{r|l}\n \text{X=10.0m}\n\end{array}$ <br>  $\begin{$ source was 2.5 m, the temperature was greatly affected by the <sup>215</sup> s =  $x=10.0$  s =  $x=$ 210 **in any 200 160 200** Time (s)<br>Fig. 18. Temperature at different locations from fire source when ventilation<br>velocity was 1.2 m/s<br>The temperature of the electrical compartment continued<br>to rise until the water mist was opened. The temperature<br> Fig. 18. Temperature at different locations from fire source when ventilation velocity was 1.2 m/s<br>The temperature of the electrical compartment continued<br>to rise until the water mist was opened. The temperature<br>curve was Fig. 18. Temperature at different locations from fire source when ventilation velocity was 1.2 m/s<br>The temperature of the electrical compartment continued<br>to rise until the water mist was opened. The temperature<br>curve was velocity was 1.2 m/s<br>
The temperature of the electrical compartment continued<br>
to rise until the water mist was opened. The temperature<br>
curve was consistent at 2.5 m and 2.0 m from the ignition<br>
source. This is because w The temperature of the electrical compartment continued<br>to rise until the water mist was opened. The temperature<br>curve was consistent at 2.5 m and 2.0 m from the ignition<br>source. This is because when the distance from the The temperature of the electrical compartm<br>to rise until the water mist was opened. The<br>curve was consistent at 2.5 m and 2.0 m fror<br>source. This is because when the distance fror<br>source was 2.5 m, the temperature was gre The was consistent at 2.5 m and 2.0 m from the ignition<br>tive was consistent at 2.5 m and 2.0 m from the ignition<br>ource. This is because when the distance from the ignition<br>ource was 2.5 m, the temperature was greatly affec arce. This is because when the distance from the ignition<br>urce was 2.5 m, the temperature was greatly affected by the<br>intion source. At 280 s, the temperature downstream of the<br>intion source reached its maximum. When the t source was 2.5 m, the temperature was greatly affected by the ignition source. At 280 s, the temperature downstream of the ignition source reached its maximum. When the time was 400 s, the temperature from different posit ignition source. At 280 s, the temperature downstream of the ignition source reached its maximum. When the time was 400 s, the temperature from different positions of the fire source remained basically constant, and the t

ignition source reached its maximum. When the time was 400<br>s, the temperature from different positions of the fire source<br>remained basically constant, and the temperature was below<br>28 °C. Ventilation increased the tempera s, the temperature from different positions of the fire source<br>remained basically constant, and the temperature was below<br>28 °C. Ventilation increased the temperature of electrical<br>compartment downstream of the fire sourc remained basically constant, and the temperature was below<br>28 °C. Ventilation increased the temperature of electrical<br>compartment downstream of the fire source. It reduced the<br>temperature of electrical compartment upstrea 28 °C. Ventilation increased the temperature of electrical<br>compartment downstream of the fire source. It reduced the<br>temperature of electrical compartment upstream of the<br>ignition source.<br>C. Fire extinguishing time<br>The co compartment downstream of the fire sou<br>temperature of electrical compartment<br>ignition source.<br>C. Fire extinguishing time<br>The comparison results were in Table :<br>cases used in this paper. The nozzle flow<br>on shortening the f The comparison results were in Table 3 between the eight<br>sess used in this paper. The nozzle flow rate had the effect<br>a shortening the fire extinguishing time in the electrical<br>ompartment of the utility tunnel. When the w Example 1 and this paper. The nozzle flow real<br>
ening the fire extinguishing time<br>
ment of the utility tunnel. When<br>
cow rate was 10 L/min, the time<br>
indoor temperature of the utility<br>
rate (0.5) and the time required to zle flow rate had the effect<br>hing time in the electrical<br>nel. When the water mist<br>the time required for the<br>he utility tunnel to drop to<br>quired to drop to 50 ℃ was<br>Note to 100°C drops to 50°C<br>(s)<br>(s) (s)<br>145 180<br>105 130 ad the effect<br>he electrical<br>water mist<br>ired for the<br>el to drop to<br>o 50 ℃ was<br><u>L CASES</u><br>Temperature<br>drops to 50°C<br>(s)<br>180<br>180



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follows: The time interesting of the start of th

Extinguishing system, the temperature of the check it is recommended [12] H. Yu, X. Zhou, and J. Capar Muslem in industrial<br>
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electrical compartment fires. The main conclusions as<br>
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(1) Within 20 seconds after the start of the water mist fire<br> electrical compartment fires. The main follows:<br>
(1) Within 20 seconds after the start of the extinguishing system, the temperature of th space of the utility tunnel electrical compar<br>
from a maximum of 800 °C to 200 °C. Lows:<br>
(1) Within 20 seconds after the start of the water mist fire  $\frac{1}{2}$  but, we in currely and the electrical compartment may drop  $\frac{1}{2}$  but,  $\frac{1}{2}$  but,  $\frac{1}{2}$  but,  $\frac{1}{2}$  but,  $\frac{1}{2}$  but,  $\frac{1}{2}$ (1) Within 20 seconds after the start of the water mist fire<br>
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extinguishing system, the temperature of the entire internal [17] Z. Bai, Y. Li, J. Zhang, A. Fewkagnace of the utility tunnel electrical compartment may drop<br>from a maximum of 800 °C to 200 °C. In other words, fine  $\frac{\cos$ space of the utility tunnel electrical compartment may drop<br>from a maximum of 800 °C to 200 °C. In other words, fine<br>weater mist played a positive role in controlling the spread of [18] Z. Bai. "Bunding changes in the com from a maximum of 800 °C to 200 °C. In other words, fine *Technology*, vol. 42, no. 3,<br>water mist played a positive role in controlling the spread of [18] Z Bai, H. Yao, and<br>fires.<br>(2) If the longitudinal ventilation velo water mist played a positive role in controlling the spread of<br>
fires.<br>
(2) If the longitudinal ventilation velocity is too high, it<br>
[1] reduce the fire in the electrical compartment. Therefore,<br>
the longitudinal ventila (3) When a fire occurs in the electrical compartment, the<br>
flow rate of fine water mist is greater than 7 L/min. After the<br>
water mist system was turned on, the temperature inside the<br>
utility tunnel could drop below 100 Solution for the sustainable revitalization of historic centres: The case<br>solution for the spaces". Applied Therma<br>sures can protect the structural safety of electrical<br>partments in the utility tunnel.<br>Numerial safety of rate of tine water mist is greater than 7 L/min. After the<br>
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y tunnel could drop below 100 °C within 300 s. These<br>
sures can protect the structural safety of electric *Technology, wol.* 81, pp. 228-236, 2018.<br> *Technology* tunnel could drop below 100 °C within 300 s. These<br> *Technology*, and protect the structural safety of electrical<br>
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