UIC COVID-19 TASK FORCE

RAILsilience

Thermographic cameras for temperature measurement of people to combat Covid-19

State of the art - **July 2020**

INTERNATIONAL UNION
OF RAILWAYS

978-2-7461-2975-7

Warning

CONTENTS

UIC COVID-19 TASK FORCE

Amid the coronavirus disease outbreak, UIC set up a task force combining UIC member companies, experts and other relevant stakeholders (AAR, AFRA, African Union, ALAF, AllRail, ANPTrilhos, APTA, CER, CIT, EIM, EPF, ERFA, ETF, ETOA, IATA, OTIF, UITP and UNECE) to work together to find ways to respond to this crisis that were adapted to the railway sector.

The UIC Covid-19 taskforce's main purpose is to provide a trusted space for our members and fellow transport associations to share information with one another regarding this crisis. As this is an unprecedented, global crisis, being able to come together and benefit from each other's experiences has been key in the fight to protect lives while still providing a minimum of our essential service: transport.

As this continues to be a global crisis, it needs a global response, and UIC is uniquely placed to create a space where rail stakeholders the world over can come together and cooperate. At our taskforce meetings we bring together railway stakeholders from Asia, Africa, Europe, the Middle East, Oceania and the Americas, and all are benefiting from each other's knowledge and experience.

Response to this crisis for the rail sector requires them to navigate a changing environment, with a day-to-day, agile approach, in the now and also continuing on to the short and medium terms.

Between March and July 2020, six UIC Guidance Documents for Railway Stakeholders have been published and made available online at: https://uic.org/news/article/Covid-19.

Since then, information has continued to be shared among members. All the information shared by the members is available upon joining the task force and registering to UIC extranet at the Covid-19 Task Force Workspace at https://extranet.uic.org/index.php .

Relevant multimedia information is available in the UIC Media Center at https://mediacenter.uic.org/fr. The UIC Covid-19 task force has also created a Linked-In group where relevant newspaper articles and upcoming webinars are shared. Join us: https://www.linkedin.com/groups/13846065/.

1. WHY MEASURE TEMPERATURE?

The Covid-19 virus can be easily transmitted from person to person, causing it to spread quickly. One of the most common symptoms of Covid-19 that can be easily identified is fever. The particularly sensitive points of virus distribution include heavily frequented places, such as rail traffic hubs in local and long-distance traffic, trains, stations but also subways and planes. An effective approach to effectively preventing the spread of the disease is to identify infected persons in the crowd. For this purpose, the body temperature can be checked in public places with an infrared measuring device. However, it is important to note that it is not possible to detect the Covid-19 disease with a thermographic camera. The camera can only measure the temperature on skin surfaces.

It should be mentioned that the elevated body temperature is a quantitative characteristic of the Covid-19 disease. People with Covid-19 may have a fever, but this is not necessarily part of the pathology of this disease, and therefore people with Covid-19 might also not have a fever.

So people with other illnesses can have an increased body temperature or this results from physical activity or due to high outside temperatures and too warm clothes. The pros and cons of temperature measurement can be seen in the fact that it is a balancing act between the protection of healthy travellers from a person suffering from Covid-19 (without being able to protect them 100% with this measure) and the unjustified taking of measures aimed at a person who does not suffer from Covid-19 but has an increased body temperature.

Added to this is the fact that passengers could rely on being protected from Covid-19 simply because the railway systems were monitored by thermal imaging cameras. As a result of this measure, they may lose sight of the fact that there is still a risk of infection with Covid-19 by people who do not have the symptom fever.

2. THERMOGRAPHIC CAMERAS AS A POTENTIAL MEASURE

The practical implementation of infrared temperature measurement without checking the temperature of each person one by one can be carried out using various types of (smart) thermal imaging cameras that were previously known from other applications. The IoT (Internet of the things) concept can provide helpful support. In this case, the artificial intelligence registers that a previously defined temperature has been exceeded and on this basis triggers an alarm in the Security Operation Center. The responsible employee now evaluates the images from the thermal imaging camera and, if available, connects them with images from a conventional camera.

Especially in epidemic and pandemic situations, such as in the case of Covid-19, the system can be regarded as reliable support and a preventive measure.

A thermographic camera is a device that creates an image with infrared radiation. The way to collect and analyse the data is called thermography. Instead of the 400-700 nanometer range of the camera for visible light, infrared cameras are sensitive to wavelengths from about 1,000 nm (1 µm) to about 14,000 nm (14 µm).

Thermographic cameras can quickly measure and visualize elevated temperatures in people without contact and – in case they are smart - also give an alarm if the temperature exceeds the predefined value. The skin temperature is measured with an accuracy of +/- 1°C from a certain distance.

The systems can recognize several people at the same time and measure their temperature. An algorithm recognizes the individual human bodies and measures the facial temperature from an optimal distance of a few meters.

There is also the possibility to have a hybrid camera, which delivers standard and thermal images of a scene at the same time. In smart systems, it is possible to display the real video image and the thermal image simultaneously. In addition, the fever alarm can also be activated in the real image only. The data of the thermographic camera are then saved in the real image by a special software. This enables the operator to identify people with elevated temperature (fever) more quickly / easily.

Thermographic cameras are ideal for permanent monitoring and can also be integrated into an existing network, so current measurements can be displayed in a control centre - if necessary, in combination with intelligent video analysis.

3. TYPES OF THERMOGRAPHIC CAMERAS

3.1 DIFFERENT SYSTEMS

Different systems are available:

- Stationary when installed on a fixed part of the infrastructure,
- Handheld for mobile and quick control,
- Fixed on some piece of body equipment,
- Mobile when installed on a UAV,
- As an alternative to the stationary system, the infrared fever measuring system can also be mounted on a tripod and is then mobile.

3.2 DRONES

Drones (UAV) can also be equipped with thermal imaging cameras. They are ideal for flying over masses and discovering people with elevated temperatures. Of course, they have to be powerful enough to be able to operate over a certain distance. They must also be used in accordance with national data protection and privacy legislation.

Source: https://store.groupgets.com/products/dji-mavic-ready-to-fly-thermal-solution-4k-video-flir-thermal-video-simultaneously

3.3 SMARTPHONE ATTACHMENTS

Attachments for smartphones are easy to use. The acquisition costs are also reasonable.

An add-on is plugged in, the smartphone itself serves as a display.

By using a so-called selfie stick, the recommended distance rules to prevent infection with Covid-19 can be followed.

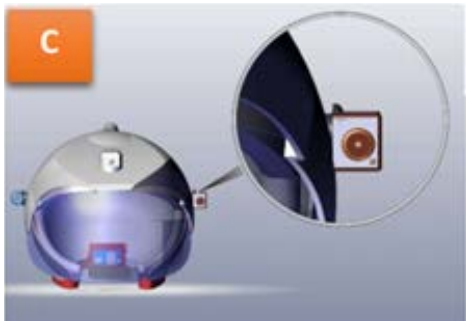
Source: https://www.flir.co.uk/products/flir-one-pro-lt/

3.4 NEW WAYS OF INTEGRATING THERMAL CAMERAS

In order to detect the corona virus more efficiently and with fewer human interactions based on the thermal image, new types of devices are taking hold.

3.4.1 Helmet integration

An example is intelligent camera technology integrated into a helmet. The thermal imaging technology is integrated into the smart helmet and combined with the IoT technology for monitoring the screening process in order to obtain real-time data. This system can also be equipped with facial recognition technology.



Source: Mohammed, M.N., H. Syamsudin et al.: Novel Covid-19 detection and diagnosis system using IoT based smart helmet.

Police officers in Chengdu, China, wearing smart helmets fitted with infrared camera
Source: The Guardian

3.4.2 Thermal Imaging Glasses

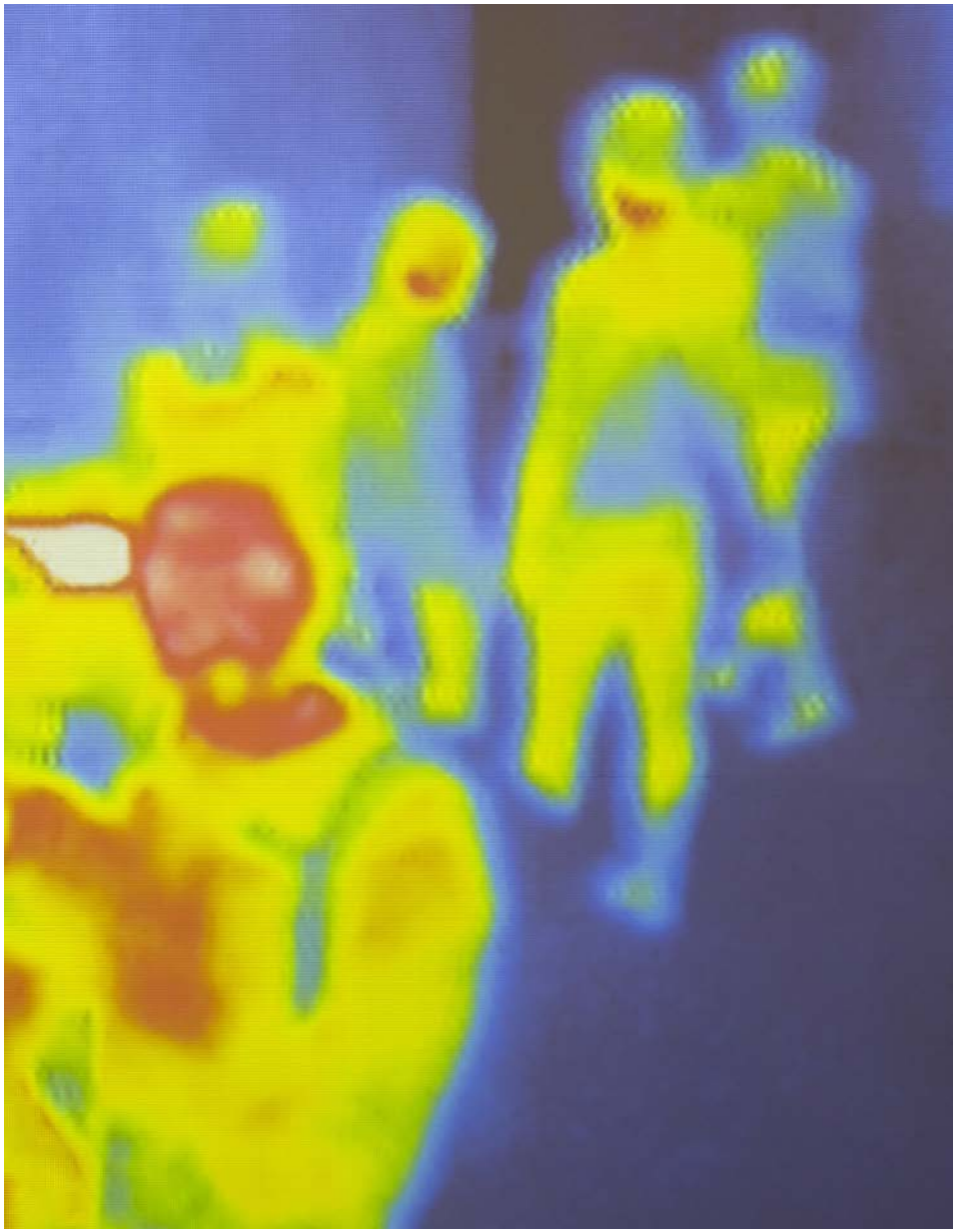
Another possibility are Thermal Imaging Glasses. It is another possible solution for quick and accurate measurement of body temperature.

The glasses are similar to ordinary sunglasses with a camera that contains an infrared temperature sensor that is suitable for mass scanning. Both individual pictures and videos can be recorded.

According to the manufacturer's description, the user can switch between full-screen infrared imaging and a reduced grayscale window in which the temperature scan is displayed.

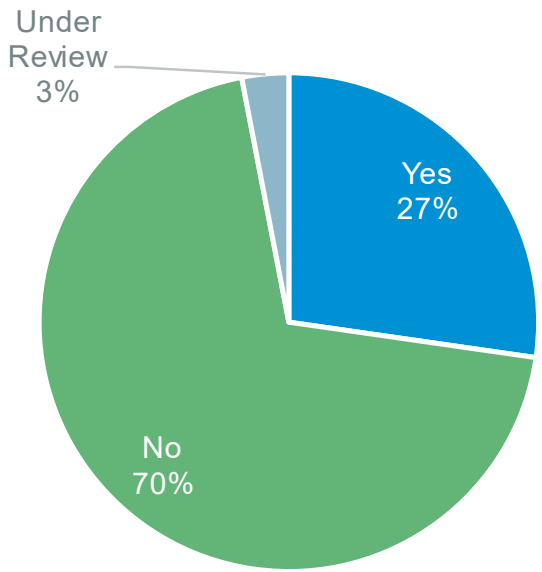
Source: HealthTech INSIDER

Source: rokid.com/en/rokid-glass-2/



4. OPERATIONAL EXPERIENCES

Most of the UIC Covid-19 Task Force members do not or do not plan to use thermographic cameras for Covid-19 related temperature screening, as was shown in RAILsilience, back on the tracks.



4.1 DEUTSCHE BAHN AG (DB), GERMANY

DB does not use thermal imaging cameras to detect elevated temperatures in humans. Thankfully, however, the company does share the experience of using this technology in other areas:

- From the point of view of data protection and the protection of individual personal rights/privacy law it can even be helpful to use only thermal imaging cameras since the person in question cannot be identified on the produced images.
- In large areas, such as station halls, the cameras should be installed high up in order to capture as many people as possible – but of course also depending on their own sensitivity to heat.
- Also, wide angle cameras should be used.
- In any case, a colour video with a differentiated colour spectrum and a high number of pixels should be used - only on this basis the area to be filtered can be determined technically for the video analysis / intelligence.
- Military devices are often more suitable due to the higher reliability, resilience, battery life and better conditions for covering larger distances.

Instruction / training of employees: the technology itself is easy to understand or self-explanatory these days. There are hardly any differences to everyday used devices. However, great emphasis should be placed on tactical and legal aspects during instruction. It should also be determined which device is used where and for what purpose.

4.2 KORAIL, SOUTH KOREA

During the Covid-19 crisis, the Korean government has implemented a 3Ts system: Trace, Test, Treat in the fight against the spread of Covid-19.

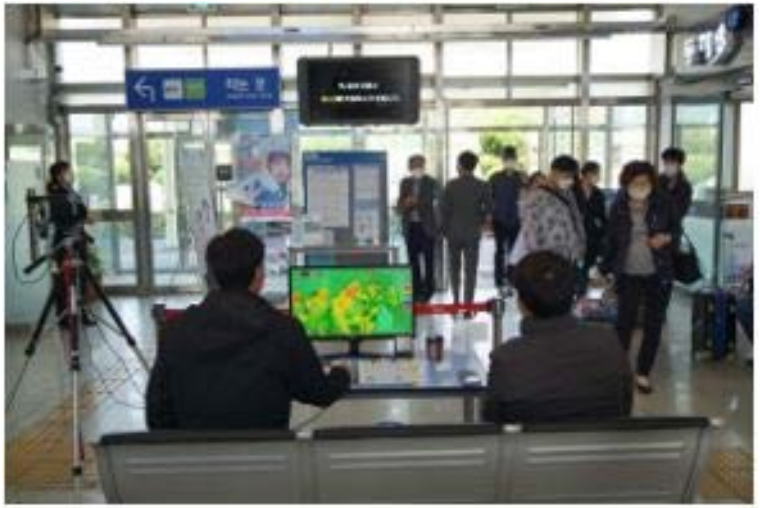
To aid in the detection of potentially infected persons, KORAIL has put into place the measure of temperature checks since the beginning of the crisis.

KORAIL is continuing this measure into the resumption phase, and as of June 10, 2020 has installed 49 thermal cameras, 42 of which are at big stations.

In this new stage of the crisis, KORAIL has been able to work together with the government to change how they react to persons who are detected with a fever.

Originally only being able to recommend the individual not to travel, they can now block the passenger from entering the train and take them to be tested before boarding.

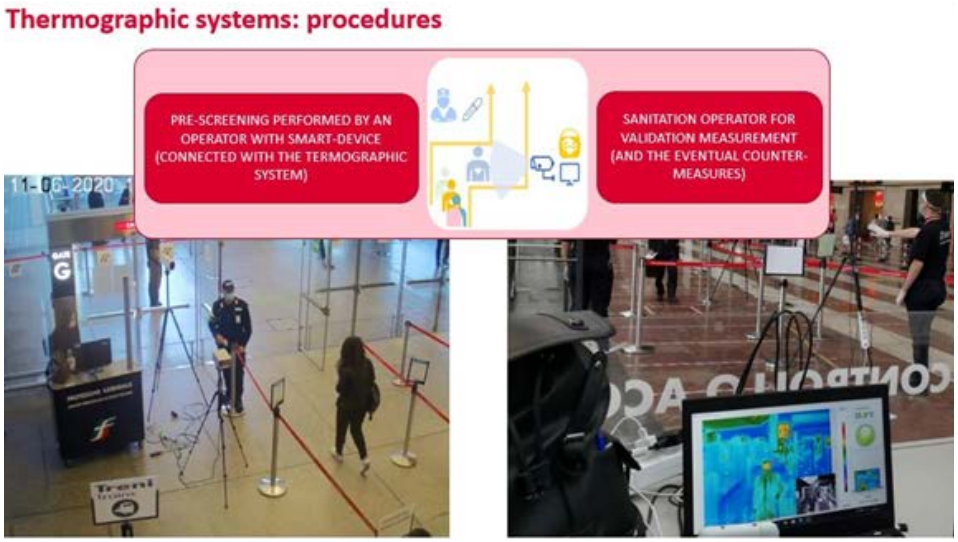
This is to protect other passengers from infection and to give other passengers the feeling of security to ride the train. This new protocol also helps the government in their policy to find every infected person.



Thermal camera used by KORAIL in Korea

4.3 FS, ITALY

During the Covid-19 crisis, the Italian government requested temperature checking in some stations. Therefore some thermographic systems were installed by FS. The pre-screening is performed by an operator with smart device (connected to the thermographic system). Sanitation operator is present for validating the measurement and for eventual counter measures.



4.4 RZD, RUSSIA

RZD has installed thermal cameras at several railway stations. Their system automatically recognizes people whose temperature is more than 37,0ºC. In the case that the temperature is over 37,0ºC, passengers are invited to conduct temperature measurements using the contact method. If the fever is confirmed, the passenger will be offered hospitalization and an ambulance call will be made.

4.5 CR, CHINA

CR is checking passengers' temperature at station entrance and exit and on trains with non-contact infrared temperature measuring equipment.

4.6 ISRAEL RAILWAYS, ISRAEL

Israel Railways have installed thermal cameras at all train stations.

4.7 ULAANBAATAR RAILWAY, MONGOLIA

After passengers get on the train, Ulaanbaatar Railway have doctors check passenger body temperature using infrared thermometer. Currently in Mongolia, every train has doctors on the train..

4.8 TCDD, TURKEY

For TCDD, contactless thermometers will be used on the personnel and passengers at the stations where there is a staff and passenger density. The thermal cameras will be used at Kapıkule, Marmaray Yenikapı, Marmaray Üsküdar, Bakırköy, Ankara, Alsancak, Ankara High-speed Station, Eryaman High-speed Station, Eskisehir and Konya High-speed stations.

4.9 SRT, THAILAND

SRT has installed thermoscan cameras at large railway stations such as Bangkok station, while other stations employ infrared forehead thermometers. If a person is detected with body temperature of above 37.5°C, he/she will then be asked to take a rest and then re-check totally up to three times. If high temperature is still present, he/she will not be allowed to enter the system and will be advised to contact medical or public health service.

4.10 SNCF, FRANCE

Starting on the 21st of July, SNCF began testing temperature screenings for passengers before boarding certain trains at the Paris-Gare de Lyon station thanks to the use of “borne de santé” (health terminals). The thermographic camera is only proposed on a voluntary basis to passengers. Those found with a high temperature (higher than 38.5°C), SNCF staff will approach the traveller to provide them with a mask, sanitary gel and to remind them about the hygiene measures to combat Covid-19. Pilot tests will also happen in two other stations. The goal of the pilot test is to be ready in case the authorities require this type of measure.

5. POTENTIAL BENEFITS

Thermographic cameras reduce the risk of cross infection because the temperature is measured without human interaction - social distancing is taken into account.

Thermographic cameras measure body temperature very precisely - with a high accuracy of +/- 0.3°C. The technology is powerful and suitable for small and large control areas with a high density of people.

The technology is therefore particularly suitable for stations and trains. The rate of incorrect measurements is reduced to a minimum by using the latest technology.

Due to the high thermal sensitivity and the high pixel resolution, the smallest temperature differences can be measured. In combination with smart video intelligence, the system can automatically trigger an (acoustic) alarm when a predefined temperature is reached. In this way, follow-up measures can be taken very promptly.

Thermographic cameras can be used mobile or stationary. This makes the system flexible and quick to use.

6. POTENTIAL CRITICALITIES

Temperature measurement alone is not enough for detecting Covid-19. Further, the thermographic camera can only display suspicious cases.

These should then be checked by medical personnel immediately - the measure therefore requires a relatively large number of personnel. Without an effective response capacity, the thermographic camera will be of little use.

If the thermal imaging camera system is not equipped with video analysis, a relatively large number of personnel is again required to evaluate the images and react accordingly.

Especially by measuring the body temperature at a distance, it can hardly be avoided that hot objects such as coffee cups are in the measuring range. Artificial intelligence ensures that such heat sources are excluded and that the alarm is not triggered in this case.

Legal requirements to install such cameras must be checked: rights regarding one's own image, basic personal rights, data protection, privacy law.

Ease of implementation likely depends on the national laws regulating on video surveillance in each country.

False **positives** can lead to potentially dangerous or unpleasant consequences.

False negatives can lead to a sick person being undetected.

The software of the thermographic cameras has to be constantly updated to protect the system from the latest cyber-attacks.

And, important to note, there is a lack of products on the market which have been specifically designed for the railway sector.

The criticalities listed below are in line with ECDC[1] findings on the subject:

"Nevertheless, temperature screening processes may help dissuade those who are sick from travelling or entering public places and enhance the confidence of healthy travellers.

In addition, they offer a further means for providing specific information to passengers on the disease, the current epidemiological situation and where to seek medical advice, if needed.

Due to the currently ongoing community transmission levels in all EU/EEA countries and the UK, if temperature screening is adopted by the national health or transport authorities, it should be performed using a specific protocol for primary and secondary screening, testing and follow-up.

This entails huge human, laboratory, logistical (PPE, sample transport, passenger transit and quarantine, etc.) and monetary resources, which will be reduce the amount available for preparedness planning for a potential second wave of the Covid-19 pandemic."

1. "Covid-19 Rail Protocol - Recommendations for safe resumption of railway services in Europe", https://www.era.europa.eu/content/covid-19-rail-protocol_en

7. RECOMMENDATIONS

The thermal camera system and its operation must comply with the laws in force in the country, especially regarding general data protection.

Thermographic cameras should meet the following requirements:

- **Real time**. A monitoring system is required for the screening process, which immediately automatically displays the thermal image of the temperature of people.
- **Accuracy**. Thermographic cameras should be able to reliably detect predefined temperatures; false alarms should be avoided and the error rate should be carefully checked when the system is deployed.
- **Performance**. It must be able to detect and report in real time that a previously defined temperature has been exceeded.
- **Completeness**. The thermographic camera system should not fail to recognize a person with an elevated temperature (this requirement can be difficult to meet, especially in dense masses).
- **Resilience**. It should be resistant and robust against malicious attacks. The software should also receive frequent updates to protect the system from cyber-attacks.
- **Reliability**. The camera system must be able to monitor the assumed largest number of events in a large camera network.

An operator should monitor and analyse the alarms. If he classifies an alarm as real, appropriate measures must be taken.

Training and instructions on thermography measurement for staff in the operation rooms should be carried out.

After an alarm has been triggered due to the exceeding of a predefined temperature, the person concerned must be specifically examined by medical personnel. This should be considered before the implementation of thermographic cameras for temperature monitoring and ensured in advance.

REFERENCES

https://esut.de/2020/04/meldungen/20037/waermebildkameras-zur-ueberwachung-von-corona/

https://www.flir.co.uk/products/flir-one-pro-lt/

https://healthtechinsider.com/2020/04/24/thermal-imaging-glasses-detect-body-temperature/

https://www.rokid.com/en/rokid-glass-2/

https://www.theguardian.com/artanddesign/2020/mar/25/10-coronavirus-covid-busting-designs

Mohammed, M.N., H. Syamsudin et al.: Novel Covid-19 detection and diagnosis system using IoT based smart helmet. In: International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 7, 2020

Contact: COVID19@UIC.ORG

#RAILsilience

L'UIC est une association professionnelle certifiée pour engagement de qualité de services par AFNOR.

UIC is a professional association certified by AFNOR for its commitment to service quality.

INTERNATIONAL UNION OF RAILWAYS
16, rue Jean Rey - 75015 Paris - France
Tel. +33 (0)1 44 49 20 20
Fax +33 (0)1 44 49 20 29
E-mail: info@uic.org

Published by: The UIC Communications Department, on behalf of the UIC Covid Task Force (J. Ramlow, L. Petersen, A. Saadaoui, V. Perez, M-H. Bonneau, P. Lorand) led by M. Guigon
Director of publication: M. Plaud-Lombard
Design: C. Filippini
Photo credit: Adobe Stock

ISBN: 978-2-7461-2975-7
Copyright deposit: August 2020

www.uic.org

#UICrail