Environmental Monitoring for Coronavirus on Workplace Contact Surfaces:

Best Practices for Viral Environmental Monitoring and Remediation

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eurofins

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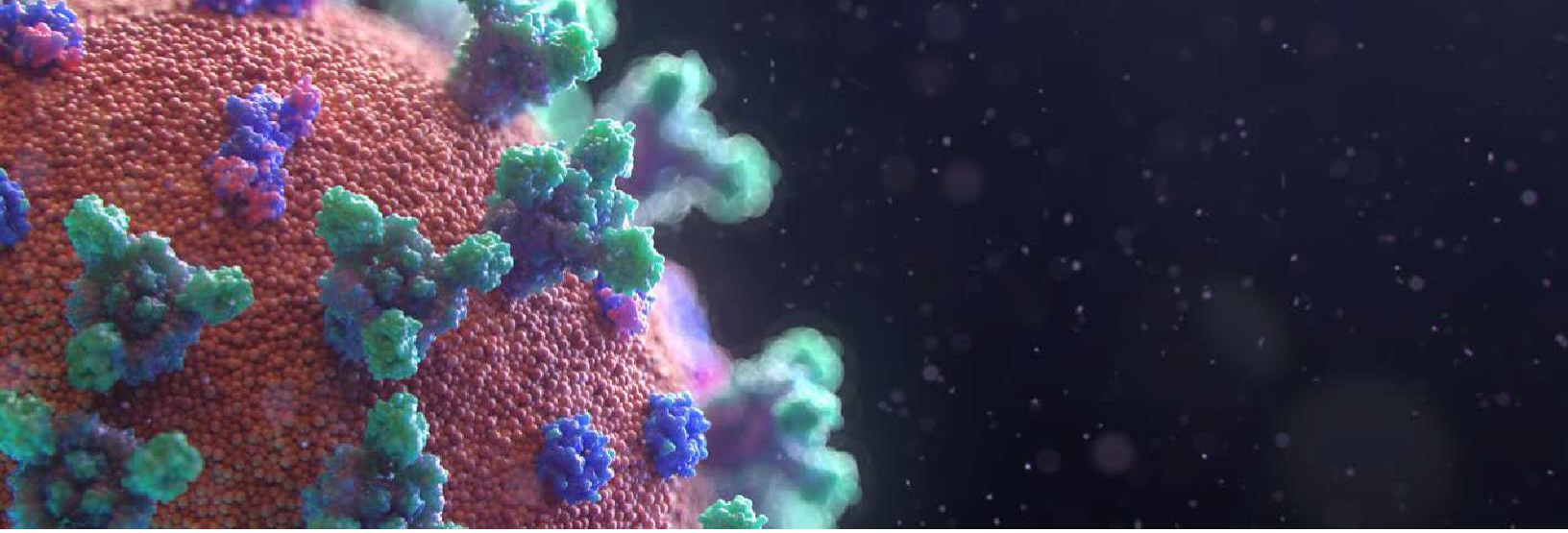

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Abstract

Companies currently face urgent health and safety concerns associated with the novel coronavirus (COVID-19), including workforce shortages, employee to employee transmission of the virus, and employee walkouts. All of these factors are leading to supply chain uncertainty and have serious impacts on business continuity. Companies that can effectively manage these health and safety concerns will be able to concentrate on what makes a difference in their bottom line – protecting employees and maintaining and growing their businesses. This white paper provides recommendations on developing a viral environmental monitoring program (EMP) for monitoring SARS-CoV-2 on workplace contact surfaces and solutions to remediate the workplace when contamination events occur.

Background

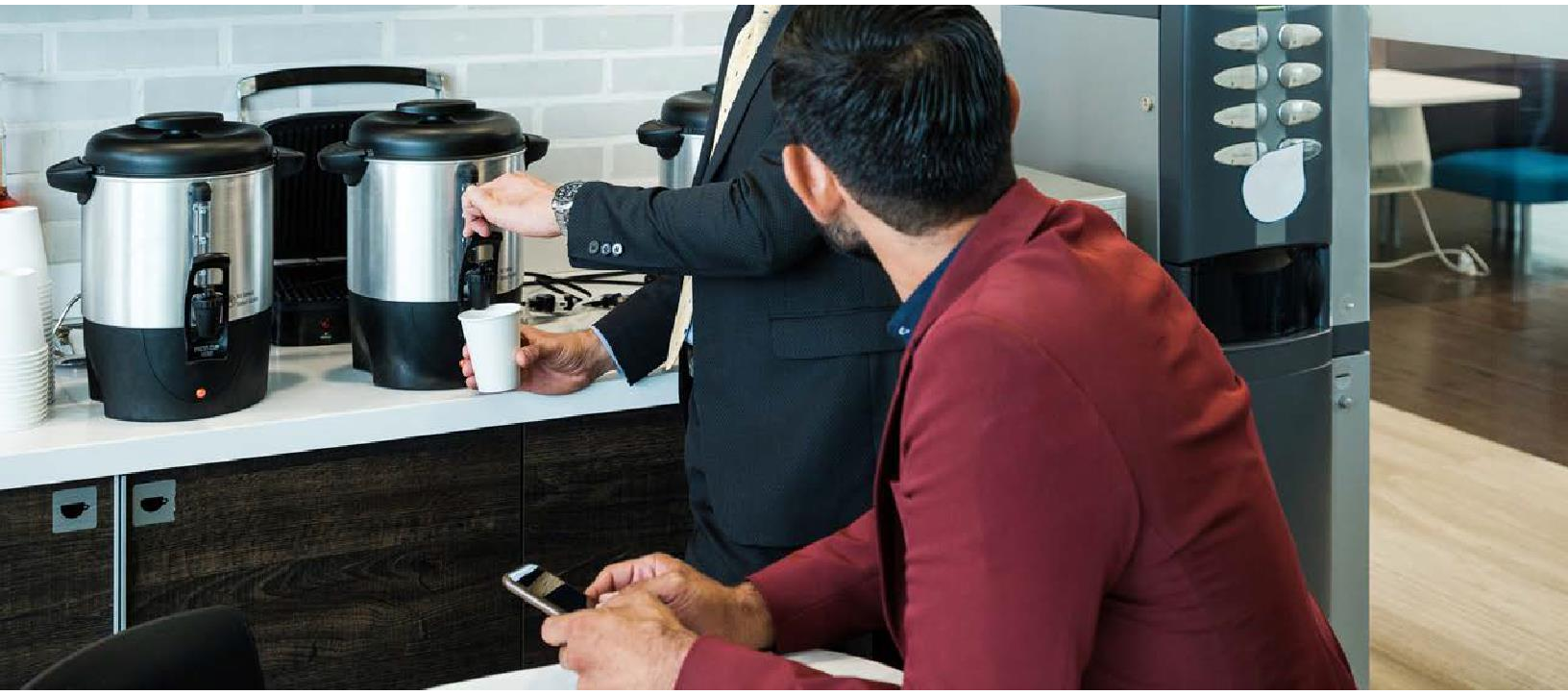
A novel coronavirus disease (abbreviated COVID-19) was first detected in Wuhan, China in December 2019.[1] Coronaviruses get their name because when viewed under an electron microscope their morphology is reminiscent of a crown or more fittingly, a solar corona. Coronaviruses have four main subgroups: alpha (α), beta (β), gamma (γ), and delta (δ). There are seven known coronaviruses that can infect people: 229E (alpha coronavirus), NL63 (alpha coronavirus), OC43 (beta coronavirus), HKU1 (beta coronavirus), MERS-CoV (beta coronavirus that causes Middle East Respiratory Syndrome or MERS), SARS-CoV (beta coronavirus that causes severe acute respiratory syndrome or SARs), and SARS-CoV-2 (beta coronavirus – the novel coronavirus that causes coronavirus disease 2019 or COVID-19). The Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome coronavirus (SARS-CoV) cause acute lung injury and acute respiratory distress syndrome which can lead to pulmonary failure and result in fatality.[2] After the first confirmed case of COVID-19 in Wuhan, the coronavirus disease rapidly spread across regions of China and around the world. On March 11, 2020 the World Health Organization's (WHO) Director-General, Dr. Tedros Adhanom Gyebreyesus, declared the coronavirus disease a global pandemic, making SARS-CoV-2 the first virus to cause a pandemic since the 2009 H1N1 influenza pandemic.[3] A pandemic declaration must fulfill two requirements. First, the novel pathogen (in this case, the SARS-CoV-2 coronavirus) must be easily spread through human to human transmission, and second, there is no vaccination yet developed to prevent the spread of the disease. Because of this, many people will contract COVID-19 in a short period of time and may overload healthcare systems. There is limited information at this time regarding the risk factors related to severity and mortality for people who contract COVID-19. Based on current available information and clinical expertise, those that may be at higher risk for the disease include, older adults ($\geq$65 years of age) and people of any age with serious underlying health conditions that may impair lung and heart function or weaken the immune system.

Transmission of COVID-19 primarily occurs when respiratory droplets from sneezes or coughs from infected people spread to those in close proximity. However, people may also contract the virus from infected animals (both domestic and non-domestic) by touching a contaminated surface or object and then subsequently touching their own mouth, nose, or eyes.

Why Monitor your Environment?

Infected individuals can shed virus particles onto inanimate surfaces. Such surfaces are called fomites. Hard surfaces and equipment are especially vulnerable to such contamination. Current research is underway to determine how long the SARs-CoV-2 coronavirus can survive on surfaces. According to a study published in the New England Journal of Medicine, SARS-CoV-2 coronavirus was detectable on cardboard for up to 24 hours and 2-3 days on plastic and stainless steel.[4] It's important to understand that the virus can be spread by asymptomatic, pre-symptomatic, and symptomatic individuals who are infected with the virus. Infected individuals likely start shedding the virus up to 48 hours before the onset of symptoms. In an interview conducted on March 31, 2020, the CDC Director, Dr. Robert Redfield reiterated these mechanisms of rapid spread. The combination of the apparent longevity of the virus on surfaces and the risk potential to have contaminated surfaces in your facility, even in the absence of employees being symptomatic or testing positive for COVID-19, highlights the importance of environmental monitoring for virus detection.

Since the virus can survive up to 72 hours on inanimate objects, disease transmission can occur from contact with contaminated hard surfaces and equipment. Therefore, it's important to understand the risk associated with commonly touched surfaces and equipment within the workplace and to implement an environmental monitoring program to monitor for and mitigate against the transmission of SARS-CoV-2 from your environment to your employees, visitors, and guests.



How do you Achieve Coronavirus Control?

To begin an environmental monitoring program you should clearly define what control looks like in your organization in terms that can be easily articulated to your workforce. It's important to survey your facility for risk related to highly-trafficked touch points and personnel hygienic practices. The COVID-19 pandemic is a quickly evolving disease, so creating a program that is nimble and will allow you to adjust in real-time to emerging government recommendations is key to success. As part of the program, you should understand how you will react to information generated from your sampling plan (no positives, sporadic positives, consistent positives, etc.). Mechanisms for surveying the workplace should include precise direction on the following:

- Pre and post operational inspection
  - Work station set-up
  - Critical supply check (Personal Protective Equipment [PPE], disinfectants, reagents, etc.)
- Pre and Post operational cleaning and sanitation
  - Develop a corporate approved SARS-CoV-2 disinfectant list
  - Create Sanitation Standard Operating Procedures (SSOP) on appropriate sanitation practices
    - Research on biocidal agents shows that many commonly used disinfectants are effective against SARS-CoV-2. The efficacy is dependent upon the concentration of the agent and the contact time. Agents tested include but are not limited to ethanol (78-95%) and sodium hypochlorite (bleach).
    - EPA list of approved disinfectants against SARS-CoV-2.[2]
- Company layout and Hygienic zoning
  - Locker rooms or designated garbing areas for employees to change into appropriate work attire before and after each shift
  - Traffic control of personnel and equipment: Limited access/Increased security
  - One directional personnel and movable equipment flow
  - Airflow/Water control
- Good personal hygiene
- Personnel screenings before entering the workplace including: physical examination (appropriate work attire, donned PPE), body temperature, wellness declaration, etc.

Environmental Sampling Collection Sites

Many industries already implement an environmental monitoring program (EMP). For example, in the food industry an environmental monitoring program is used to monitor the manufacturing facility for pathogens and allergens to determine if sanitation programs and personal hygiene practices are effective against cross-contamination. The pharmaceutical and medical device industries likewise monitor manufacturing sites for hygienic conditions. A well-designed routine coronavirus EMP will include multiple samples from various areas throughout the facility. It's important to understand that the facility size does not necessarily dictate the number of specimens that should be collected. Rather, the number of identified high-risk commonly touched surfaces should dictate the number of sampling sites. Sampling sites should be determined based on the risk associated with common touch points and facility design before specimen collection begins to take place. High-risk sampling sites may include but are not limited to: time clocks, doors, hand washing stations, shared keyboards, shared equipment and utensils, break rooms, locker rooms, outdoor smoking areas, etc. Additionally, when developing an EMP and determining sampling sites, airflow should be taken into consideration, as SARS-CoV-2 is proven to remain viable in aerosols.[4] Recommendations for sampling sites in common workplace environments are described in further detail in Table 1, below.

When determining if a sampling site is high, medium, or low risk you should consider the percentage of your employees who come in contact with the identified surface or object and opportunity for wide spread transmission of the virus. Higher risk sites should be sampled at a greater sampling frequency than lower risk sites. A detailed sampling site log and facility map that identifies the location and name of sampling sites should be created to aid those collecting samples and to ensure each site is being sampled on a pre-determined frequency. The environmental monitoring plan should contain written detail on how to appropriately, aseptically collect specimens. In addition to collecting sampling site information, the time, date, and any activity or condition which may impact the sample result, should be documented. Such activities or conditions may include: an employee testing positive for COVID-19, changes to cleaning and sanitation practices, positive or negative pressure airflow, and facility maintenance.

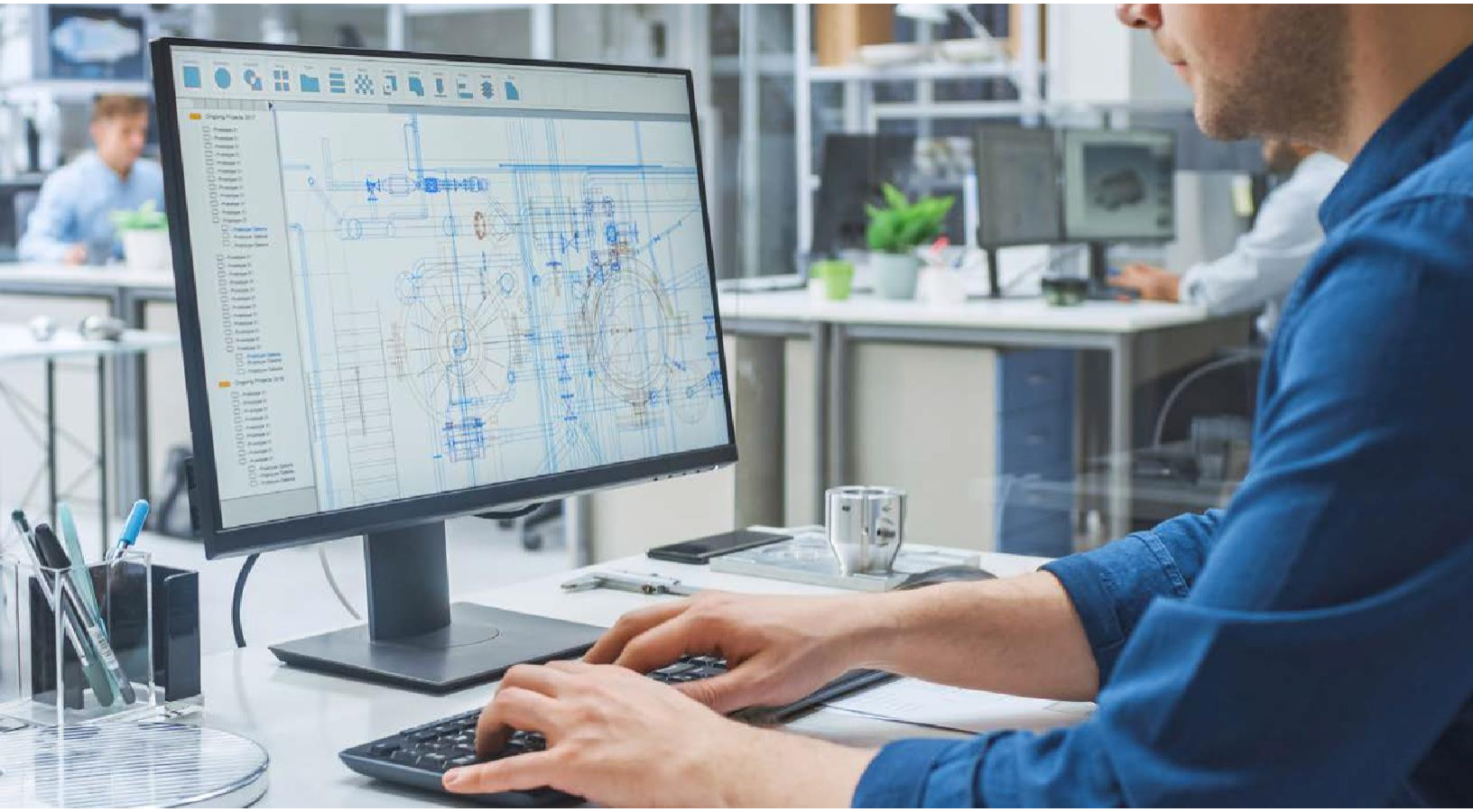
Table 1. Examples of recommended sampling sites based on risk of SARS-CoV-2 transmission in workplace environments.

Potential SARS-CoV-2 Transmission Areas	High Risk Samples Sites	Medium/Low Risk Sampling Sites
Company parking garage & parking lots	Guard gate ticket button, elevator button, stairway doors and knobs, stairway hand railing	Elevator walls, stairway walls, floors
Company lobby & waiting room	Door knobs, light switches, countertops, sign-in sheet clipboards & pens, chairs & armrests, TV remote controller, end tables	Walls, magazines, floors
Office spaces	Door knobs, light switches, desktops, tabletops, chairs & armrests, keyboards, mice, phones, headsets	Walls, magazines, floors
Production facility	Door knobs, light switches, equipment buttons/dials, benchtops, tabletops, keyboards, mice, phones, conveyor belts, walkway hand railing, stairway hand railing, maintenance tools, forklift steering wheels, faucet handles, paper towel dispensers, soap dispensers (if not hands free), cleaning supplies (broom handles, squeegees, mops, etc.)	Walls, floors
Break rooms	Door knobs, light switches, countertops, cabinet knobs, drawer knobs, tabletops & benches, faucet handles, paper towel dispensers, soap dispensers (if not hands free), microwaves, oven door handles, refrigerator doors and handles, vending machines, trash can lids, water fountain button	Walls, floors
Restrooms & locker rooms	Door knobs, light switches, faucet handles, paper towel dispensers, soap dispensers (if not hands free), restroom stall doors & door handles, locker doors, toilet handles, trash can lids, feminine napkin dispensers & waste receptacles	Walls, floors

When to Test your Environment for Coronavirus?

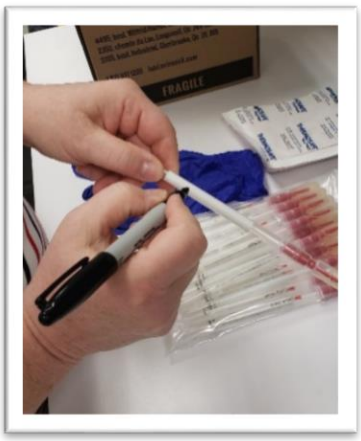
A coronavirus EMP plan will indicate if SARS-CoV-2 is being transferred on contact surfaces and equipment in your workplace. To determine if SARS-CoV-2 is present on contact surfaces and equipment and to establish a baseline of your environment's current state, you should sample your environment during or at the end of each shift. If you choose to sample at the end of each shift you should do so before cleaning and sanitation takes place in order to establish a true baseline. Like traditional environmental monitoring plans, a coronavirus EMP plan is a lagging indicator of risk in the environment, as time to result is 48 hours upon laboratory sample receipt. When you receive a positive result, it's important to conduct additional testing directly after cleaning and sanitation activities take place to determine if your cleaning and sanitation procedures are working effectively to remove the risk associated with SARS-CoV-2 present in your environment. Removal of unnecessary highly-frequented contact surfaces/equipment, workplace segregation, and traffic control will help you determine which employees are viral shedders. It's important to select disinfectants that are effective at removing viable SARS-CoV-2 from your environment. Eurofins recommends selecting disinfectants that are appropriate for your work environment from the EPA's list of approved disinfectants for SARS-CoV-2 to ensure virus removal through cleaning and sanitation. Your EMP should answer the following questions:

- Does coronavirus exist in my workplace environment?
- Is my routine cleaning and sanitation program eliminating the threat of coronavirus?
- Where is coronavirus stemming from (employees, guests, maintenance, incoming receivables, etc.)?
- Do I have an active asymptomatic employee shedding virus in the workplace?

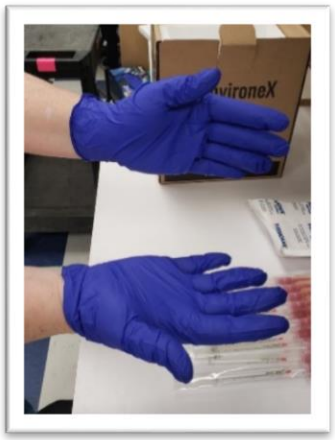


Sampling Protocol

1. When receiving the kit, ensure that the Ice-Pack remains frozen. If necessary, freeze it beforehand for storage and shipment of the sample.



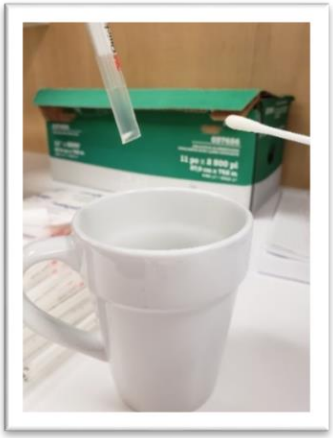
2. Identify the sample.



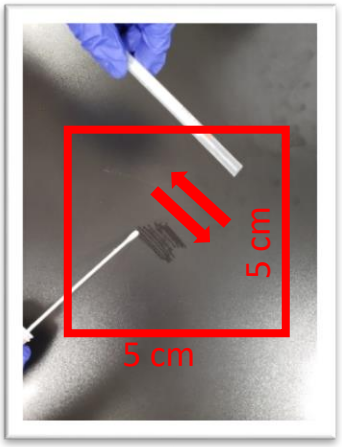
3. Put on protective gloves.

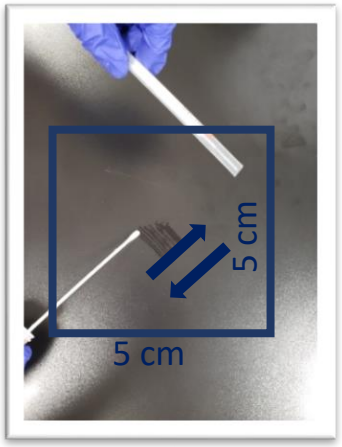
4. Take the swab and bend the tip at 45 degrees.

5. Press the tip of the swab to deliver liquid.

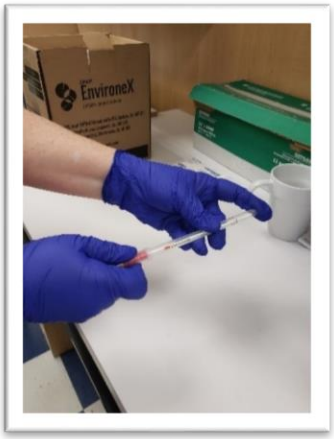


6. Discard liquid.
Please note that the liquid swab must be completely emptied.



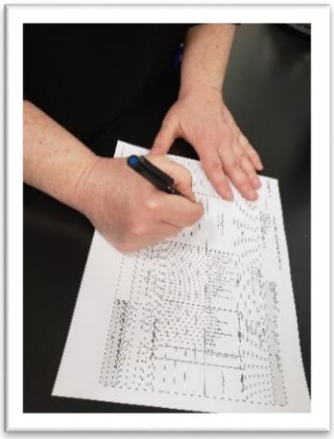


7. Swab **approx. 25 cm^2** : rubbing the swab thoroughly on the area with **constant pressure** to the swab. **Rub the surface horizontally then invert the swab and rub vertically.**



8. Replace the swab and push it well so that it is **airtight**.

9. Clean outside of the bag with an alcohol wipe.
Place swab in bag and seal.



10. Fill out the Sample submission form.

11. Put the bag with the swab, the Ice-Pack and the Sample submission form in the box and send it to the laboratory.

Eurofins' Environmental Monitoring Sampling Methods

We offer a comprehensive service solution to screen for a broad range of SARS-related coronaviruses, as well as a confirmation assay for SARS-CoV-2. Our assays utilize an RNA extraction technique and analysis based on a one-step, real-time polymerase chain reaction (PCR) for the detection of SARS-related coronaviruses, as well as SARS-CoV-2 confirmation in swab samples of environmental surfaces. The assay is accompanied by a murine norovirus as a positive control. This two-step procedure is in alignment with the testing procedure recommended from WHO and the German Health Authority. Table 2, below describes in detail the two available assays Eurofins offers for environmental monitoring samples.

Table 2. Eurofins Assays to Screen for SARS-related coronaviruses and Detect SARS-CoV-2.

Assay	Assay Test Description	Limit of Detection (LOD)	Turnaround Time (TAT)
VIRSeek SARS-CoV-2 Screen	A real-time-PCR assay to screen specimens for the envelope gene (E-gene) present in a broad range of SARS- and SARS-related coronaviruses. The assay was developed as an initial screening assay to determine if coronavirus is present.	≤ 5 copies	48 hours*
VIRSeek SARS-CoV-2 Ident	A real-time-PCR assay that specifically detects the RNA-dependent RNA polymerase (RdRP-gene) of the SARS-CoV-2 virus, and does not cross-react with SARS-CoV, MERS-CoV, or seasonal human coronaviruses HKU1, OC43, NL63, 229E.	≤ 5 copies	48 hours*

*Turnaround Time is 48 hours from the time of sample receipt.

Labeling, Shipment, and Storage of Specimens

Eurofins recommends labeling, shipping, and storing specimens according to the World Health Organization laboratory guidance. The World Health Organization recommends the following:

Transport of specimens within national borders should comply with applicable national regulations. International transport of specimens should follow applicable international regulations as described in the WHO Guidance on regulations for the transport of infectious substances 2019-2020.[7]

Establish a Baseline and Trend Tracking

Collect preliminary data for each location and determine if coronavirus is currently present in your environment. Utilize the data to build trending tools to identify contact surfaces and equipment that cause habitual viral sites. Trending this data will help you determine if you have coronavirus being introduced to your environment and across which shifts the introduction is occurring. If you receive positive tests for the coronavirus, your environment is out of control. You will want to utilize this data to indicate when your environment is going out of control, so you can react with appropriate corrective actions quickly. Image 1, below is an example of a trend analysis that demonstrates an environment going out of control, a corrective action being taken, and then the results returning back to within acceptable range after the corrective and preventative actions have been implemented. Table 3, below demonstrates how tracking and trending data is important in delivering information related to habitual harborage sites. Habitual harborage sites can tell you a lot about the possibility for coronavirus spread in your company. These sites should be thoroughly examined for employee transfer points, disinfection protocol, with consideration for removal from operations to prevent the spread of the virus to employees. If your company has multiple shifts, you should monitor all predetermined sample locations across each shift to determine when and where the viral spread is occurring. In some instances, it may be necessary to segregate access to the area (first shift/second shift/third shift) to identify which sub-group is the source of contamination to prevent re-inoculation of the virus into the workplace.

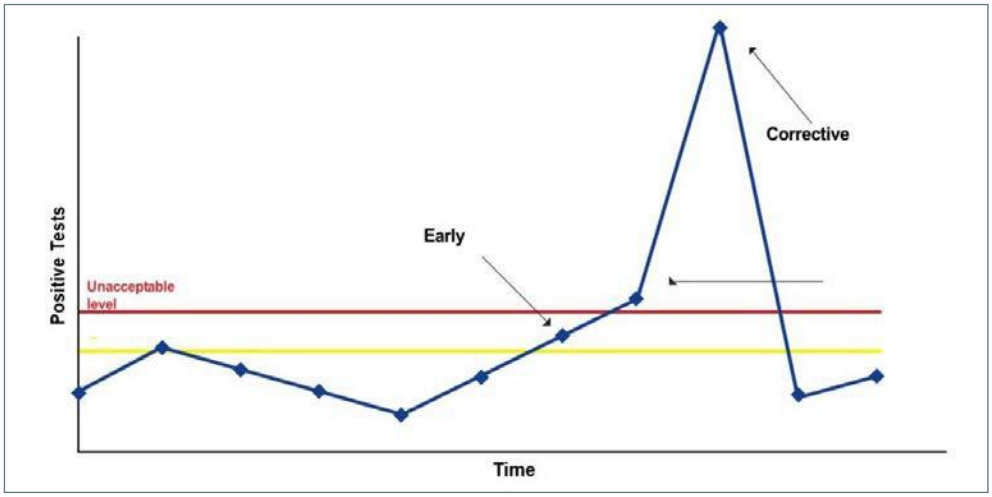


Image 1. An illustration of trend tracking utilized to alert you when your environment goes out of control and the results after corrective actions have taken place to inform you if your environmental monitoring program is working effectively.

Table 3. An example of how to trend SARS-CoV-2 EMP data to determine if contact surfaces and equipment act as habitual viral sites for coronavirus. In the below image sites #8, #9, #16 would be considered habitual viral sites and should be inspected, broke down and examined, and/or considered to be removed from operations to prevent the spread of the coronavirus. Since site #22 has only tested positive once it would be considered a hot spot but not yet a habitual contamination site. In the event of a positive sample, intensified cleaning and sanitation should take place in the area, as well as re-sampling.

Coronavirus EMP Sampling Site & Data Log					
		Sampling Dates			
Sampling Site ID	Location	1/1/2020	1/7/2020	1/14/2020	1/21/2020
Site #1	Door knob 1	Not Detected	Not Detected	Not Detected	Not Detected
Site #2	Door knob 2	Not Detected	Not Detected	Not Detected	Not Detected
Site #3	Door knob 3	Not Detected	Not Detected	Not Detected	Not Detected
Site #4	Door knob 4	Not Detected	Not Detected	Not Detected	Not Detected
Site #5	Door knob 5	Not Detected	Not Detected	Not Detected	Not Detected
Site #6	Table 1	Not Detected	Not Detected	Not Detected	Not Detected
Site #7	Table 2	Not Detected	Not Detected	Not Detected	Not Detected
Site #8	Table 3	Not Detected	Detected	Detected	Detected
Site #9	Table 4	Detected	Detected	Not Detected	Not Detected
Site #10	Table 5	Not Detected	Not Detected	Not Detected	Not Detected
Site #11	Chair 1	Not Detected	Not Detected	Not Detected	Not Detected
Site #12	Chair 2	Not Detected	Not Detected	Not Detected	Not Detected
Site #13	Chair 3	Not Detected	Not Detected	Not Detected	Not Detected
Site #14	Chair 4	Not Detected	Not Detected	Not Detected	Not Detected
Site #15	Vending Machine 1	Not Detected	Not Detected	Not Detected	Not Detected
Site #16	Vending Machine 2	Detected	Detected	Detected	Detected
Site #17	Telephone 1	Not Detected	Not Detected	Not Detected	Not Detected
Site #18	Telephone 2	Not Detected	Not Detected	Not Detected	Not Detected
Site #19	Telephone 3	Not Detected	Not Detected	Not Detected	Not Detected
Site #20	Telephone 4	Not Detected	Not Detected	Not Detected	Not Detected
Site #21	Bathroom Faucet 1	Not Detected	Not Detected	Not Detected	Not Detected
Site #22	Bathroom Faucet 2	Detected	Not Detected	Not Detected	Not Detected
Site #23	Bathroom Faucet 3	Not Detected	Not Detected	Not Detected	Not Detected
Site #24	Bathroom Faucet 4	Not Detected	Not Detected	Not Detected	Not Detected
Site #25	Bathroom Faucet 5	Not Detected	Not Detected	Not Detected	Not Detected

What to do When Coronavirus is Found in your Environment

Trending and tracking your workplace's EMP data is important because it will help you and your team immediately react when you encounter a positive sampling site. An environmental monitoring program should clearly define what control looks like in your organization in terms that can be easily articulated to your workforce. It's important to understand how you will act if SARS-CoV-2 is found in your environment. Immediate action, such as cleaning and sanitation, should be taken to limit the spread of the virus to employees and other contact surfaces. When testing for coronavirus (CoV) with the VIRSeek Screen assay and choosing not to confirm for SARS-CoV-2 with the VIRSeek Ident Assay, then you should treat a presumptive positive result for general CoV as if it were SARS-CoV-2. If choosing to confirm for SARS-CoV-2 and you receive a presumptive positive for CoV and the confirmation for SARS-CoV-2 comes back not detected, then you should, at minimum, perform additional cleaning and sanitation and emphasize good personal hygiene practices, as this is an indication that employees are shedding virus into the environment and your disinfection procedures are not working effectively. The following remediation strategies are suggested when CoV and SARS-CoV-2 are found in your environment:

- Thoroughly clean and disinfect all contact surfaces and equipment in the area. This includes items like tools, hardware, and air ducts near the positive sampling site. Follow decontamination procedures recommended by the CDC[8] https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/disinfecting-your-home.html and your sanitation chemical supplier.
- Resample positive sampling sites and take vector samples in the surrounding areas where positive tests were found. For example, if a swab taken from a mechanical room bench top is suspect, the bench top is re-swabbed along with the bench top drawer handles, adjacent tools, and surrounding bench top(s).
- Breakdown and inspect contact surfaces and equipment and/or remove the number and types of surfaces, for example: magazines, condiments, appliances, utensils, tools, etc.
- Re-clean and implement more frequent cleaning and disinfection activities and resample as needed.
- If any of the additional testing days give an unacceptable result, work in the area should cease until evidence demonstrates compliance. Sites with multiple out of specification results in a row are habitual contamination sites and have an employee who's shedding the virus in constant contact. These sites should be thoroughly examined for employee transfer points, disinfection protocol efficacy, and other remediation strategies, including: equipment removal, employee health screenings, and employee workplace segregation.

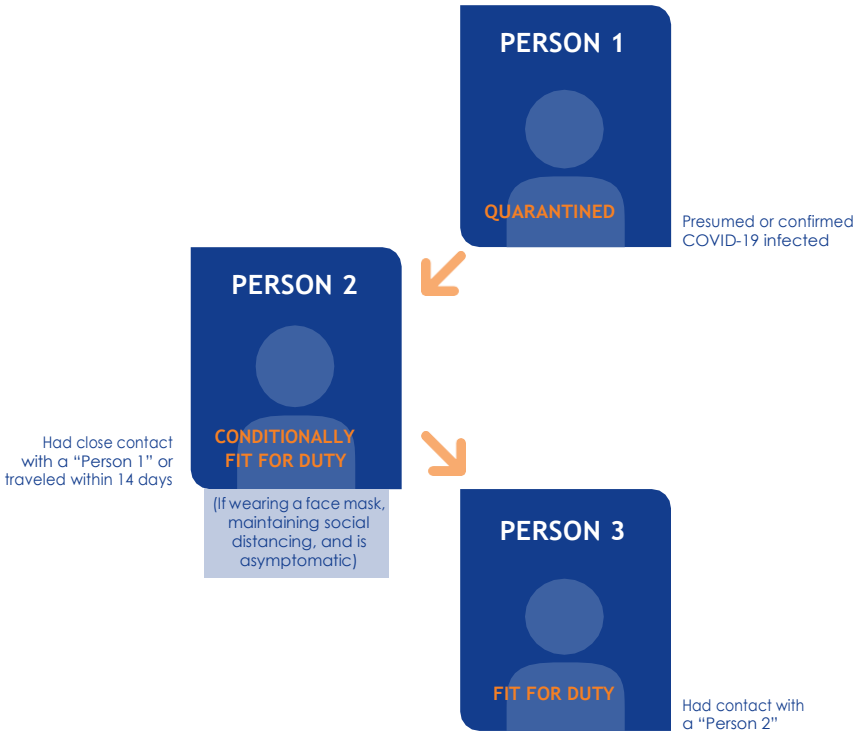
Additional testing should take place and should include re-sampling the positive sampling site, as well as, vector sampling. Vector sampling is a process for identifying the source and movement of pathogens. When vectoring you should consider taking at least 3 additional samples of the surrounding surfaces and equipment. When considering where to take vector samples, consider the fact that a sneeze or cough can spread virus through respiratory droplets over a large distance (>20 feet)[9], so take vector samples well beyond the known contamination site. If vector sampling sites come back positive for the virus take addition vector samples around each positive site. You should keep detailed records and track data for vector sampling sites as precisely as you do for normal sampling sites. For high-risk organizations, such as healthcare facilities, the World Health Organization recommends conducting daily consecutive testing of positive sampling sites and surrounding areas until 7 consecutive days of negative results are achieved.[6] For non-high-risk organizations, Eurofins recommends conducting daily consecutive testing of positive sampling sites and surrounding areas until 3 consecutive days of negative results are achieved.[6] Once remediation has been proven effective by meeting the aforementioned recommendations, return to normal sampling frequency.

Routine Preventive Controls to Prevent Coronavirus in the Workplace

- Reinforce proper employee hygienic practices.
- Audit operational and maintenance practices.
- Review andmonitor GMPs.
- Review and monitor cleaning and sanitation protocols.
- Repair structural damage and eliminate or redesign contact surfaces or equipment that test positive for coronavirus to eliminate habitual viral sites.
- Control airflow and water pooling or drainage backups.
- Conduct employee health screenings, which may include offering coronavirus clinical testing and/or coronavirus antibody testing, and take daily body temperature checks of employees when they arrive on the job site. Additionally, offering medical leave to encourage employees whom are ill to stay at home.

General Guidelines for Assessing SARS-CoV-2 Implicated Personnel

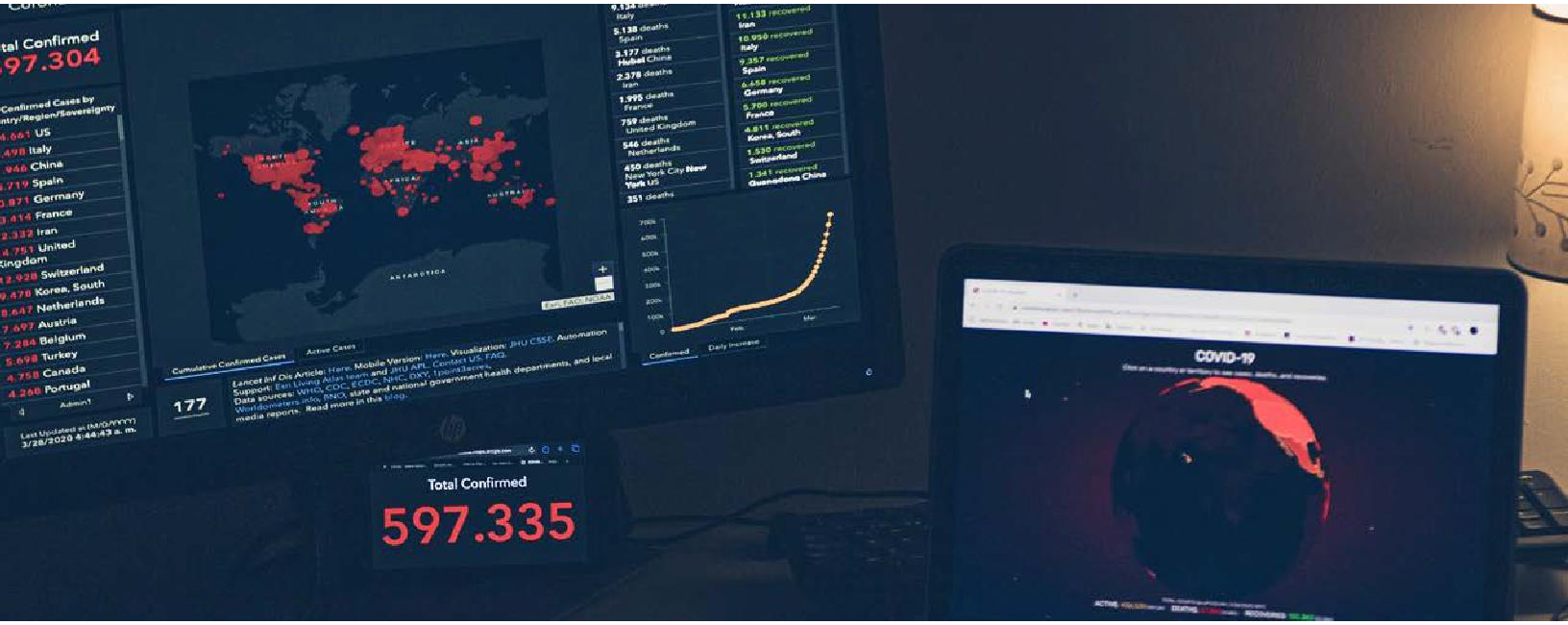
While collecting environmental surveillance samples: Treat a SARS-CoV-2 positive environmental location as a Person 1. Anyone in close contact with a positive location (Person 1) would be a Person 2.



When to Take Corrective Actions if SARS-CoV-2 is Found?

Corrective actions should be taken if cleaning and sanitizing steps do not prevent coronavirus from being found on sampling sites. The following steps are suggested when corrective actions are necessary:

- Stop operations in affected area and limit access.
- Thoroughly clean and disinfect all contact surfaces and/or equipment in the area. This includes items like tools, hardware, and air ducts near the positive surface or object.
- Resample areas where positive tests were found, as well as surroundings to determine if contamination is localized or spread. Increase frequency of sampling in the area where positive tests are found.
- Breakdown and/or inspect contact surfaces and equipment associated with positive sampling sites.
- Do not restart operations until all tests are negative for 7 consecutive days (high risk industries) or 3 consecutive days (non-high-risk industries).
- Once remediation has proven successful and the recommended number of consecutive days of negative results have been achieved, normal sample frequency may resume. Operations may resume, but heightened workplace segregation, PPE requirements, and disinfection should occur.
- Segregate access to the area (first shift/second shift/third shift) to identify which sub-group is the source of contamination.
- Conduct pre-operational inspection and resampling.
- If the problem persists, consider eliminating or redesigning the contaminated contact surface or object, revising your disinfection protocol, or attempting to identify the employee shedding virus into the workplace.
- Document corrective actions and consider developing an SOP and employee training to prevent recurrence.

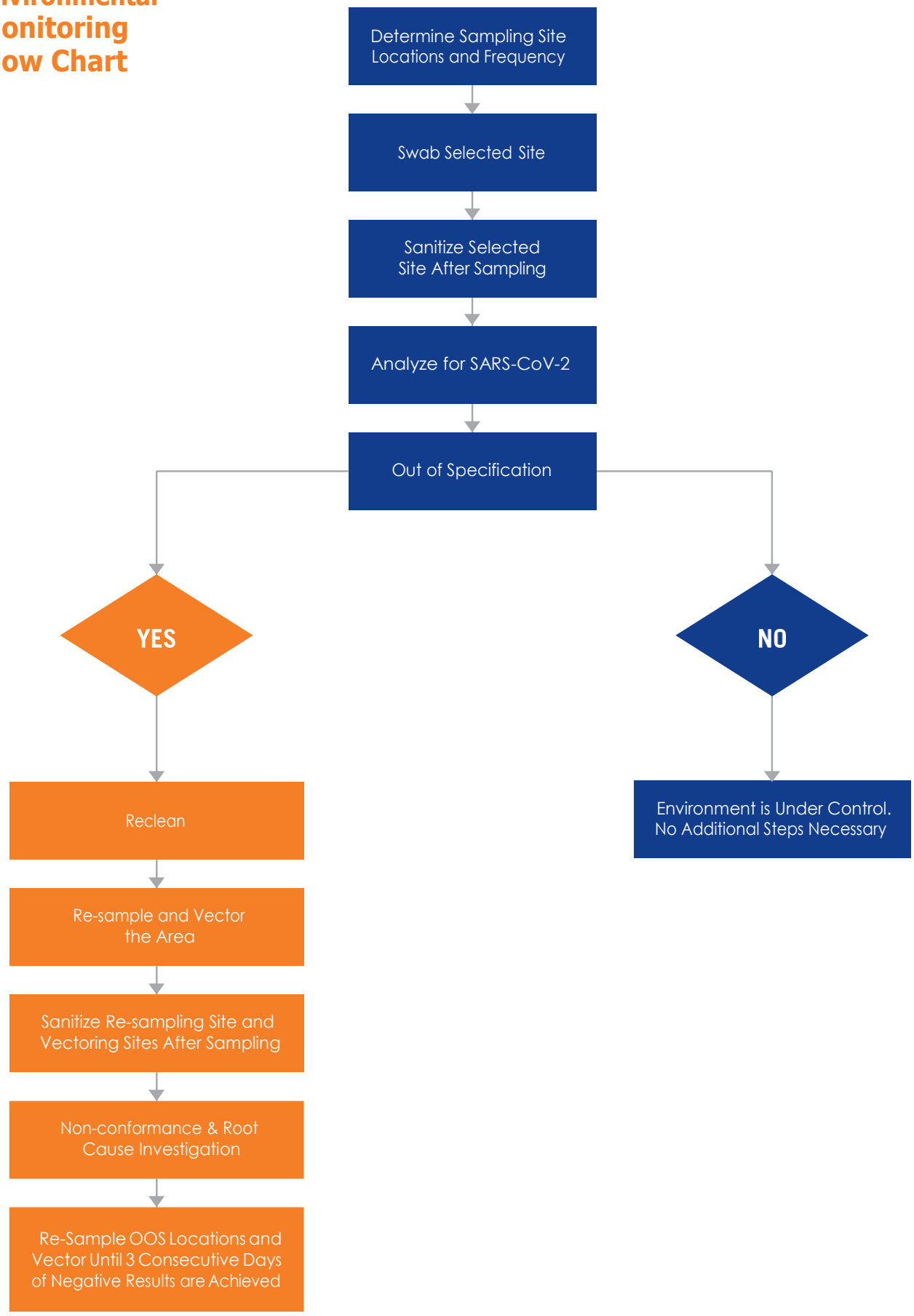


List N: Disinfectants for Use Against SARS-CoV-2

The EPA has approved disinfectants for use against SARS-CoV-2. Eurofins recommends selecting a disinfectant that is appropriate for your facility and that the label directions for the disinfectant be followed for safe, effective use. Additionally, it's important to adhere to the disinfectants recommendations for contact time, which is the amount of time the disinfectant is allowed to sit while visibly wet. Below is a table of the EPA's approved active ingredient(s) disinfectants that are effective against the human coronavirus SARS-CoV-2.[10]

Active Ingredient(s)	Contact Time (in minutes)
1,2-Hexanediol	10
Ethanol	0.5 (30 seconds)
Glycolic acid	10
Hydrogen peroxide	5
Hydrogen peroxide; Ammonium carbonate; Ammonium bicarbonate	5-6 (depending on concentration)
Hydrogen peroxide; Peroxyacetic acid	0.5 (30 seconds)-10 (depending on concentration)
Hypochlorous acid	10
L-Lactic Acid	5-10 (depending on concentration)
Peroxyacetic acid	1
Phenolic	5-10 (depending on concentration)
Quaternary ammonium	1-10 (depending on concentration)
Quaternary ammonium; Ethanol	1-2 (depending on concentration)
Quaternary ammonium; Isopropanol	0.5 (30 seconds)
Silver ion; Citric acid	1-3 (depending on concentration)
Sodium chlorite	10
Sodium hypochlorite	1-10 (depending on concentration)
Sodium hypochlorite; Sodium carbonate	0.5 (30 seconds)
Triethylene glycol; Quaternary ammonium	5

Environmental Monitoring Flow Chart



Ethical Considerations

It is essential to understand that if SARS-CoV-2 is found in your workplace's environment that there is a possibility for the virus to spread to your employees and visitors. Developing an environmental monitoring program for your organization is important for understanding the current associate risk and appropriate remediation strategies to prevent the spread of coronavirus among your employees. Ethical considerations for implementing a coronavirus EMP will vary by country; however, according to the World Health Organization some countries may mandate that coronavirus EMPs fall under public health surveillance (emergency response) acts and may not require ethical approval from an Institutional Review Board.

Reference List

1. World Health Organization. Disease Outbreak News: Pneumonia of unknown cause – China https://www.who.int/csr/don/05-january-2020-pneumonia-of-unkown-cause- china/en/?fbclid=IwAR2v89e9lp70O6GTra13FIPHCLw4WJ8kL20Uylx5zZNtWAYvbR0sEATr_rg (Accessed 22 January 2020)

2. Muhammad Adnan Shereen, Suliman Khan, Abeer Kazmi, Nadia Bashir, Rabeea Siddique, COVID-19 infection: Origin, transmission, and characteristics of human coronaviruses, Journal of Advanced Research, Volume 24, 2020, Pages 91-98, ISSN 2090-1232, https://doi.org/10.1016/j.jare.2020.03.005

3. World Health Organization. WHO Director-General's opening remarks at the media briefing on COVID-19- 11 March 2020 https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-mediabriefing-on-covid-19 ------ 11-march-2020

4. N van Doremalen, et al. Aerosol and surface stability of HCoV-19 (SARS-CoV-2) compared to SARS-CoV-1. The New England Journal of Medicine. DOI: 10.1056/NEJMc2004973 (2020)

5. World Health Organization. Surface sampling of coronavirus disease (COVID-19): A practical "how to" protocol for health care and public health professionals. https://apps.who.int/iris/bitstream/handle/10665/331058/WHO2019-nCoV-Environment_protocol-2020.1-eng.pdf

6. The World Health Organization Website. https://www.who.int/

7. The World Health Organization Guidance on regulations for the transport of infectious substances 2019-2020. https://www.who.int/ihr/publications/WHO-WHE-CPI-2019.20/en/

8. Centers for Disease Control and Prevention. Guidelines for Environmental Infection Control in Health-Care Facilities, Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). Available from: https://www.cdc.gov/infectioncontrol/pdf/guidelines/environmental-guidelines.pdf (accessed 20 July 2017)

9. Otter et al., 2016, J. Hospital Infect.; Han et al., 2013, J. Royal Soc. Interface

10. https://www.epa.gov/pesticideregistration/list-n-disinfectants-use-against-sars-cov-2