Information Note
No. 1550 – January 2021

Norwegian Oil and Gas Association Document "COVID-19 and Offshore Diving (Norway) – Rev. 7"

This Information Note supersedes Information Note IMCA D 14/20 *Norwegian Oil and Gas Association Document COVID-19 and Offshore Diving (Norway)* which is withdrawn.

Members should note that the Norwegian Oil and Gas Association has revised and updated its very useful document setting out measures to be taken to reduce the spread of Covid-19 during manned underwater operations on the Norwegian Continental Shelf. The document is entitled, "COVID 19 and Offshore Diving (Norway)" and it is currently in its seventh revision.

The latest news and clarifications related to coronavirus (COVID-19) and Norwegian oil and gas operations can be found at the link below. Options for Norwegian or English language can be selected from the navigation bar.

https://www.norskoljeoggass.no/en/covid-19/news-and-clarifications/

While "COVID-19 and Offshore Oil and Gas (Norway) – Rev. 7" can be accessed using the above link, for convenience the document has also been made available as an appendix to this Information Note.

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Norwegian Oil and Gas Covid-19 and Offshore Diving (Norway)

Measures to be taken to reduce spread of Covid-19 during manned underwater operations on the Norwegian Continental Shelf

The principal author of this document is Jan Risberg MD, PhD
Norwegian Oil and Gas Association, Forum Diving and Underwater operations, appreciate the work that Dr Risberg and others has given.
The report has been published by the Norwegian Oil and Gas Association, Forum Diving and Underwater operations.

We would welcome any comments and improvements to this document. Please submit suggestions for changes to Jan Risberg (jri@nui.no). The revision history of the document is published on the next page and future revisions will be published on the Norwegian Oil and Gas Association web-page.

AMENDMENTS

Rev#	Date	Comment
7	16.11.20	References updated. Data on asymptomatic and presymptomatic carrier status enhanced. Availability for point-of-care PCR and antigen tests elaborated. Recommendation for pre-embarkation and in-chamber nasopharyngeal virus testing detailed. Procedure for disinfection of breathing equipment revised and simplified.
6	20.4.20	Specified instructions for cleaning and disinfecting Kirby Morgan equipment in Appendices 1 and 2. Underscoring that Klorhexidine is not an efficient disinfectant. Expanded section of asymptomatic carriers. Table 1 recalculated based on a pre-embarkation exposure period of 0-5 days and a column for incubation period inserted. Text revised related to this topic. Editorial and text changes.
5	25.3.20	Minor text changes. Modified statement of quarantine, underscoring the uncertainty of asymptomatic carriers. Attached poster on handwash (Appendix 3). Released for public access through Norwegian Oil and Gas Association.
4	24.3.20	Specific guidance on cleaning and disinfection of Kirby Morgan equipment, incl Appendix 3 (photo series) completely removed based on feedback (risk of causing critical equipment failure). Pre-review before transmission to Norwegian Oil and Gas Association for public release.
3	24.3.20	Restructuring of document (layout and headings). Revision of contents based on feedback received on Rev 2. Added Appendix 2 with Norwegian text intended for inshore diving. Appendix 3 procedure for Kirby Morgan™ and Interspiro™ equipment revised. Expanded section on incubation period and efficacy of quarantine. Limited (not public) distribution for review of changes.
2	20.3.20	Clarified document authorship, reformatted to PDF and distributed in public
1	20.3.20	Complete revision of document. Contents presented as plain text and structured with headings. Detailed data on SARS-CoV-2 and Covid-19, hygienic measures, cleaning and disinfection procedures for diving equipment.
MOM Rev 0	13.3.20	As “Draft” below but structured as MOM with input from meeting participants. Conclusions remaining as bullet-points
Draft	13.3.20	Document original title “Topics for discussion – Covid-19 and offshore diving (Norway)” presented at meeting 13.3.20. Structured as bullet-point conclusions

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1 Background

WHO has declared Covid-19 as a pandemic infectious disease. Measures are implemented internationally and nationally to reduce the spread and protect vulnerable persons. All sectors of the community are expected to contribute and comply with national regulations as well as best professional practice. While the present pandemic is active, future MUO should be planned to minimize spread.

2 Contributors to and formal status of this document

2.1 Formal status

This document was initially drafted by the author on request from representatives from the Norwegian diving industry. Contributors to the document are identified in section 8. The document was forwarded to Norwegian Oil and Gas Association for public release 25.3.20.

Later revisions have been reviewed by a large number of representatives from the Norwegian diving industry. The decision to release the contents on the Norwegian Oil and Gas Association webpage has been taken by “NOROG Forum for dykking og undervannsintervensjon”.

3 Scope

The scope of this document is to supplement national and industrial guidance (such as IMCA D06/20 (Novel Coronavirus (COVID-19) – Guidance for Diving Contractors)) in matters related to prevention of Covid-19 infections during MUO on the NCS. This document is in some areas intentionally more prescriptive than the IMCA Information Note. However, the document is intended to supplement rather than replace IMCA D06/20. If disparity exists between the documents, expert guidance should be sought before a final conclusion is taken. An Appendix in Norwegian language has been added for the benefit of Norwegian in-shore diving.

3.1 Document applicability – Surface Oriented diving

This document was primarily developed for preparation of saturation diving operations offshore. While most of the general principles should be equally applicable for Surface Oriented diving, the medical complications of a Covid-19 infection in saturation may be much worse than that for a Surface Oriented diver since the latter within reasonable time could be evacuated to hospital for advanced medical care.

4 Terms and definitions

Antibody	A protein produced by the immune system as a defence for infection
Antigen	A molecular structure on a pathogen (e.g. virus) that may bind an antibody.
ARDS	Acute respiratory distress syndrome. Respiratory failure caused by a large number of causes – including Covid-19 disease
Close contact	Term to identify subjects with significantly increased exposure to the SARS-CoV-2 virus from a Covid-19 infected patients. Definition varies slightly between public health authorities, but includes in Norway (*the list is abbreviated*): • have lived in the same household as a person with confirmed COVID-19 disease • have been in direct physical contact (e.g. shaken hands) with someone with confirmed COVID-19 disease • have been in direct contact with saliva (e.g. been coughed upon) from someone with confirmed COVID-19 disease • have been in close contact with, or been near (closer than 2 metres), face to face with a person with confirmed COVID-19 disease for more than 15 minutes • have been in an enclosed space (e.g. a classroom, meeting room, waiting room etc.) with a person with confirmed COVID-19 disease for more than 15 minutes and closer than 2 metres
Covid-19	Abbreviation for Coronavirus Disease 2019. The disease caused by SARS-CoV-2
ICU	Intensive care unit. A medical ward providing advanced medical care for severely ill patients
Incubation period	The time from the patient contracts the infection until the first symptom arise
IQR	Interquartile range. When results from a sample is presented in an increasing order, the interquartile range will represent the mid 50% of the sample – i.e. 25% will have results lower and 25% will have results higher than the IQR
Median	The value separating the higher and lower half of a population. A median incubation period of 5 days implies that 50% of the patients will experience symptoms 5 days after being infected
MUO	Manned Underwater Operations
NCS	Norwegian Continental Shelf
NIPH	Norwegian Institute of Public Health (Folkehelseinstituttet, FHI)
PCR	Polymerase Chain Reaction. A method to test for presence of (virus) DNA or RNA
RH	Relative Humidity
SARS-CoV-2	Abbreviation for the virus causing the disease Covid-19. Full name Severe acute respiratory syndrome coronavirus 2.

5 SARS-CoV-2 and Covid-19 facts – background for risk assessment

The median incubation period for Covid-19 cases is 5.1 days (95% CI 4.5-5.8d) (1) with 6.7d (5.7-7.9) to reach the 75 percentile and 11.5d (8.2-15.6) to reach the 97,5 percentile, see Fig 1. A 10-14 days observation period is commonly applied for quarantine in the public health domain. Knowledge of Covid-19 disease spread (transmission, disease presentation, disease severity) is still limited but increasing rapidly. The fraction of asymptomatic SARS-CoV-2 is difficult to measure, but ranged 15-31% in two recent reviews (2, 3). The Norwegian Institute of Public Health (NIPH) assumes a 40% fraction of asymptomatic individuals in their mathematical model of Covid-19 disease in Norway. Infectivity of asymptomatic carriers is probably less than symptomatic patients (3, 5), but this remains to be ascertained. The prevalence, incidence and reproductive number (R) have shown large variation between countries and during the pandemic, and any number cited in this report will be outdated too quick to be of any value. Saturation divers may be restrained within the pressure chamber for a long period, and a risk assessment related to Covid-19 infection should consider the need for hospital treatment. In the largest study published, including 72314 cases from China up to February 2020, 81% reported mild disease, while severe and critical disease was observed in 14% and 5% of the cases respectively (6). The need for hospital treatment will depend on a large number of variables, but the NIPH mathematical model assumes that 1,1-2,9% of infected Norwegian Covid-19 patients in the 30-59 age group will need such care. Patients may develop Covid-19 associated Acute Respiratory Distress Syndrome (ARDS) and some of these will require advanced medical care in the Intensive Care Unit (ICU). Tzotzos et al. (8) reviewed 1000 publications reporting incidence of COVID-19 associated ARDS in hospitalized patients. In 17 selected studies including 2486 patients, approximately 1/4 needed treatment in the ICU. Approximately 1/3 of the hospitalized patients developed ARDS. The mortality rate of ARDS reached 45%. Mortality varied significantly between countries, patient age and other risk factors, but underscores the high morbidity and mortality of patients in need of hospital treatment for Covid-19 .

The knowledge of duration of infectious period during Covid-19 infection is incomplete, but was addressed in a recent review (10). The mean time of infectious period was 14 days. A small number of studies reported duration of 22-26 days before two negative PCR-results were sampled. Another recent similar review (11) reported slightly longer duration (mean 18,4 days of RNA shedding), with longer duration in patients hospitalized with severe illness. Long lasting virus shedding has been reported in some studies (viral RNA detected up to 92 days after symptom onset). In Norway, the policy adviced by NIPH for patients with mild and moderate disease is to isolate for 10 days after start of symptoms. After this period, if the patient is otherwise healthy and no fever has been registered the past 48 h, the isolation can be lifted. No confirmative PCR tests are recommended. Stricter rules applies for patients with serious Covid-19 disease.

Even though transmission through droplets has been shown to be the most common mode of virus transmission, indirect transmission via contaminated surfaces cannot be ruled out, particularly in confined spaces like saturation chambers. Coronavirus aerosol survival is dependent on temperature and relative humidity (13). 80% RH with 20 °C was least favourable for virus survival with a half-time of 3h while 50% RH allowed a half-time of 3d. In cold environment (6 °C) and 80% RH survival was longest with almost 4d halftime. Coronavirus is highly resistant to freezing and will survive 25 cycles of freezing/thawing (14). Coronavirus may survive on steel surface for 2d, on metal surfaces for 5d and on plastic surfaces for 9d (15, 16). A saturation decompression procedure would typically range 4-10 days depending on water depth. A Covid-19 pneumonia would impose a significant health risk to the diver as it could develop into respiratory distress and ARDS. A summary (17) stipulate a median time from first symptom to radiologically confirmed pneumonia of 5 days (IQR 3-7d) and from symptom onset to intensive care unit admission to 11 days (IQR 7-14d). There is no knowledge on how the illness would develop in divers in saturation. Any risk assessment on development of Covid-19

illness in the cohort of medically screened divers exposed to high ambient pressure, raised temperature, increased humidity, hyperoxia and a recognized “conventional” microbiological burden would be highly speculative. Available data suggests that virus survivability would be extended in the saturation environment.

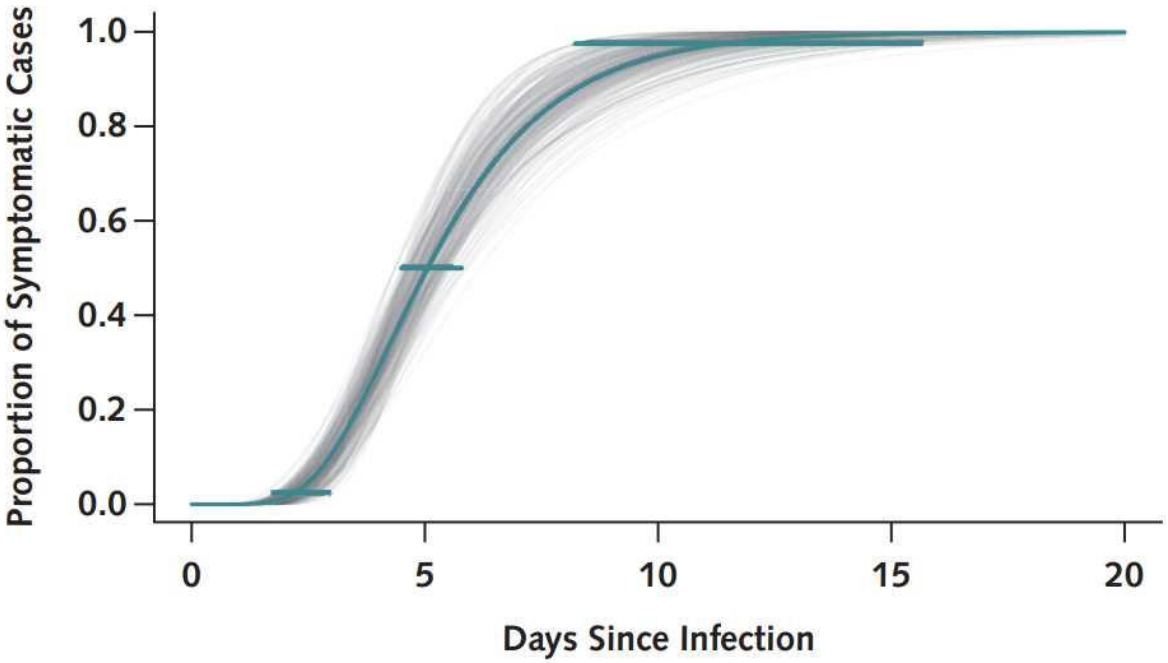

Fig 1 Incubation period for Covid-19 in days presented as a cumulative density function based on a log-normal distribution. From (1)

6 Measures to reduce the likelihood and consequences of Covid-19 infections during offshore MUO

6.1 Contingency

Transmission of SARS-CoV-2 occurs through direct, indirect, or close contact with infected people through infected secretions such as saliva and respiratory secretions or their respiratory droplets. Close contacts on the same shift would have an increased likelihood of infecting each other. Try to organize shifts to allow replacement for critical functions in the event of an infectious outbreak. Sharing beds ("hot bunking") should be discouraged, establish routines wherever possible to reduce close contacts between critical personnel on time off (cabin allocation, recreational areas etc.). See definition of close contacts above.

Consider whether administrative close contacts between the nurse and other workers could be limited and replaced by written, telephone and videoconference alternatives. The intention is to reduce the risk of infecting the nurse in contacts not related to health care.

6.2 Personnel selection

6.2.1 Questionnaire

The clinical characteristics of Covid-19 illness are similar to other respiratory infections and seasonal flu. A structured screening questionnaire to exclude personnel with relevant symptoms should be put in place. The questionnaire should include travel history the past 14 days, exposure to patients with confirmed Covid-19 or other respiratory disease and any symptoms of respiratory illness (fever, cough, dyspnoea, fatigue and musculoskeletal pain). Personnel with current upper or lower respiratory tract infection or flu-like symptoms (fever, malaise, aches) or other symptoms indicative of Covid-19 (e.g. recent loss of smell or taste) should not be allowed to embark. Appendix 1 and 3 to IMCA D06/20 can be used.

6.2.2 Pre-embarkation quarantine

A pre-sat quarantine of 14d is probably an effective measure to prevent Covid-19 infection in saturation. Establishing crew collection points that ensures effective quarantine prior to embarking may be practically demanding. Efficacy of active monitoring during disease outbreaks has been discussed by Reich et al (18) in the relation to cost-benefit. An online calculator for such analysis has been presented by Reich et al. (19) as an offspring of the analysis of Covid-19 incubation time published by Lauer et al. (1). Table 1 below presents extracts of expected efficacy of active monitoring. "Active monitoring" was the measure used by US CDC during the Ebola outbreak in 2014-2016 to closely monitor development of symptoms for 21d following exposure. The outcome of such monitoring would be either (18):

1. No symptoms warranting clinical follow-up
2. No symptomatic infection with the disease of interest, but occurrence of symptoms that necessitate ruling out of the disease of interest
3. Symptomatic infection with the disease of interest occurring during the individual's period of active monitoring
4. Symptomatic infection with the disease of interest occurring outside the individual's period of active monitoring

Though this model was based on a public health surveillance program, it's general principle could be applied to a group of divers monitored during a quarantine period (e.g. on a vessel or a hotel). The table (Table 1) could be used as a basis for quantitative risk assessment. The rightmost column ("Infected at day of arrival) would represent the worst case scenario – a diver entering pre-embarkation quarantine on the day of being infected. The numbers listed in this

column will effectively show which fraction of *infected* divers that will remain asymptomatic depending on the length of quarantine. On a group level, this is not a representative situation. Not all divers will be infected, and amongst those being infected, not all will be infected at the day of pre-embarkation quarantine. The risk for getting infection will depend on community prevalence and daily incidence of Covid-19. As per Nov 2020 these numbers are estimated to be in the order of 250 and 46 per 100 000 inhabitants. This number has shown great variation during the pandemic and will probably not reflect the future situation nor exposure level for divers from other countries. In the absence of better data, the middle column presents fraction of missed cases in a group exposed to a "very high risk level" (18). This is a very conservative approach, which is selected to include the uncertainty of asymptomatic carriers of SARS-CoV-2. It is presumed that this cohort has been exposed to a high risk for virus transmission the five days preceeding entrance of quarantine. A pre-quarantine exposure period of 0-5 days is chosen somewhat arbitrarily but is suggested as a baseline. The mid column could then be used as part of a quantitative risk analysis. The required length of quarantine could be determined based on the risk acceptance level for Covid-19 occurring in saturation. If the decision is taken that "we should cater for the worst-case situation that a diver is infected at the day of embarkation" the rightmost column (incubation time column) should be used.

The limitations of these presumptions should be recognized. The data of incubation times in Covid-19 patients (1) is limited as it is only based on 181 cases. The model is based on public active disease surveillance rather than measures taken to identify development of symptoms in divers during a quarantine. Virus shedding from asymptomatic and presymptomatic carriers is largely unknown (5, 20-22) and will affect the conclusions (increasing the fraction of undetected infections) but this uncertainty is probably best handled by stratifying divers to a higher risk group (e.g. "very high risk"). On the other hand, it could be argued that infection risk is substantially less than 10% even in high endemic areas of Covid-19.

Day	Very high risk (1:10) Infected 0-5 days before arrival	Infected at day of arrival (=incubation time)
1	8.2 (3.2-10.0)	99 (96-100)
2	6.1 (1.8-9.9)	99 (96-100)
3	4.2 (0.9-9.0)	90 (81-97)
4	2.7 (0.4-7.1)	72 (61-83)
5	1.7 (0.2-5.1)	51 (38-63)
6	1.0 (0.8-3.6)	34 (19-47)
7	0.6 (0.3-2.5)	21 (8-34)
8	0.4 (0.1-1.7)	13 (3-24)
9	0.2 (0-1.2)	8 (1-18)
10	0.1 (0-0.9)	5 (0-13)
11	0.1 (0-0.6)	3 (0-10)
12	0.1 (0-0.5)	2 (0-7)
13	0.1 (0-0.3)	1 (0-5)
14	0 (0-0.2)	1 (0-4)

Table 1 Estimated fraction (%(5-95% CI) of monitored persons from an unscreened population with undetected infection of Covid-19 as a function of days of monitoring. This fraction will depend on the incubation time (rightmost column), likelihood of achieving infection and the time of infection before monitoring is initiated. The middle column provide data for a cohort of subjects at "very high risk" (one in ten infected) and pre-monitoring infection period 0-5 days. Adapted from (19) based on the publications of (1, 18)

6.2.3 Pre-embarkation SARS-CoV-2 testing

Tests for presence of SARS-CoV-2 are presently (October 2020) more readily available (see section 6.6.2). The benefit of pre-embarkation testing is mainly the detection of asymptomatic

carriers of virus and patients in the pre-symptomatic stage of disease development. The interpretation of a positive PCR test in a patient having suffered Covid-19 is however challenging as such patients may continue to discharge virus RNA for some time after a complete recovery (11). Presence of a positive PCR test more than three weeks after start of infection is unlikely to indicate a status of contagiousness (11). The contagiousness of asymptomatic carriers remains unresolved, but data suggest a lower risk of disease transmission from asymptomatic patients (3, 23). However, we recommend that a positive test (PCR or antigen) should be considered a finding suggesting asymptomatic or pre-symptomatic status and the person should be isolated until further assessment has been completed.

6.2.4 Medical and physiological selection criteria

The question as to whether stricter selection criteria should be imposed to exclude persons with a higher risk of severe disease remains open. Currently there is no advice to enforce stricter selection, but it is recognized that the incidence of complications secondary to Covid-19 increases as a function of age and particularly for subjects older than 60 years (9). Obesity, diabetes, hypertension, cardiac, renal and kidney illness are generally considered risk factors (24) but persons with such diseases would in general be expected to be excluded from diving irrespective of Covid-19 specific criteria.
The question of resumption of diving after Covid-19 infection has been addressed in DMAC Guidance note 33 (25).

6.2.5 Restriction on decompression time – saturation diving

Covid-19 may develop to a severe illness requiring advanced and intensive medical care well beyond the capacity of that available on a DSV. The time required for decompression from saturation will delay such treatment. As mentioned earlier, the average period from first symptom to hospital admission for Covid-19 will be in the order of five days (17). If the decompression is started once the first symptom appears, the likelihood of experiencing life-threatening disease development in the chamber system should be minimised. Based on this, saturation storage depth should be chosen to avoid decompression exceeding five days unless additional measures are taken to reduce the likelihood of developing Covid-19. Such measures should as a minimum include thorough precaution during the pre-embarkation period with quarantine, questionnaire and SARS-CoV-2 testing (PCR or antigen). A second sample should be taken three days after pressurisation to further detect asymptomatic and presymptomatic carriers. The period of three days is advised as a compromise between the sensitivity to detect virus from asymptomatic and presymptomatic carriers versus the likelihood of developing disease if an infected diver entered the chamber. Additional risk reducing measures, e.g. prolonged time at living depth, should be considered based on assessment of operational factors and risk (infection prevalence).

6.3 Hygienic measures

Cleaning of hands should be done with conventional hand detergents if dirty. Alcohol based hand disinfectants (>60% Ethanol) can be used on *clean* hands – allow 20-30 sec to reach full effect. Regrettably, hand disinfection with ethanol represents an off-gassing concern as well as a fire risk in the saturation diving environment. However, conventional hand wash with soap is effective against the SARS-CoV-2. For any high risk procedure (close contact handling of fellow divers, physical contact, food preparation) the hand wash should be done in the professionally recommended method which takes slightly longer time (40-60 sec). A poster like this (included in Section 0 Appendix 3, to this document) provides guidance on the specific procedures.

Information to all personnel on the transmission of the disease and preventive hygienic measures is paramount. Disinfectants should be readily available. Consider closing of gyms, saunas, cinemas and similar. Cleaning and disinfection routines should be re-assessed,

particularly surfaces that are frequently touched (e.g. door handles, tables, staircase handrails, arm rests, keyboards, control panels, serving utensils etc.).

Consider improvements of HVAC filter systems to allow filtering of virus particles. Technical aspects will decide whether this is feasible or necessary. Consider whether filters could/should be inserted in vent outlets from cabins intended for isolation of patients.

Diver gas and reclaim systems: Do these contain or is it possible to install filters improving removal of microbiological agents? Consider filtering of reclaimed gas and it's re-use for divers breathing.

6.4 PPE

There should be sufficient stores of PPE for microbiological protection (gloves, coveralls, respiratory protections, face shields/eye protections). Some of this equipment would only be relevant for the nurse, but procurement of supplies should be addressed well in advance of the diving operation.

6.5 Cleaning and disinfection

6.5.1 Surfaces

Cleaning and disinfection procedures should be effective against SARS-CoV-2. As an initial step consider this general advice on cleaning and approved disinfectants in Norwegian and English language. Cleaning should be done with conventional detergents. A large number of disinfectants are effective against SARS-CoV-2. However, off-gassing and skin irritation is a particular concern in offshore diving. One disinfectant has been extensively used in saturation diving – with good experience and a favourable toxicological profile:

- Rely+On Virkon, 1%, 10 min contact time (26)

Alternatives that may be considered for disinfection outside the hyperbaric chamber are:

- Ethanol surface disinfection (>70% for 1-2 min) (15)
- Household bleach 0.1% (e.g. Klorin® 4%, 1 dl for 4l water) with 10 min of contact time (15, 27)
- Rely+On Pera Safe for 10 min (15)

Reports of virucidal efficacy of Klorhexidine are contradictive (15, 28, 29), and until this has been resolved we dissuade against using Klorhexidine as a disinfectant against SARS-CoV-2.

The SARS-CoV-2 virus is thermolabile and heat will inactivate it, however there is limited data available on required temperature and exposure time. Previous work on the similar SARS-CoV virus (31, 32) suggests that the virus will be fully inactivated after 30 min exposure to 58 °C and after 10 min at 68 °C. A domestic dishwasher will wash with a temperature of 65-70 °C temperature unless heat-preserving ("Ecological") programs are chosen.

6.5.2 Divers' breathing equipment

Helmets and diver's breathing equipment should be sanitized according to manufacturers procedures. Poper disassembly and reassembly will require the hats to be taken out of the bell to ensure that such procedures are performed by qualified personnel. While disinfection as described in Appendix 4 should be feasible for surface oriented diving, it is recognized that the limited space within the diving bell makes such a procedure impractical for saturation diving. However it is recommended to spray the interior of the helmet with a non-toxic disinfectant (such as Rely+On Virkon) between users unless the helmet has been sanitized by other means.

6.6 Handling suspected infections of Covid-19 and close contacts to these

6.6.1 Handling subjects with close contact to Covid-19 identified patients

The vessel shall establish systems for quarantine of asymptomatic but potentially infected subjects. There should similarly be prepared systems for isolation of subjects with infectious disease (minor symptoms as well as Covid-19 potential disease).

6.6.2 Biological testing for SARS-CoV-2 virus

As per October 2020 capacity for virus testing has increased in Norway as well as most other countries. The most widespread and best verified test method is PCR testing of virus RNA. PCR testing has close to 100% specificity, which means that a positive test can be trusted. The analytical sensitivity of PCR is also high, meaning that the method is able to detect very low levels of virus. However, for clinical testing the sensitivity of the method is limited by the possibility that the swab sample from an infected person does not contain virus. This risk is increased when the method is used to screen asymptomatic persons, presumably due to lower levels of virus present in the airways. The Norwegian Institute of public health estimates the clinical sensitivity of laboratory PCR to be approximately 80% for SARS-CoV-2.
PCR-based analyses are now also available as point-of-care (POC) testing. PCR POC tests generally has sensitivity and specificity comparable to what is found for conventional laboratory PCR tests. Additionally, antigen tests are available. Antigen POC tests have in general high specificity, but lower sensitivity than PCR tests (33). The test procedure with swabbing in nose and/or throat (nasopharynx) are the same for PCR and antigen testing. Adequate equipment for swabbing should be available on the vessel.

Test kits for analysis of antibodies (IgM and IgG) in blood are available. However, antibodies are not detectable in the early phase of infection and there is insufficient data to allow interpretation of the results with respect to infectivity and immunity. It is our opinion that testing for antibodies has no place for screening or diagnosis of Covid-19.

6.6.3 Handling upper and lower respiratory tract infections

Emergency response plans should include identification of optimal ports considering sailing distance and available health care facilities and means of transportation in the event of a severe infectious disease.

6.6.3.1 Divers in the chamber (sat diving)

Unless appropriate steps have been taken to exclude Covid-19 infection (based on professional medical advice) any upper or lower respiratory infection and flu-like infection should call for initiation of saturation decompression. Continuous separation of TUP's and living chambers must be considered where possible. Only one dive team in TUP at the time should be considered closing doors between living chamber/wetpot to TUP when not transferring personnel. In the event of an infectious outbreak, abortion of the diving operation is advised.

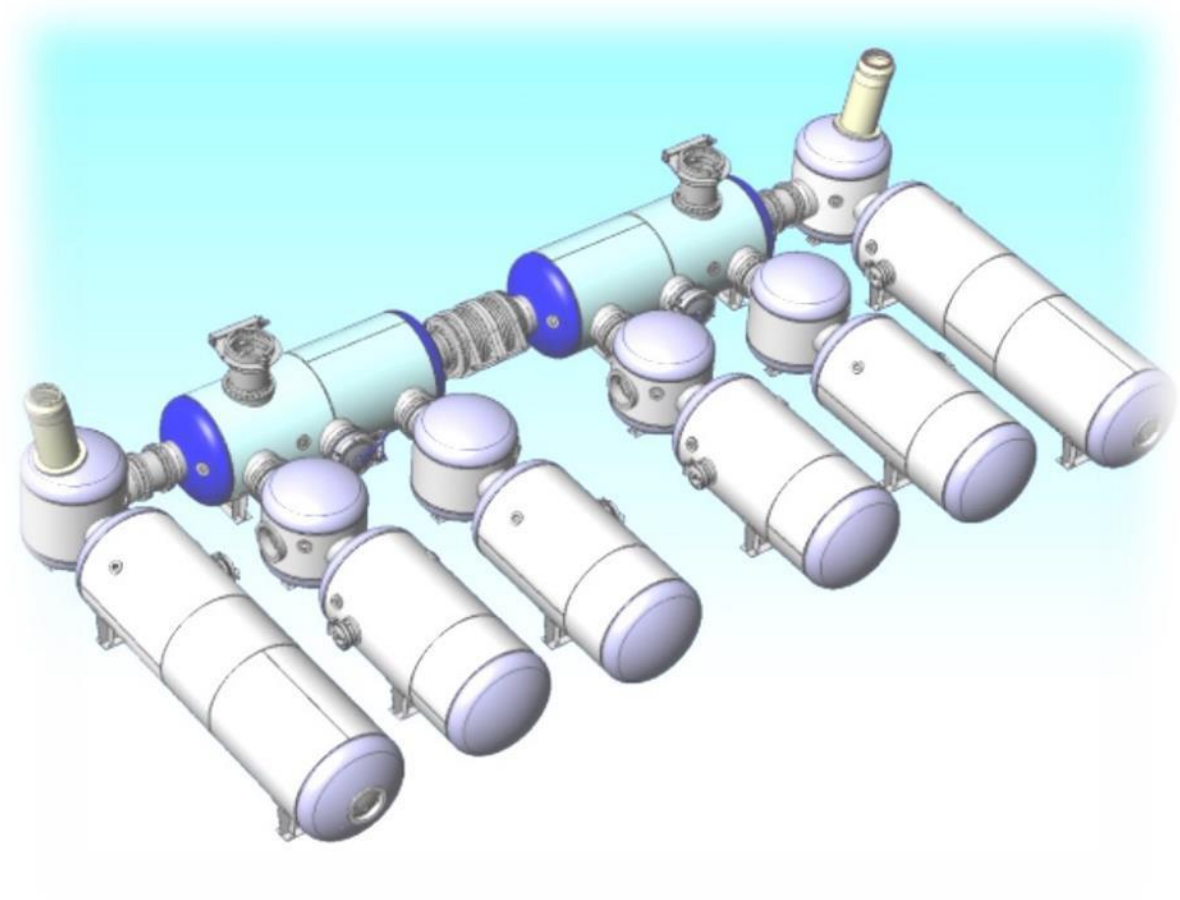

Figure 1 Example of saturation system layout allowing separation of TUP's between different living chambers. Presented with permission from Øyvind Loennechen, Technip FMC.

In the event that infection occurs, the final decision of treatment and post-dive quarantine and isolation would be the one of the duty diving physician in collaboration with national and local health authorities. However, the operator and diving contractor should establish plans for the event that disembarking of infected divers and other personnel will take place in port rather than by helicopter. There should be plans for optimal extraction of infected patients, minimizing the risk for spreading infectious agents. The diving contractor, operator and provider of SAR-services should plan for the event that infected patient(s) would need medical evacuation by helicopter.

6.6.3.2 Other crewmembers (incl. diving support personnel, project personnel, project crewmembers)

Plans should be prepared for establishing quarantine and isolation of subjects/patients (i.e. nomination of cabins, food provision etc.).

7 Surface supplied diving

Hygienic measures and disinfection procedures should be enhanced (as discussed previously). Selection criteria similar to saturation divers should take place (i.e. exclude divers with ongoing infections, close contacts to Covid-19 patients etc.). However, there is no reason to exclude divers based on age or comorbidity as discussed previously for saturation divers.

8 Acknowledgement and contributors

The author carries the formal responsibility for the contents of this document. However, the work has progressed through a series of meetings and e-mail correspondence. The persons below are recognized for their valuable feedback, support and improvements through the series of revision (see front page). Their important contribution does however not imply that they endorse the contents in person or through their employers.

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Appendix 1 - Cleaning procedures for diver's hat and breathing equipment

General

Cleaning and disinfection should be completed according to the maintenance procedures of the diving contractor. Consult manufacturer's instructions when needed.

Interspiro Divator™

The maintenance including cleaning procedures can be downloaded from this site. While the Divator Full Face Mask can be comparatively easily cleaned and disinfected, the procedure for appropriate regulator dismantling (required to complete the disinfection) is more complicated. As per the manufacturer's instructions, the regulator should be disassembled prior to disinfection. This will introduce a risk for erroneously re-assembly of the regulator. The authors of this document have contacted a number of Norwegian dive technicians who has unanimously agreed that dismantling of the oral nasal and disassembly of the regulator should be limited to those having extensive training and sufficient practice to uphold the skills. It is not ideal to provide recommendation on disinfection procedures deviating from the manufacturer's, but in the present situation a balance must be sought between the risk of infectious spread vs loss of breathing gas. We recommend these steps:

- Whenever possible, the Interspiro Divator mask should be considered a personal diving equipment not to be shared with other divers.
- Whenever logistic resources allow, the cleaning and disinfection procedures addressed by the manufacturers should be followed. This will include dismantling the oral nasal from the mask and dismounting and disassembling the regulator as per the manufacturers' instruction between users and for every month of use. We dissuade against allowing divers without sufficient training to do this maintenance and recommend either of the two alternative procedure below when this is not possible.
    - Soaking procedure
        - Keep the mask pressurized
        - Remove the microphone
        - Rinse with water to remove visible dirt. Use a neutral or slightly acidic detergent such as Zalo™ or Fairy™ liquid.
        - Soak in 1% Rely+Virkon™ for 10 min
        - Rinse with luke water to remove remaining Virkon
        - Drying may further reduce risk of virus survival but is not required.

Kirby Morgan™ band masks and helmets

General

Maintenance manuals can be downloaded from this page on the Company's website. The main principle recommended by the manufacturer to dismantle oral nasal, nose clip and open the front shield of the regulator. It is recognized that this require training and experience to avoid critical equipment failure. The procedure recommended by the manufacturer has not been adapted by the diving industry, but disinfection is required to avoid transmission of disease. We would recommend that the procedures include these aspects:

- Rinse with water. Any visible dirt should be removed, if needed use a neutral detergent but a slightly acidic domestic detergent such as Zalo® or Fairy® will work fine as well. Don't use "Grønnsåpe" as this may leave a fatty layer that will inactivate later disinfection and be a layer for biofilm.

- SARS-CoV-2 spreads by means of droplets from expired air/gas. Rinsing and disinfection should include neck dam, oral nasals (including the microphone), nose clips and the exhalation part of the regulator.
- There is a large number of disinfectants available and the selection will depend on efficacy, availability, cost, logistics (e.g. contact time, requirement for PPE) and any undesirable effect on the equipment to be infected. If no other decision has been made, we suggest the use of Rely+On Virkon®. It is not claimed that Rely+On Virkon® is "better" than alternative disinfectants, but it is approved for technical disinfection and has been used in diving since many years without recognized problems on humans or equipment.
    - Rely+On Virkon® 1% for 10 min. Soak the equipment in a bath. Make a new solution every 5 days. For equipment that cannot be soaked, use a spray or put on a cloth, but keep the area covered for a minimum of 10 minutes.
- Alternative disinfectants include alcohol (disinfectant alcohol with >75% ethanol) with a contact time of 1-2 min, Rely+On Pera Safe® 16,2g/l. Make a fresh solution every 24h. Household bleach (e.g. Klorin®) may be used in a 0,1% Solution (1 dl of Klorin® 4% in 4l of water) but has high pH (basic solution) , might be corrosive and use of PPE is imperative.

Appendix 2 – Smittevern ved dykking. Rengjørings- og desinfeksjonsprosedyrer for dykkeutstyr (Norwegian text)

Innledning og formål

Alle deler av samfunnslivet påvirkes av den pågående Covid-19 epidemien. Formålet med dette *vedlegget* er å beskrive hvilke tiltak man bør iverksette ved innaskjærs dykking for å redusere smitterisikoen. Dokumentet er basert på et mer omfattende engelskspråklig dokument, men dette sammendraget er med hensikt gjort mer kortfattet for å oppsummere de viktigste og mest relevante forholdene for innaskjærs dykking i Norge.

Organisatoriske forhold

Prøv å organisere arbeidet på en slik måte at nøkkelpersonell ikke jobber i fysisk nærhet der det er mulig. Smittes en person vil nærkontakter normalt bli plassert i karantene.

Informasjon

La diskusjon om smittevern bli en del av morgenkaffen, oppstartmøtet e.l. Hør hvilke forslag de ansatte har til å forbedre smittevernet. Hent hyppig og regelmessig informasjon fra helsemyndighetene på www.fhi.no eller www.helsenorge.no . En rutine som den du nå holder kan fort bli utdatert.

Ikke skriv rutiner som omhandler «alt» eller plakater som er så tettskrevne at ingen orker lese dem. Fra denne siden hos Helsedirektoratet kan du laste ned flere gode plakater (på mange språk) som kan trykkes opp. Fokuser på det som vi vet er viktigst:

- Hold deg oppdatert fra anerkjente kunnskapskilder som www.fhi.no og www.helsenorge.no
- Følg myndighetenes anbefalinger, hold avstand, ha god hoste- og nysehygiene. Unngå personkontakt der det er mulig. Hyppig håndvask og desinfeksjon
- Gjennomgå virksomhetens rutiner for rengjøring og desinfeksjon av pusteutstyr (se under)

Rengjøring og desinfeksjon av pusteutstyr

Innledning

Covid-19 viruset (SARS-CoV-2) spres gjennom dråpesmitte. Pusteutstyret kan dermed spre smitten fra en dykker til en annen og *må* rengjøres og desinfiseres for å hindre smittespredning. Følg disse rådene:

- ***Der det overhode er mulig bør maske, neseklype («nose block») og pusteventil være personlig dykkeutstyr som ikke byttes mellom dykkerne.***
- Maske og pusteventil som deles mellom dykkerne må først vaskes og deretter desinfiseres – se detaljer under.

Generelt om rengjøring og desinfeksjon

- Følg virksomhetens prosedyrer for rengjøring og desinfeksjon. Benytt produsentens anbefalinger der det ikke er utarbeidet egne selskapsinterne prosedyrer.
- Skyll med vann for å fjerne synlig forurensing. Bruk om nødvendig såpevann med nøytralt eller lett surt rengjøringsmiddel (som f.eks. Zalo). Skyll i så fall vekk såpen etterpå.
- Desinfiser med egnet desinfeksjonsmiddel. Rely+On Virkon er utmerket og har i praksis vist seg godt egnet uten å ødelegge materialene i pusteutstyret. La utstyret ligge i 10 min i Virkon 1% løsning før det tas opp og skylles. Husk å merke beholderen med dato for utblandet løsning – det skal lages ny bruksløsning etter maksimalt fem dagers bruk.
- Alternative desinfeksjonsmidler inkluderer

  - Desinfeksjonssprit (f.eks. Antibac, minimum 75% konsentrasjonstid, virketid 1-2 min)
  - Rely+On Perasafe 1%. Virketid 10 min. Bruksløsning må skiftes daglig
  - Klorin, 0,1% (Selges normalt i 4% konsentrat og må da fortynnes med 1dl til 4l vann). Klorin er svært skadelig ved inhalasjon og ved sprut mot øynene – bruk korrekt verneutstyr. Klorin kan også korrodere og oksidere metaller.
- Vandig Klorhexidin er *ikke* effektivt mot Coronavirus og bør ikke benytt. Det er mer effektivt å benytte vanlig rengjøringsmiddel hvis ikke det er effektive desinfeksjonsmidler tilgjengelig.

Spesifikke anbefalinger for utvalgte typer pusteutstyr

Innledning

Disse anbefalingene er *ikke* ment å erstatte produsentens råd. Vi tror likevel det kan være nyttig å understreke enkelte forhold fordi produsentens vaske- og desinfeksjonsråd har vist seg vanskelig å etterleve i praksis.

Interspiro Divator

Masken inkludert oral nasalmasken: Rengjøring med f.eks. Zalo etterfulgt av desinfeksjon med Virkon vil være en god rutine. Et alternativ til dette vil være å vaske den i vaskemaskin i 65-70 grader med minimum 1t program (ikke bruk «hurtigprogram» eller «spareprogram»).
Regulatoren (andretrinnet): Produsenten anbefaler at den demonteres for å sikre at rengjøring og desinfeksjon blir god nok. Demontering av regulatoren vil øke risiko for feilfunksjon hvis det ikke gjøres av opplært personell og bør ikke gjøres av den enkelte dykker. Der det ikke er mulig å ha regulator som personlig pusteutstyr eller dykketekniker kan foreta rengjøring så vil nedenstående prosedyre være beste alternative løsning:

- Skyll regulatoren med rikelig vann, fjern all synlig forurensing
- La regulator være tilkoblet trykkluftkilde og legg den i desinfeksjonsløsning. Vi anbefaler Virkon med 10 min virketid
- Skyll med rikelig vann for å fjerne rester av desinfeksjonsmiddel

Kirby Morgan båndmasker og hjelmer

Den største smittefaren er i oral nasal, neseklype og regulator. Disse *må* rengjøres og desinfiseres mellom hver bruker. Følg virksomhetens rutiner. Hvis ikke det foreligger selskapsinterne prosedyrer så anbefaler vi nedenstående:

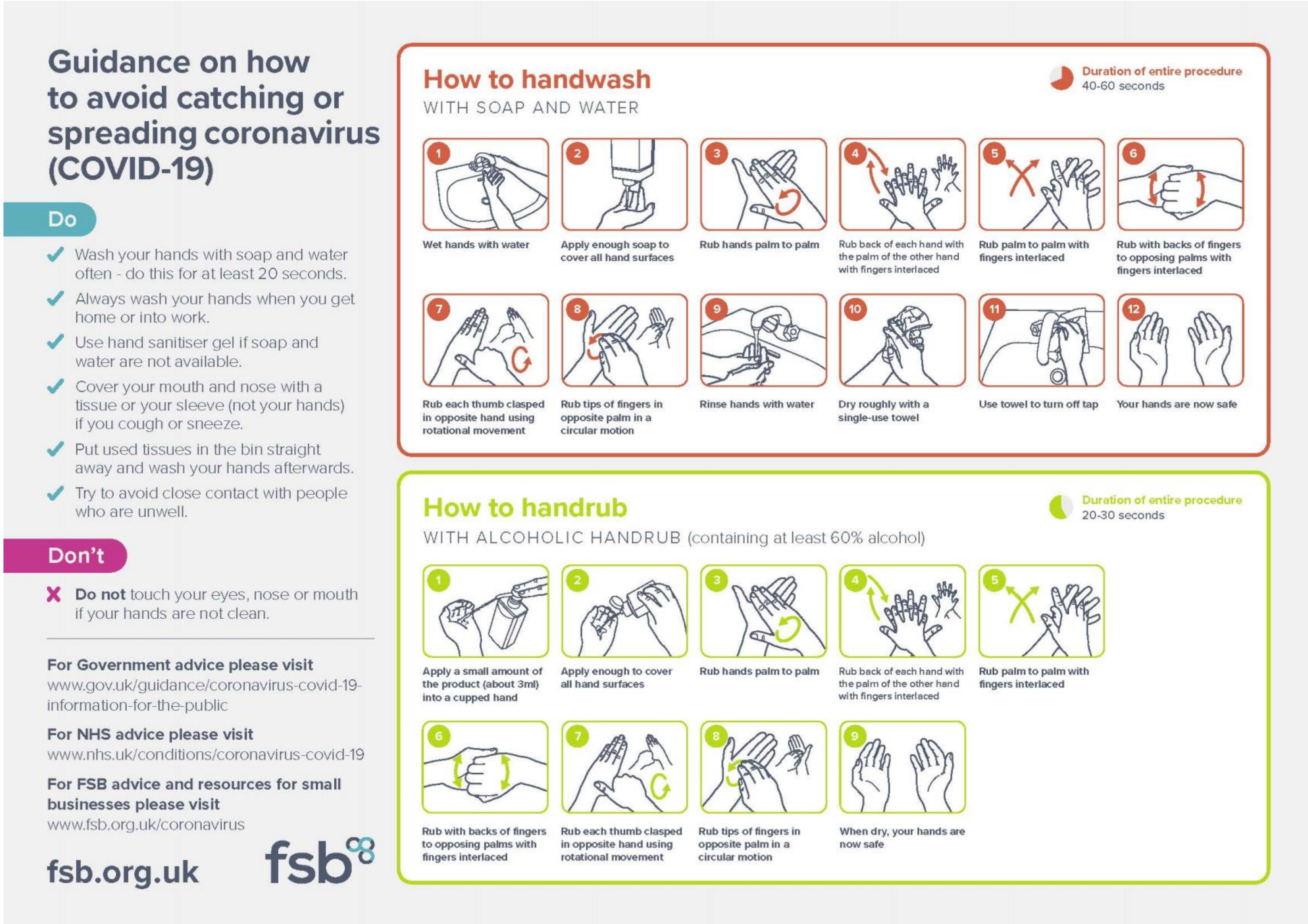
- La utstyret være trykksatt under hele prosedyren
- Skru av strøm til mikrofon/høyttaler
- Skyll vekk synlig forurensing. Bruk om nødvendig Zalo e.l.
- Legg utstyret i et Virkon 1% desinfeksjonsbad og la virke i 10 min. Væskespeilet legges slik at høyttaler holdes over væskespeilet.
- Skyll rikelig med ferskvann

Mikrofon: Erfaring har vist at de kan fungere dårligere over tid. Dette skyldes typisk at det er gjenværende væske i/bak mikrofonen. Som et alternativ til å la mikrofonen ligge i Virkon-bad så kan den sprayes med rikelig desinfeksjonssprit (evt en desinfeksjonsserviett) og la den lufttørke. På slutten av dagen kan det være lurt å ta ut mikrofon fra oralnasal og løsne høyttalerne fra silikonbeskyttelsen og la dem lufttørre til neste dag. Det er ved utgivelse av denne utgaven (Rev 7) ikke rapportert om vesentlige tekniske komplikasjoner ved å følge denne prosedyren de siste 4 mnd.

Appendix 3 – Handwash poster

Source

The poster on the next page has been downloaded from www.fsb.org.uk

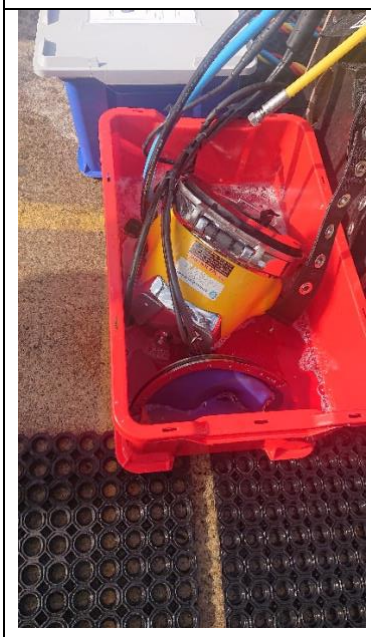

Guidance on how to avoid catching or spreading coronavirus (COVID-19)
Do
Wash your hands with soap and water often - do this for at least 20 seconds.
Always wash your hands when you get home or into work.
Use hand sanitiser gel if soap and water are not available.
Cover your mouth and nose with a tissue or your sleeve (not your hands) if you cough or sneeze.
Put used tissues in the bin straight away and wash your hands afterwards.
Try to avoid close contact with people who are unwell.
Don't
Do not touch your eyes, nose or mouth if your hands are not clean.
For Government advice please visit
www.gov.uk/guidance/coronavirus-covid-19-information-for-the-public
For NHS advice please visit
www.nhs.uk/conditions/coronavirus-covid-19
For FSB advice and resources for small businesses please visit
www.fsb.org.uk/coronavirus
fsb.org.uk
How to handwash
WITH SOAP AND WATER
Duration of entire procedure 40-60 seconds
1 Wet hands with water
2 Apply enough soap to cover all hand surfaces
3 Rub hands palm to palm
4 Rub back of each hand with the palm of the other hand with fingers interlaced
5 Rub palm to palm with fingers interlaced
6 Rub with backs of fingers to opposing palms with fingers interlaced
7 Rub each thumb clasped in opposite hand using rotational movement
8 Rub tips of fingers in opposite palm in a circular motion
9 Rinse hands with water
10 Dry roughly with a single-use towel
11 Use towel to turn off tap
12 Your hands are now safe
How to handrub
WITH ALCOHOLIC HANDRUB (containing at least 60% alcohol)
Duration of entire procedure 20-30 seconds
1 Apply a small amount of the product (about 3ml) into a cupped hand
2 Apply enough to cover all hand surfaces
3 Rub hands palm to palm
4 Rub back of each hand with the palm of the other hand with fingers interlaced
5 Rub palm to palm with fingers interlaced
6 Rub with backs of fingers to opposing palms with fingers interlaced
7 Rub each thumb clasped in opposite hand using rotational movement
8 Rub tips of fingers in opposite palm in a circular motion
9 When dry, your hands are now safe

Appendix 4 – Photo gallery – disinfection procedures (Bilder desinfeksjonsprosedyre)

Examples of soaking KMB and Superlite in Virkon disinfection solution

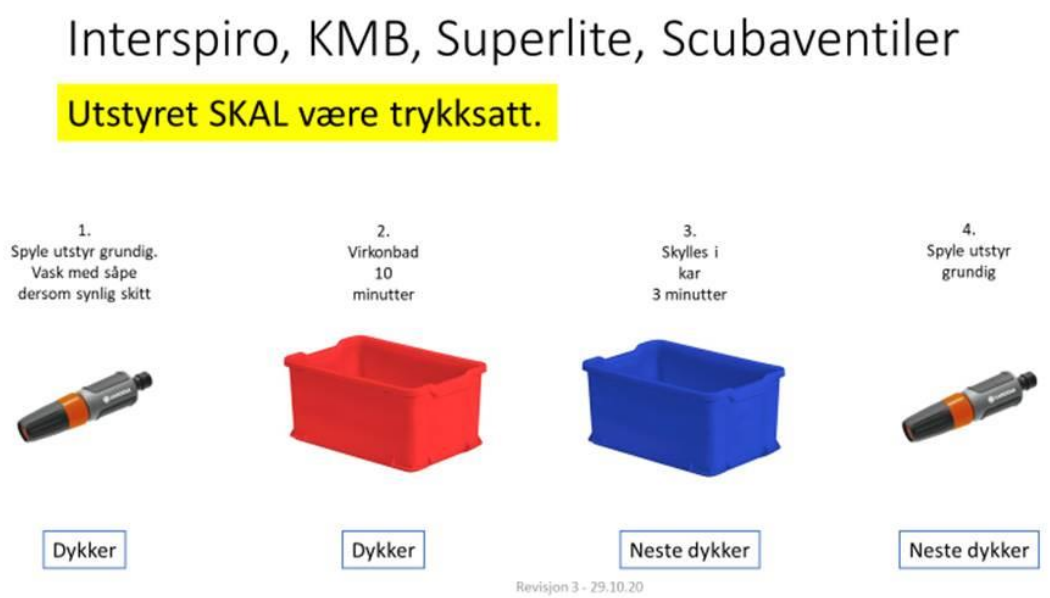
KMB 18B mask and neck dam (Photo: Frode Kaland, Western Norway University of Applied Sciences, Diver Education)

Superlite 37SS. Fluid level is kept below the headphone level (Photo: Frode Kaland, Western Norway University of Applied Sciences, Diver Education)



Superlite 37. Fluid level is kept below headphone level.
(Photo: Frode Kaland, Western Norway University of Applied Sciences, Diver Education)

Disinfection of Interspiro Mk III (Norwegian language only)



Figur 1 Disinfection procedure for Interspiro MkII as per Western Norway College of Applied Sciences, Diver Education. Credit: Frode Kaland. The regulator and microphone remains in place, the regulator is kept pressurized to avoid ingress of disinfection solution to the supply side. Sequence when the same mask is used in sequence by two divers. 1. Diver 1 rinse. 2: Diver 2 soak in Virkon for 10 min. 3. Diver 2: Soak in freshwater for 3 min. 4. Diver 2: Rinse.