

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

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Background and scope of this document

Covid-19 has developed as a pandemic infectious disease and is characterized by the WHO as a public health emergency of international concern. Measures are implemented internationally and nationally to reduce the spread and protect vulnerable persons. All sectors of the community is 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. This document was initially drafted by Jan Risberg (see details below) for a meeting between Norwegian Diving Physicians 13.3.2020. A follow-up meeting with additional participants was completed 16.3. The document was distributed for 16.3 meeting participants in Rev 1. The enclosed Rev 2 is identical except for clarifying authorship responsibility. *As per Rev 2 this document has status as draft and has not been endorsed by meeting participants, operators, diving contractors or authorities.*

Contributors to the contents of this document

The contents (conclusions) of this document was agreed by the meeting participants though not formally voted upon.

Participants meeting 13.3.2020

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Participants meeting 16.3.2020

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Scope

The scope of this document is to supply additional, and national, guidance to the document in preparation by IMCA and DMAC. This document is in some areas intentionally more prescriptive than the draft text of the IMCA and DMAC guidance. However, the document is intended to supplement rather than replace the awaited IMCA/DMAC guidance. If disparity

exists between the documents, expert guidance should be sought before a final conclusion is taken.

Relevance of sat vs 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 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.

Should saturation diving take place?

Current knowledge of Covid-19 disease spread (transmission, disease presentation, disease severity) is limited. WHO data suggests that 15% of the infected acquire “severe” illness, while another work (Tian et al, Journal of Infection 2020) reported 17.6% severe cases in Beijing during Jan 20th to Feb 10th 2020 (N=262). Wu et al (Jama Intern Med, 2020) reported that among 201 patients with Covid-19 associated pneumonia, 42% developed Adult Respiratory Distress Syndrome (ARDS). Hospital-treated ARDS had a mortality of 52%). Higher age and comorbidity were risk factors for ARDS. This was an unscreened population from China and certainly not representative for the off-shore divers, however in the absence of other data the epidemiological reports so far suggest that complications of Covid-19 requiring advanced medical treatment cannot be ignored.

Coronavirus aerosol survival is dependent on temperature and relative humidity (Ijaz et al, J gen Virol 1985). 80% RH with 20 °C was least favorable 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 may survive on steel surface for 2d, on metal surfaces for 5d and on plastic surfaces for 9d (Kampf et al, J Hosp Infect 2020, Doremalen et al NEJM 2020). 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 recent summary (Wilson et al. Emerg Infect Dis 2020) 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 dives in saturation. Any risk assessment on development of Covid-19 illness in the cohort of highly selected 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.

Personnel selection

Exclusion of personnel with increased likelihood of transmitting infectious illness should be put in place. The clinical characteristics of Covid-19 illness is difficult to separate from other respiratory infections and seasonal flu. Accordingly a structured screening to exclude personnel with increased risk of infectious disease transmission. The questionnaire should as a minimum include travel history the past 14 days, exposure to patients suffering Covid-19 or other respiratory disease and any symptoms of respiratory illness (Fever, cough, dyspnea,

fatigue and musculoskeletal pain). Personnel with current upper or lower respiratory tract infection or flu-like symptoms should not be allowed to embark. A pre-sat quarantine of 14d is probably an effective measure to reduce the likelihood of contracting Covid-19 infection while in saturation. Establishing an effective quarantine is practically demanding.

The question as to whether stricter selection criteria should be imposed remains open. Currently there is no advice to enforce stricter selection, but it is recognized that the incidence of complications secondary to Covid-19 increase as a function of age over 50 years and particularly for subjects older than 60 years.

Hygienic measures on board

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 areas unless preventive hygienic measures (cleaning and disinfection) can be enforced and complied with. Cleaning and disinfection routines should be re-assessed, particularly surfaces that are frequently touched (e.g. door handles, tables).

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

Diver gas and reclaim systems: Does these contain or is it possible to install filters improving removal of microbiological agents?

Helmets and diver's breathing equipment: Manufacturers procedures should be adhered to.

Contingency

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

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 reduce the risk of infecting the nurse in matters not related to health care.

Biological testing for SARS-CoV-2 virus

As per 18.3 there is insufficient capacity for SARS-CoV-2 testing in Norway. However equipment for sampling nasopharynx specimens) should be available on the vessel. Test kits for blood sampling (IgM and IgG) is under development and should be considered once commercially available.

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).

Handling upper and lower respiratory tract infections

Divers in the chamber (sat diving)

Unless appropriate steps have been taken to exclude Covid-19 infection (e.g. quarantine, testing) any upper or lower respiratory infection and flu-like infection should call for initiation of saturation decompression. Abortion of the diving operation should be considered based on a risk assessment for viral transmission to the other living chambers.

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, there should be plans for the event that debarking of infected divers and other personnel will take place in port rather than helicopter. There should be plans for optimal extraction of infected patients, minimizing the risk for spreading infectious agents.

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.).

Surface supplied diving

Hygienic measures and disinfection procedures should be enhanced (as discussed previously). Selection criteria similar to sat.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.

Cleaning and disinfection

Cleaning and disinfection procedures should be effective against SARS-CoV-2. Consider this general advice on [cleaning](#) and approved [disinfectants](#) (in Norwegian) and [English](#). Cleaning should be done with conventional detergents. A large number of disinfectants are effective against SARS-CoV-2. One of these, conventionally applied in saturation chambers, is:

- [Virkon, 1%, 10 min action time](#)

Alternatives that may be considered for surface pressure based disinfection are:

- [Ethanol surface disinfection \(>70% for 1-2 min\)](#)
- Household bleach 0.1% (e.g. Klorin® 4%, 1 dl for 4l water) with 10 min of contact time, [Ref 1](#) and [Ref 2](#))
- [Pera Safe for 10 min](#)

Cleaning of hands should be done with conventional hand detergents if dirty. Alcohol based hand disinfectants (>60% Ethanol) can be used on *clean* hands.

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

General

Cleaning and disinfection should be completed according to manufacturers instructions.

Interspiro Divator™

The maintenance including cleaning procedures can be downloaded from [this site](#). While the Divator Full Face Mask can be comparatively easily be cleaned and disinfected, the procedure for appropriate regulator dismantling (required to complete the disinfection) is more complicated. As per the manufacturers instructions, the regulator should be dismantled prior to disinfection. This will introduce a risk for erroneously assembly of the regulator. The authors of this document has contacted a number of Norwegian dive technicians who has unanomiously agreed that dismantling of the oronasal and 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 oronasal 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 the alternative procedure below when this is not possible.
 - Dismount the regulator from the mask
 - Rinse with water, luke if possible. Remove any dirt with a neutral detergent or alternatively a slightly acidic detergent such as Zalo™. Rinse.
 - Soak the mask in desinfectant. We suggest Rely+On Virkon™ as described for the Kirby Morgan™ equipment as described below.
 - Pressurize the regulator and let it stay soaked in disinfectant for the time required. This would be 10 min for Rely+On Virkon™.
 - Rinse to remove the disinfectant
 - If at all possible let the equipment dry in a warm (20-30 °C) room, but any procedure allowing air drying of the equipment will contribute tor reduce the spread of virus.

Kirby Morgan™ band masks and helmets

General

Maintenance manuals can be downloaded from [this page](#) on the Company's website. The main principle is:

- Helmets and hoods should be cleaned. Oronasals and regulators should be cleaned and disinfected
- Dismantle the oronasal, open the regulator cover and remove the diaphragm

- Rinse with water. Any visible dirt should be removed, preferably a neutral detergent but a slightly acidic domestic detergent such as Zalo 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.
- Disinfect. There are 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 unwanted effect on the equipment to be infected. If no other decision has been made, we suggest the use of Virkon™. It is not claimed that 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.
- 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

Innledning

Dette vedlegget er under utarbeidelse. Forventes ferdigstilt fra forfatter ila 20.3 eller 21.3. Innholdet vil være en forkortet Norsk beskrivelse av det øvrige innholdet i dokumentet med unntak av Appendix 3.

Appendix 3 – Photos of Kirby Morgan Superlite™ and KMB18B™ dismounting and disassembly for cleaning and disinfection (Norwegian text only)

Introduction

We are sincerely indebted to the valuable discussions with Frode Kaland at the Western Norway University of Applied Sciences, Faculty of Engineering and Science, Diver Education. Most importantly he has produced a series of photos demonstrating the dismounting and disassembly of Kirby Morgan™ masks and helmets and included some important advices. These photos are not to be considered as replacement for the ones in the manufacturers manual, but we believe that they are valuable supplements to the manufacturer's information.

Rengjøring av masker og hjelmer

Frode Kaland 17.03.2020

Tidsbruk – sånn omtrentlig.

- | | |
|------------------------|-------------------------------------|
| • Superlite: | |
| • Demontering | 1-2 minutter |
| • Rengjøring | x minutter |
| • Spriting og virketid | x minutter |
| • Montering | 2 minutter |
| • KMB 18B | |
| • Demontere hood | 1-2 minutter |
| • Demontering | 1-2 minutter |
| • Rengjøring | x minutter |
| • Spriting og virketid | x minutter |
| • Montering | 2 minutter |
| • Montering av hood | 5 minutter (her kan det gå mer tid) |

Demontering består av:

- Ventilhuslokk/front.
- Orálnasalmaske.
- Utligningsenhet.
- Innmembran i maske.
- Høytaler (mikrofon) i maske.
- Ekstra for 18-masken er hood.

Frode Kaland

Opplæring

- Personer må læres opp i dette, da det ikke er vanlig å gjøre dette hos OSS.
- Vi bruker Antibac 75% på sprayflaske. Ufortynnet.

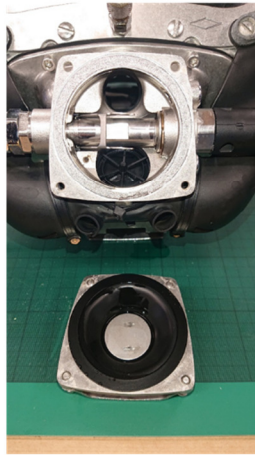
Frode Kaland

Superlite 37SS med Superflow 455



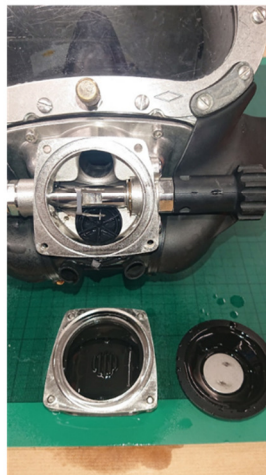
Frode Kaland

Demontering



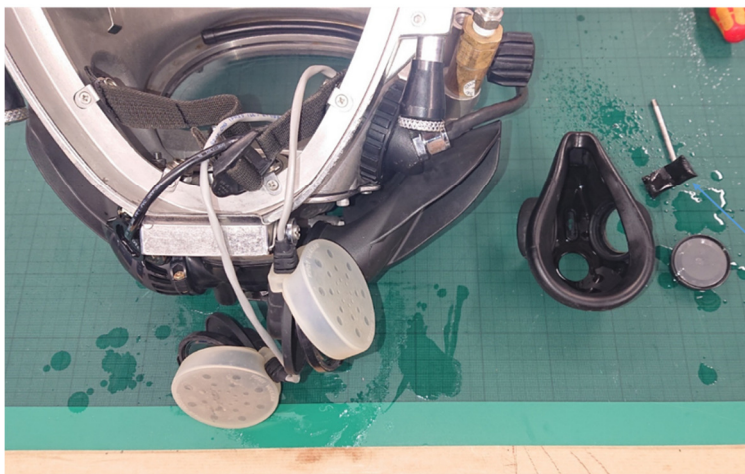
Demontere fire skruer i front.

Frode Kaland



Innvendig ventil er synlig.
Membran kan tas ut.
Antibac sprayes på alle flater.

Frode Kaland

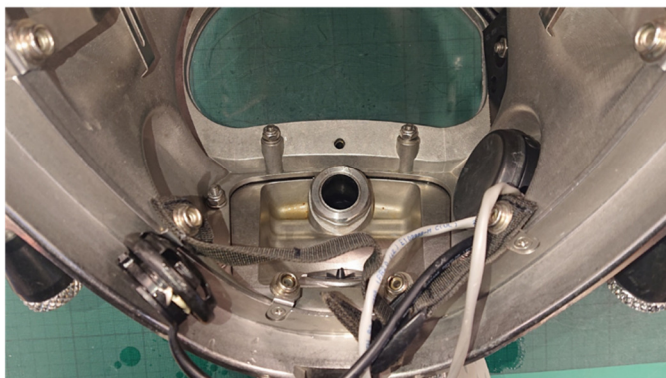


Løsne neseutligningsenhet.
Oralnasal (munn- og nesemaske) tas ut.
Enveisventil tas ut.
Høytaler tas ut av oralnasalmaske.
Antibac sprayes på alle flater.

Obs på utligningsenheten. Er i neopren.

Frode Kaland

Innvendig maske uten innermaske

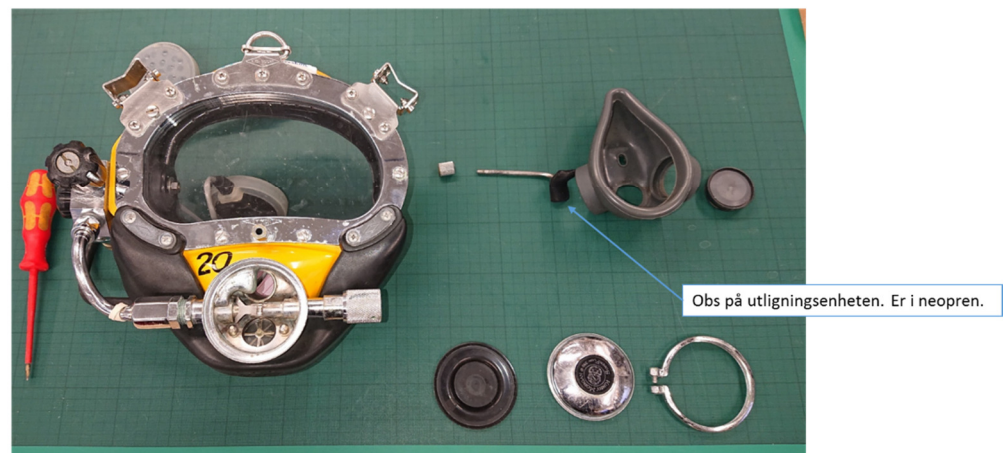


En del kriker og kroker.
Spray med antibac over alt.
La tørke.
Skyld med ferskvann.
Obs: Mikrofon må også sprayes.

Innerhette (hatliner) er personlig.

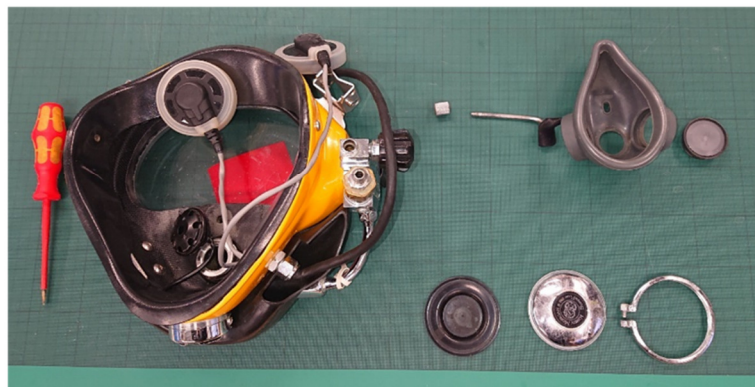
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KMB18B



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KMB 18B



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