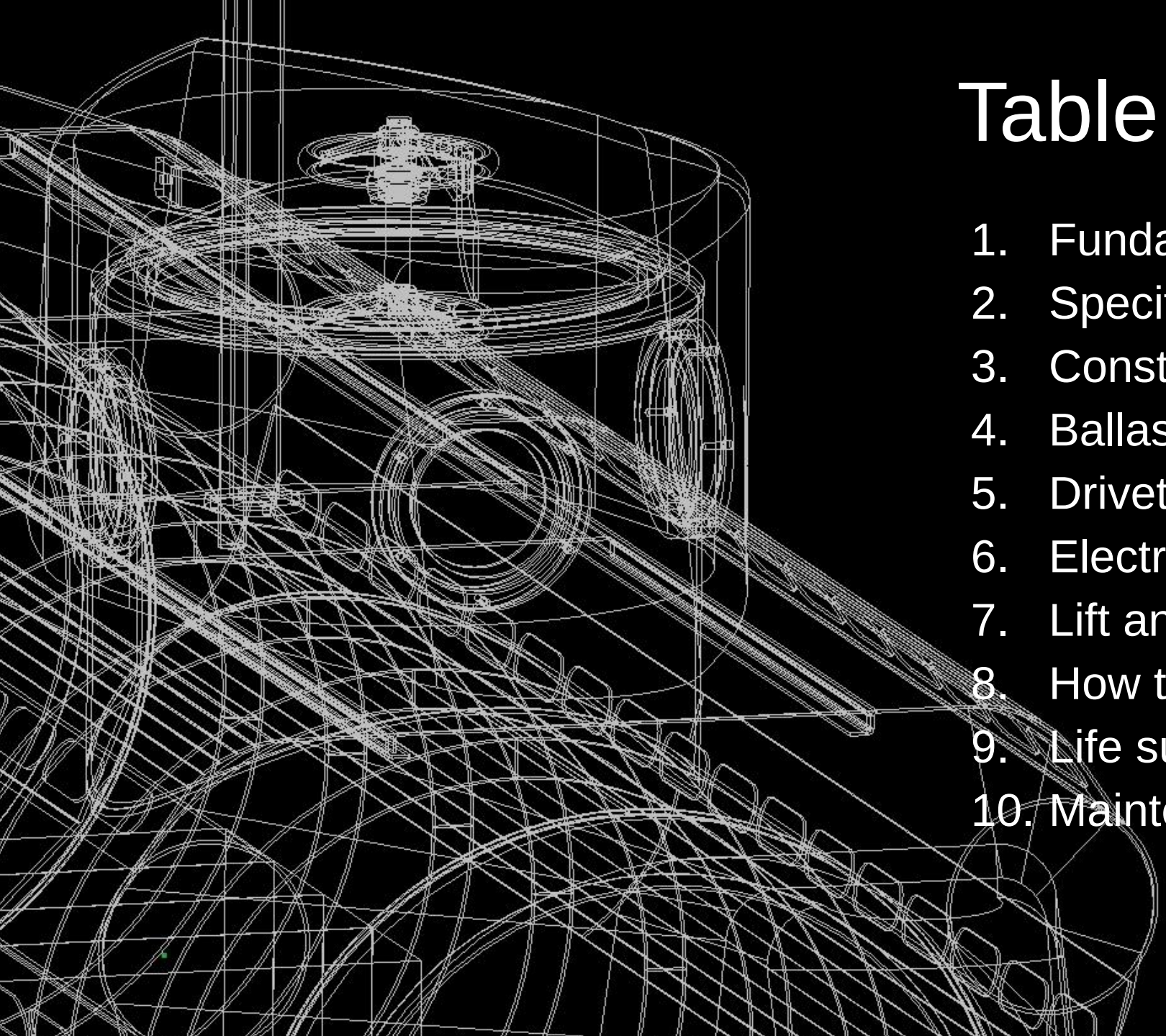
Submarine Harren

Operation & Maintenance Manual



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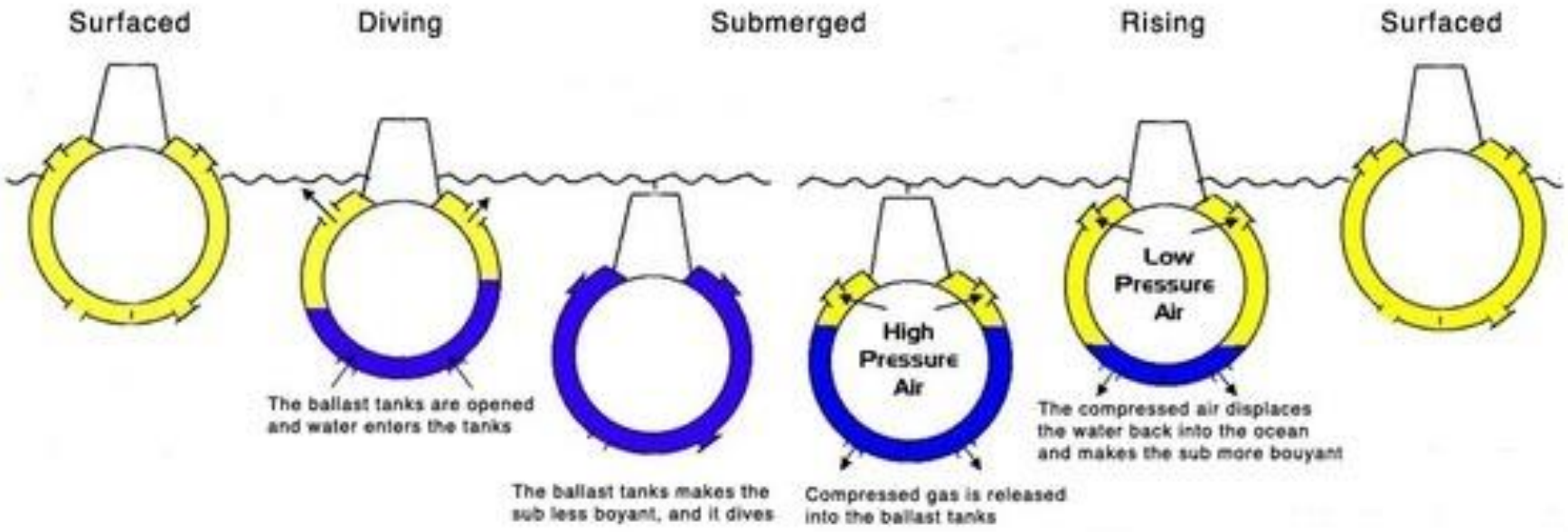
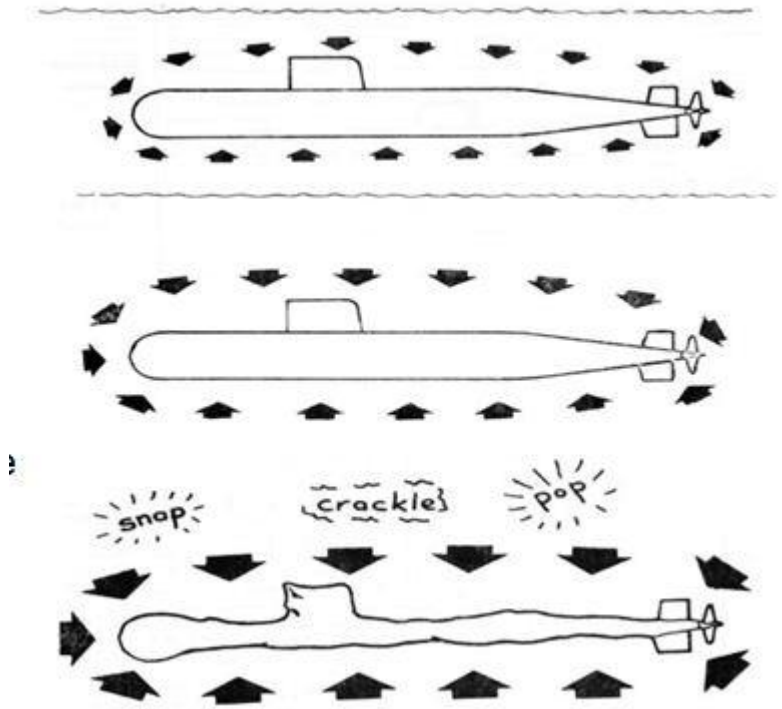
1. Fundamental knowledge

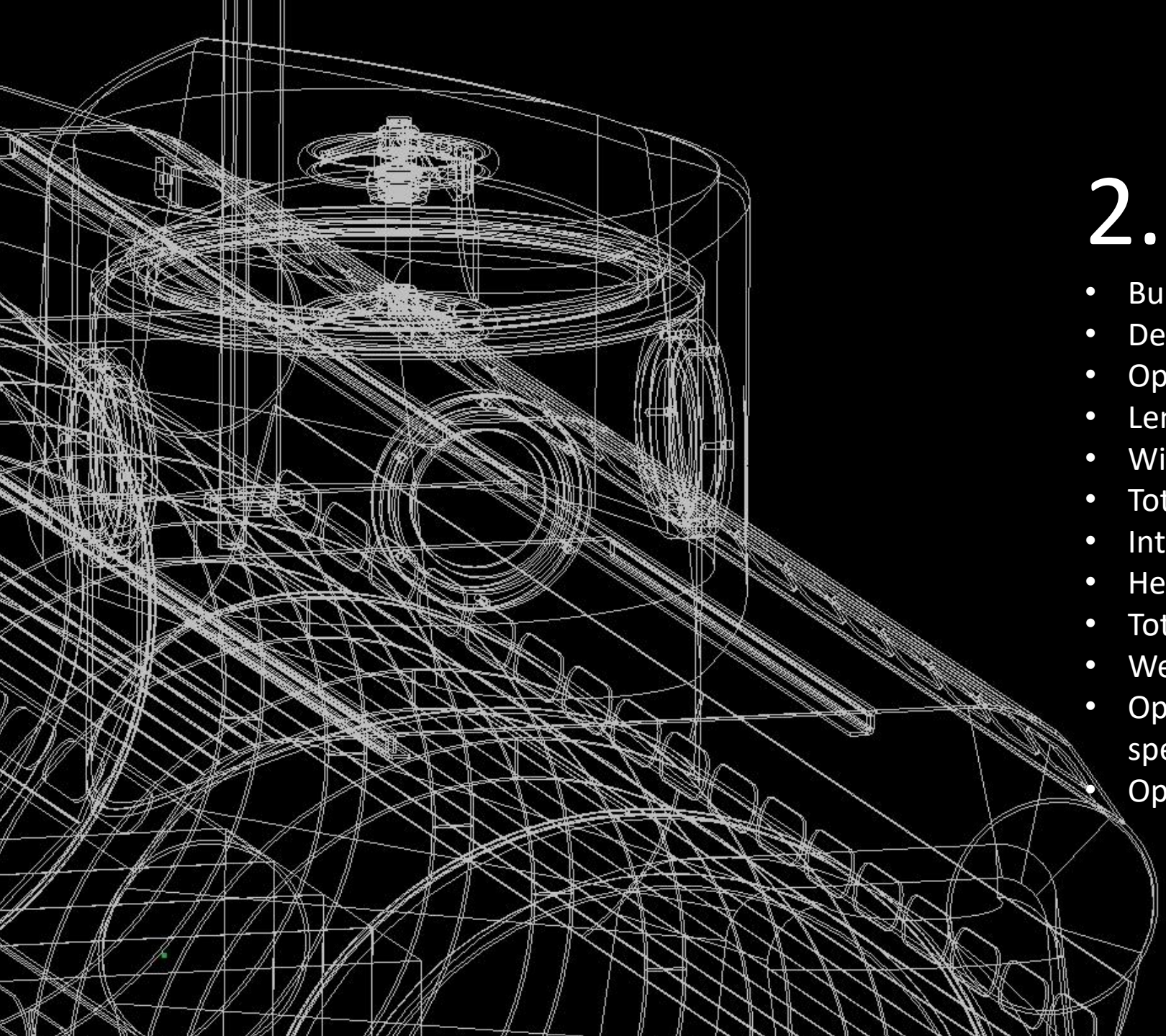
"It's all about buoyancy"



Pressure

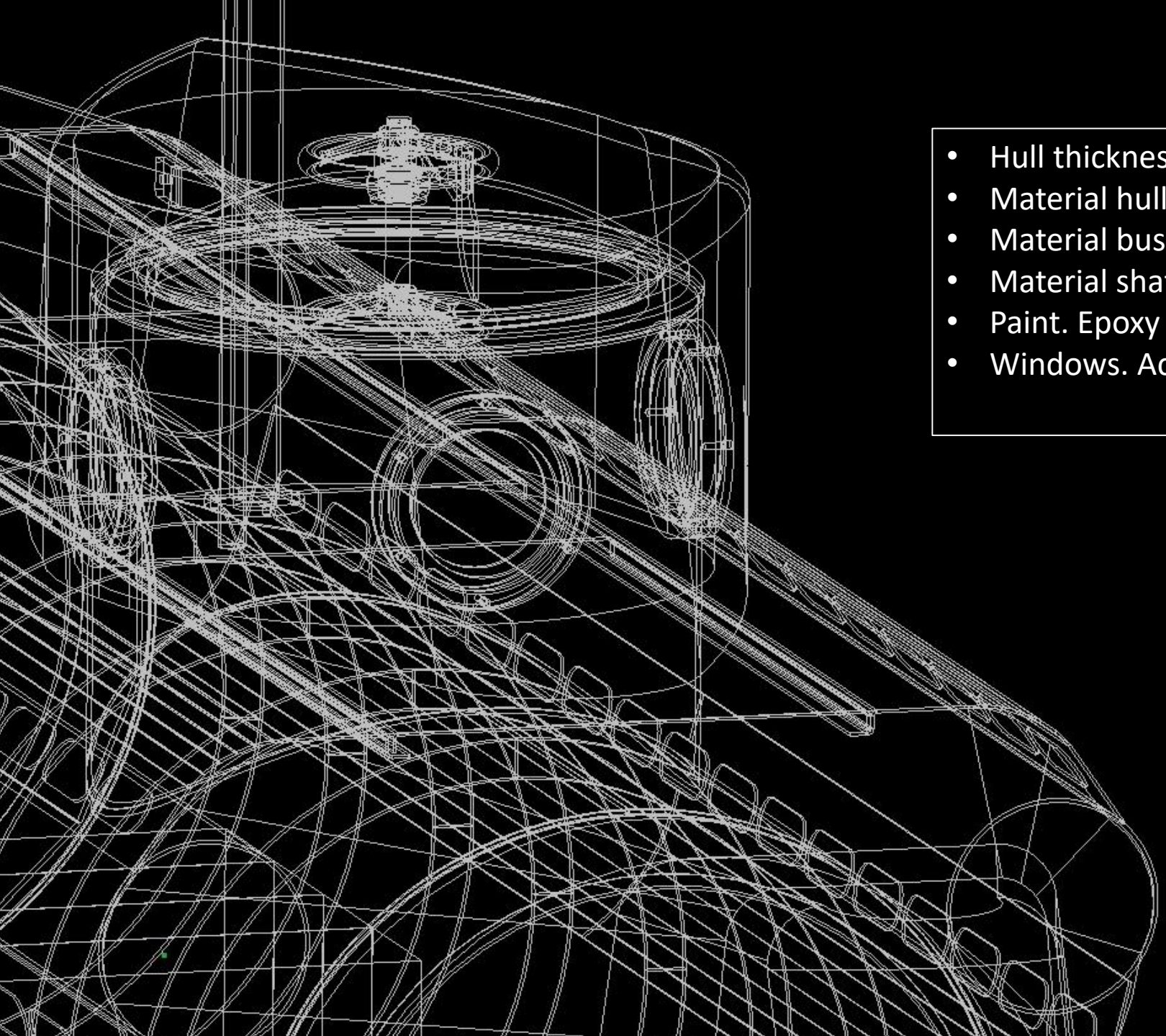


Surface(1ATM)	1 bar
10m	2 bar
20m	3 bar
30m	4 bar
40m	5 bar
50m	6 bar



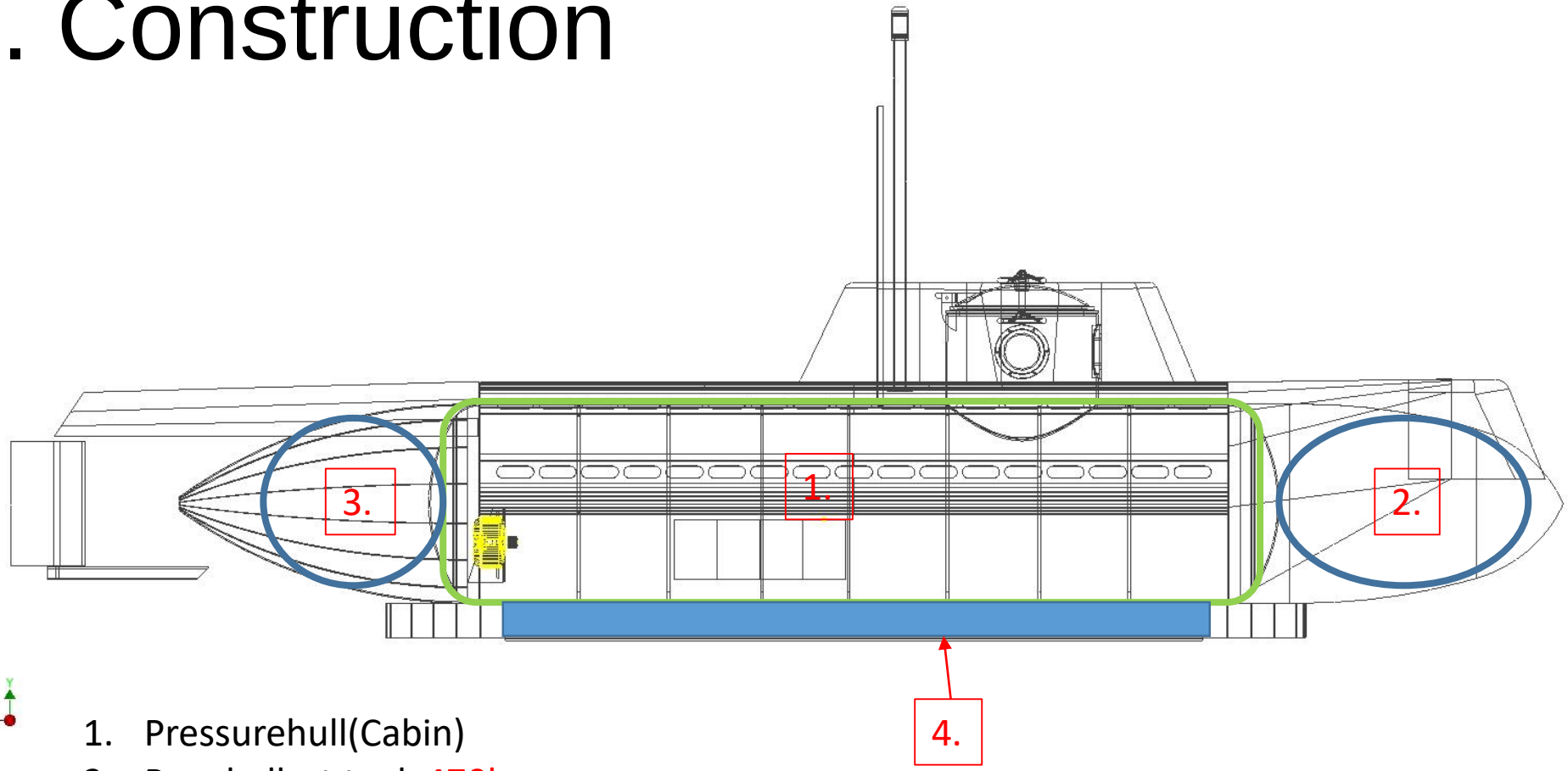
2. Specification

- Built between 2014-2018 By Martin Hedin
- Design depth 50m
- Operational depth 20m(test dive to 20m)
- Length 6.2m
- Width outside 1.1m
- Total Width(trim rudder) 1.6m
- Internal width 0.8m
- Height(WO periscope) 1.55m
- Total height 2.8m
- Weight 2700kg
- Operational distance electric 15km cruse speed.
- Operational distance diesel ?

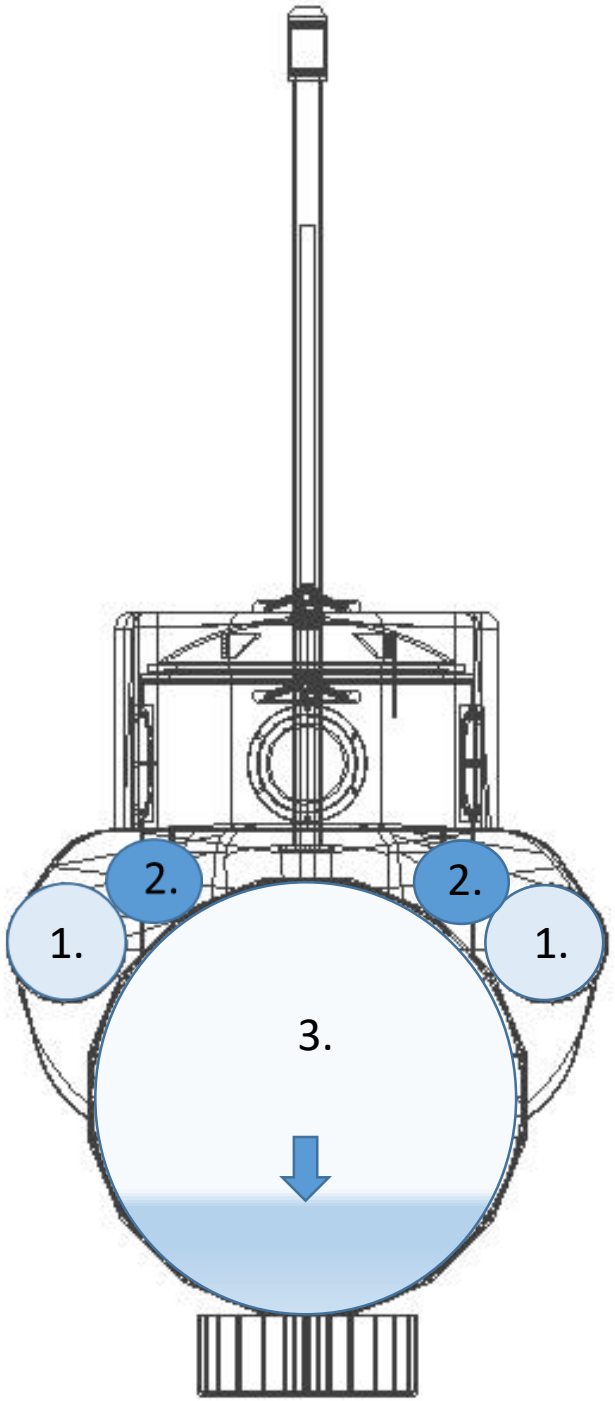


- Hull thickness 5mm
- Material hull. mild steel
- Material bushings. Brass
- Material shafts, Stainless EN1.4404
- Paint. Epoxy
- Windows. Acrylic

3. Construction



1. Pressurehull(Cabin)
2. Bow ballast tank 470l
3. Stern ballast tank 370l
4. External weight 800kg

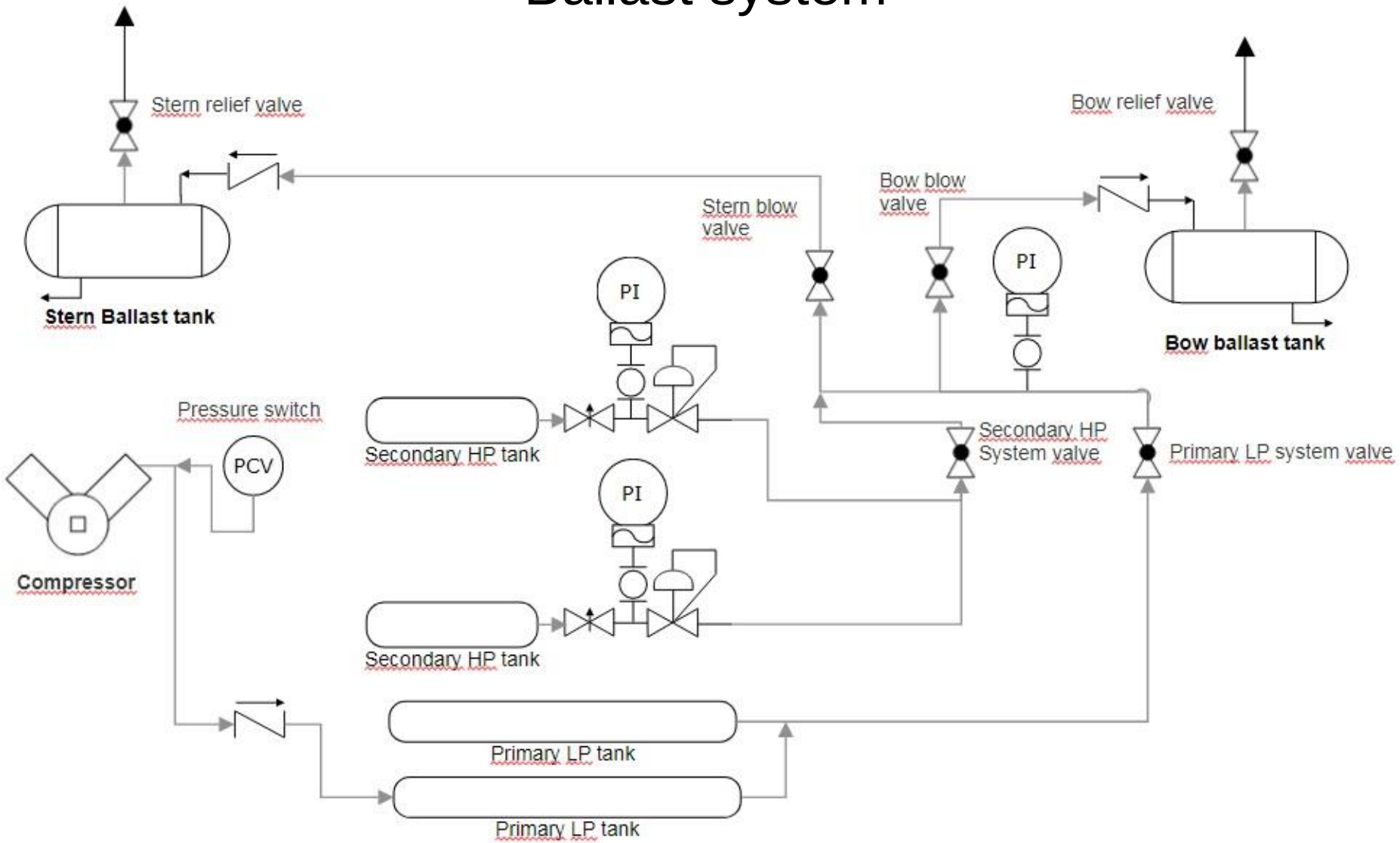


4. Ballast System

"Air to pump out water"

1. Primary LP tanks(8 bar)
2. Secondary HP tanks(200 bar)
3. Ballast tank

P&ID
Ballast system



Secondary HP tanks(200 bar)
”regulators”

Ballast relief valve stern

”Outside hull”

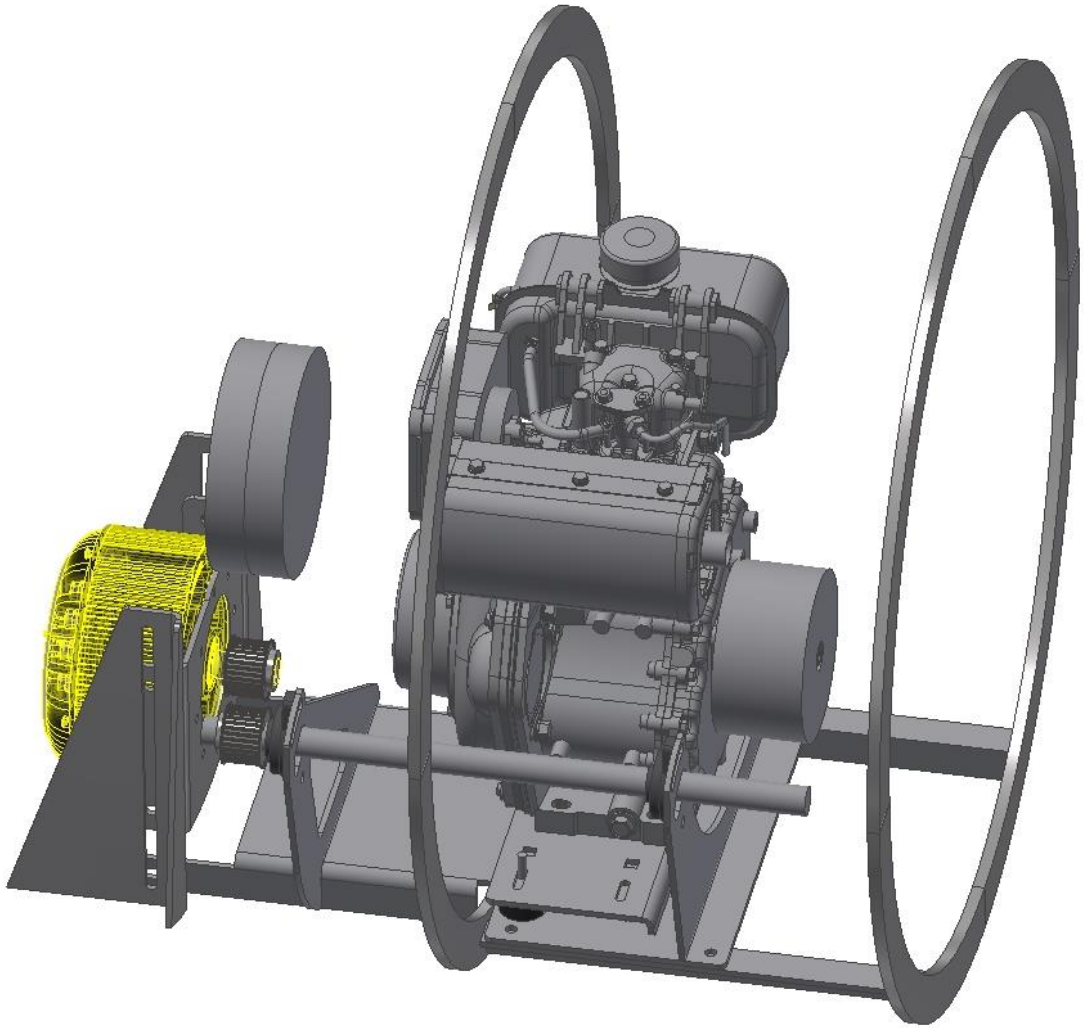
Ballast relief valve bow

”Outside hull”

Ballast blow valves

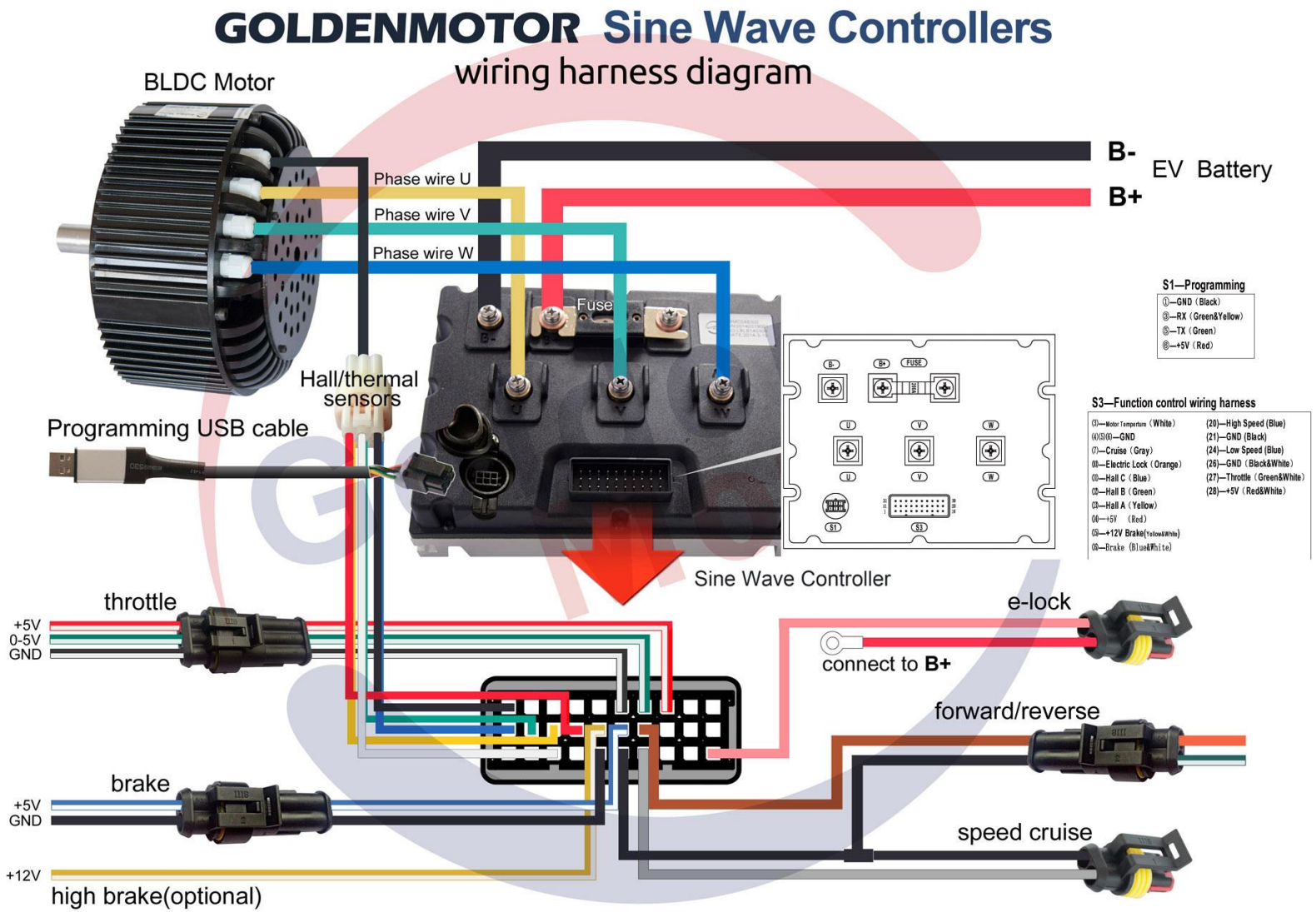
”Inside hull”

5. Drivetrain

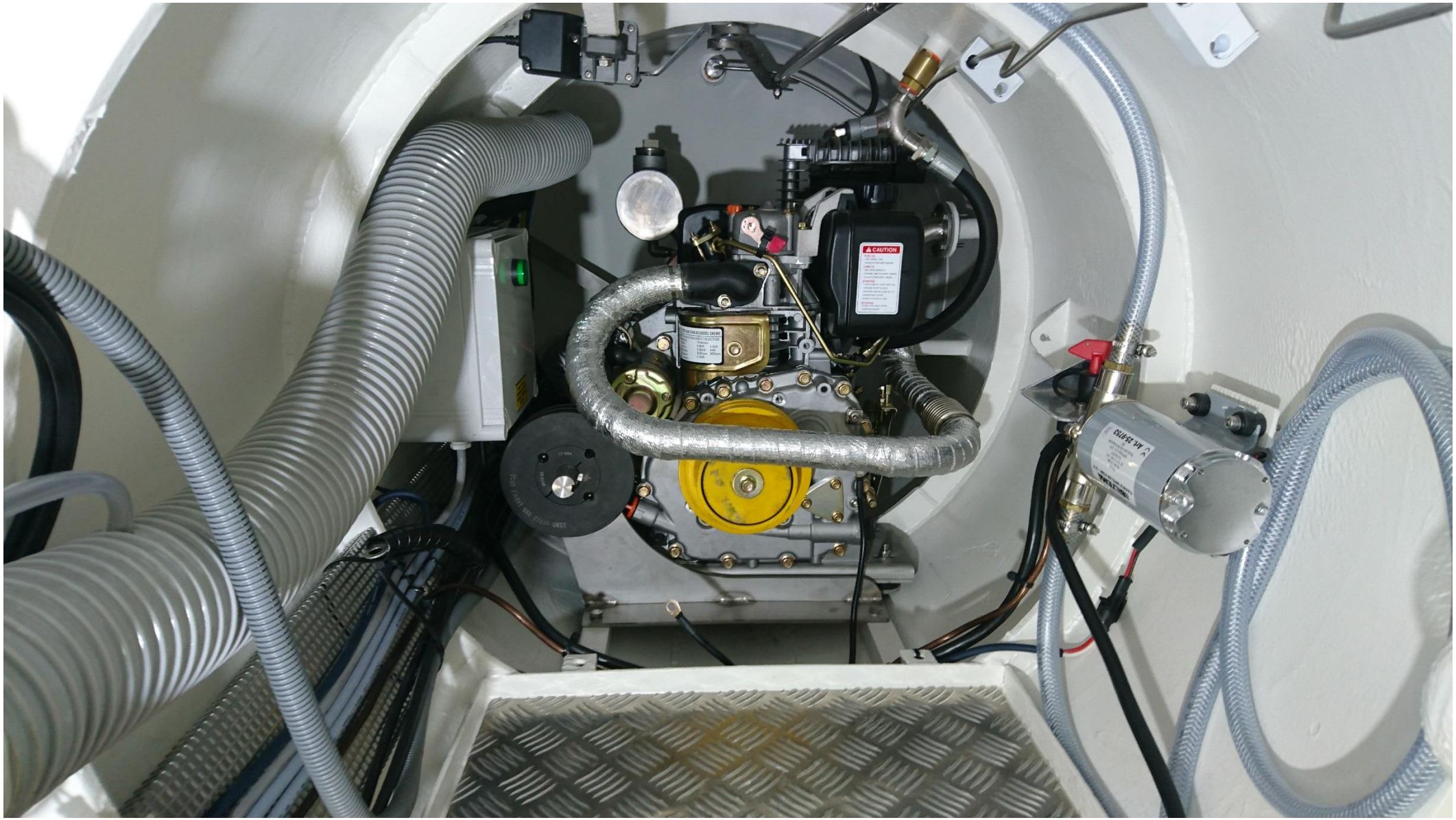


The submarine have 5kW electric motor for propulsion mainly. It also has a 5,5hp diesel engine for surface transport. Both are conected with drivebelts to propeller shaft. The diesel engine has a centrifugal clutch so it only works on high rev.

5kW BLDC 48v Motor



5.5hp Diesel



7. Lift and transport

- Equipped with a trailer
- Be sure to fasten the vessel as shown on picture(tight)
- Only use the trailer short distance
- Trailer is built for slow speed
- Trailer is custom built for the vessel
- Be sure to place the vessel so the weight don’t get to high on the towbar. Aligning markings on sub and trailer.

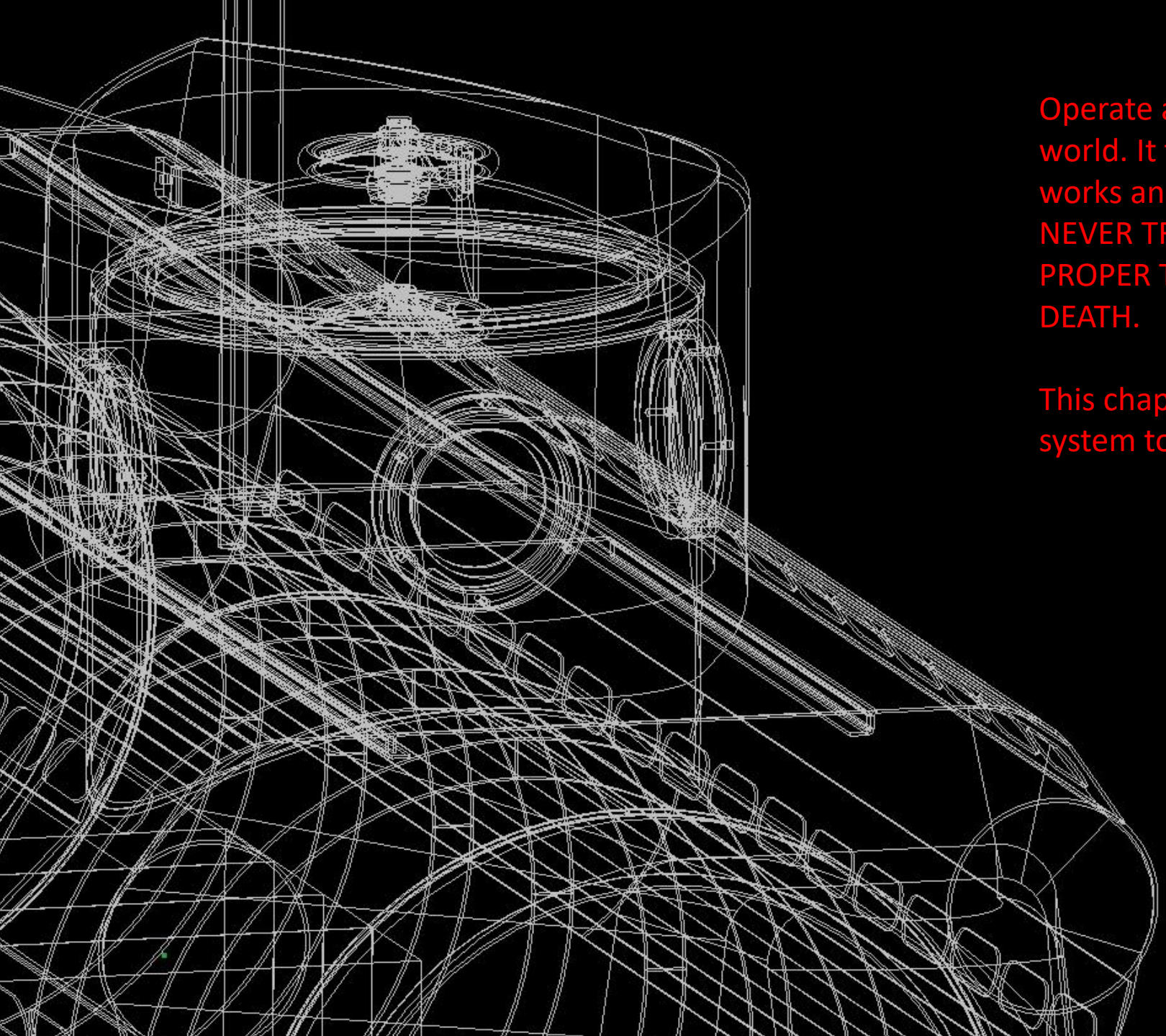
- Always use approved lifting equipment
- Attach only to the lifting hoist
- Do not add weight to the submarine
- Stay out of the way when lifting

- Straps angle max 30°

Always check for leaks or bubbles before releasing the straps. If leaks are detected when launching, immediately lift the vessel up from water and inspect, replace or repair faulty parts before launching again.

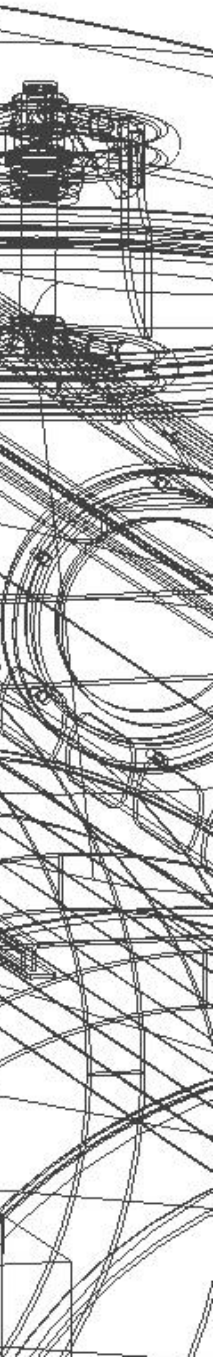
NEVER DO ANY REPARATION WHEN VESSEL IS SET TO SEA!

8. How to operate

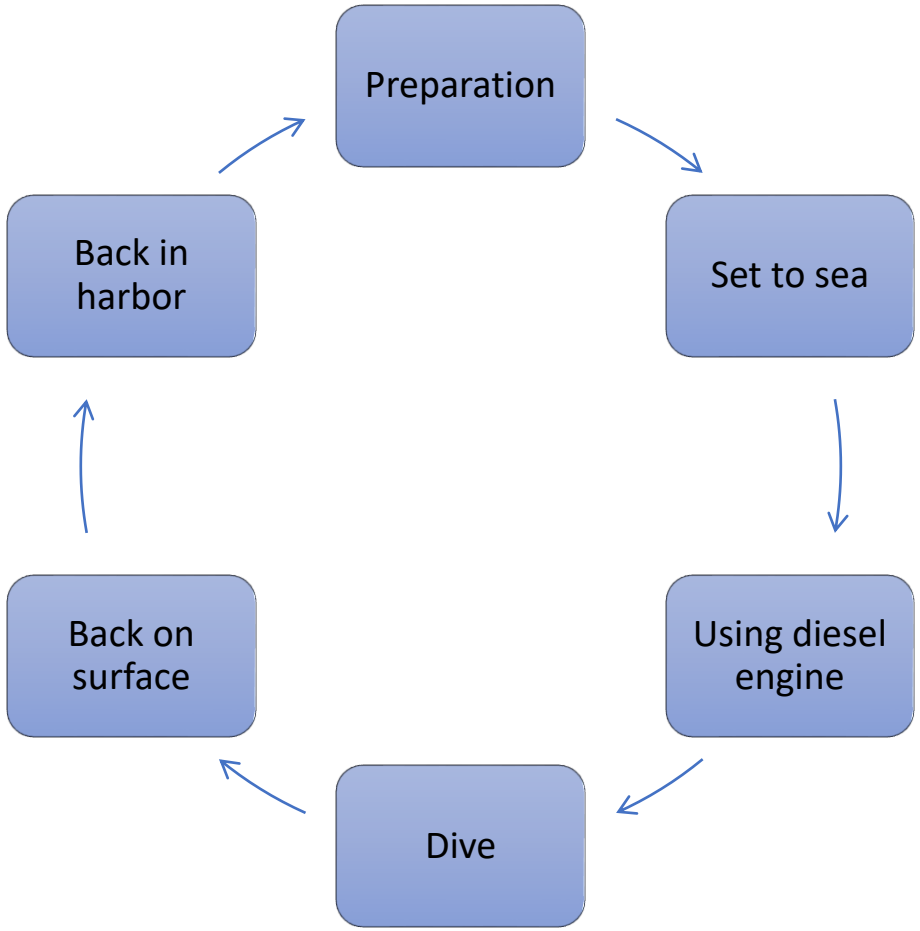


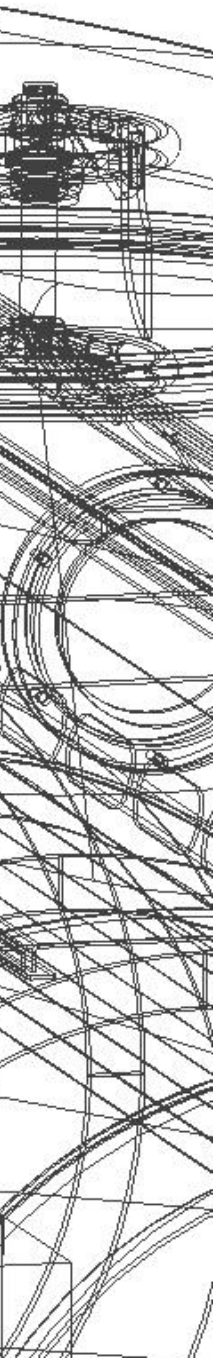
Operate a submarine is not the easiest thing in the world. It takes time to understand how the system works and the laws of physics that comes with it. NEVER TRY TO OPERATE THE SUBMARINE WITHOUT PROPER TRAINING. COULD RESULT IN EMIDIATE DEATH.

This chapter is a guide to learn to know the sub and its system to be able to operate it responsible and safe.



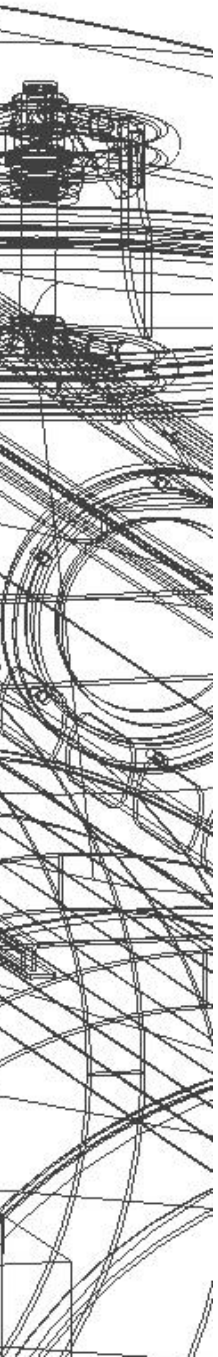
“Checklist it’s easy to forget”





Preparation step by step

- Unlock hatch
- Open secondary pressure tanks min 200bar
- Check main tank pressure min 8bar
- Check for leaks bubbles etc…
- Drain the condensation tank
- Turn on main electrical switch
- Check voltage min 49v
- Turn on trim tabs(switch panel)
- Check communication system



Set to sea step by step

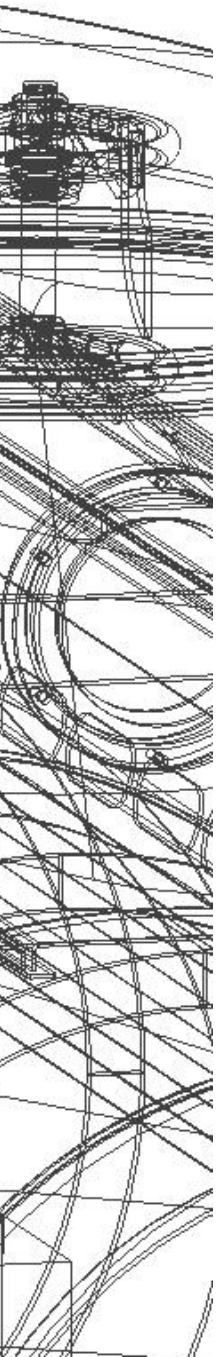
Start ignition (electrical mode), Reverse is only possible in this mode

Set trim tabs to ON(switch panel)

Set VHF to ON(switch panel)

Set Sonar to ON(Switch panel)

Drive safe and do not enter bad weather



Using diesel engine, step by step

Shut of ignition(electric motor)

Be sure the hatch is open. NEVER USE DIESEL ENGINGE WHEN HATCH IS CLOSE, causes vacum

Be sure condensation tank is empty, drain if needed.

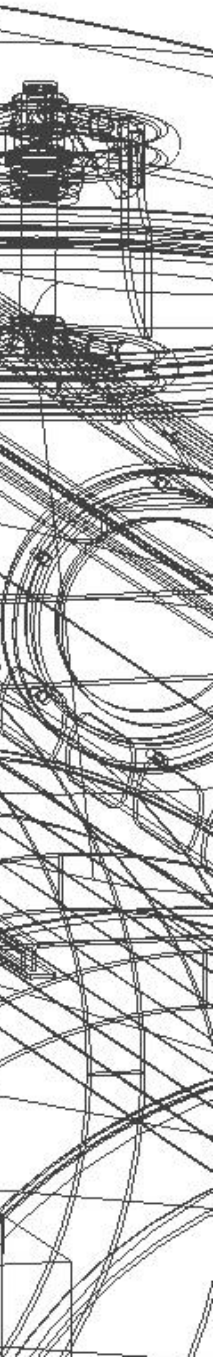
Open exhaust valve

Open fuel valve

Push down decompression switch

Turn on ignition and start the engine

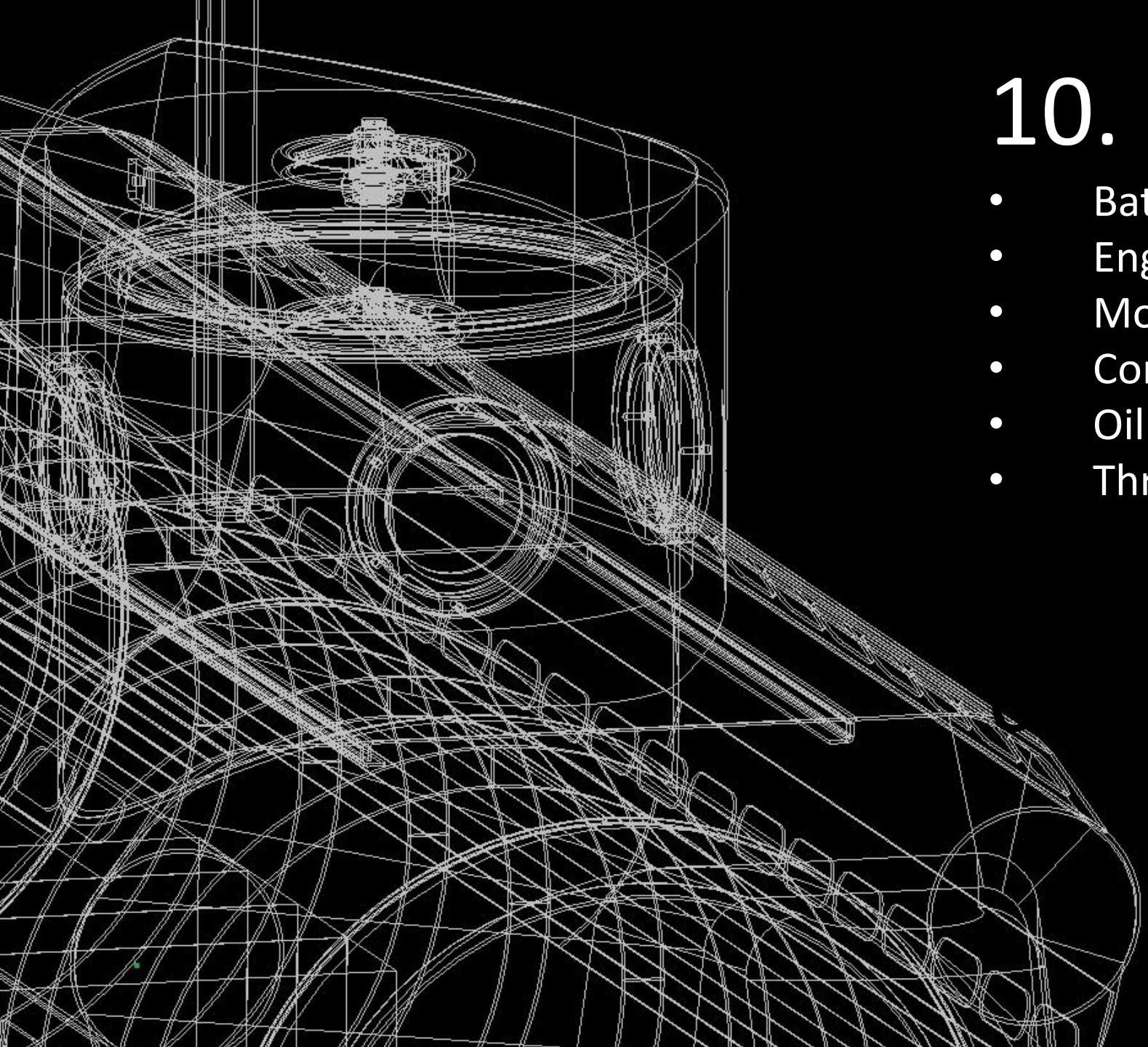
Do not run the engine on high rev



Dive, step by step

Never dive if depth exceeds operational depth!

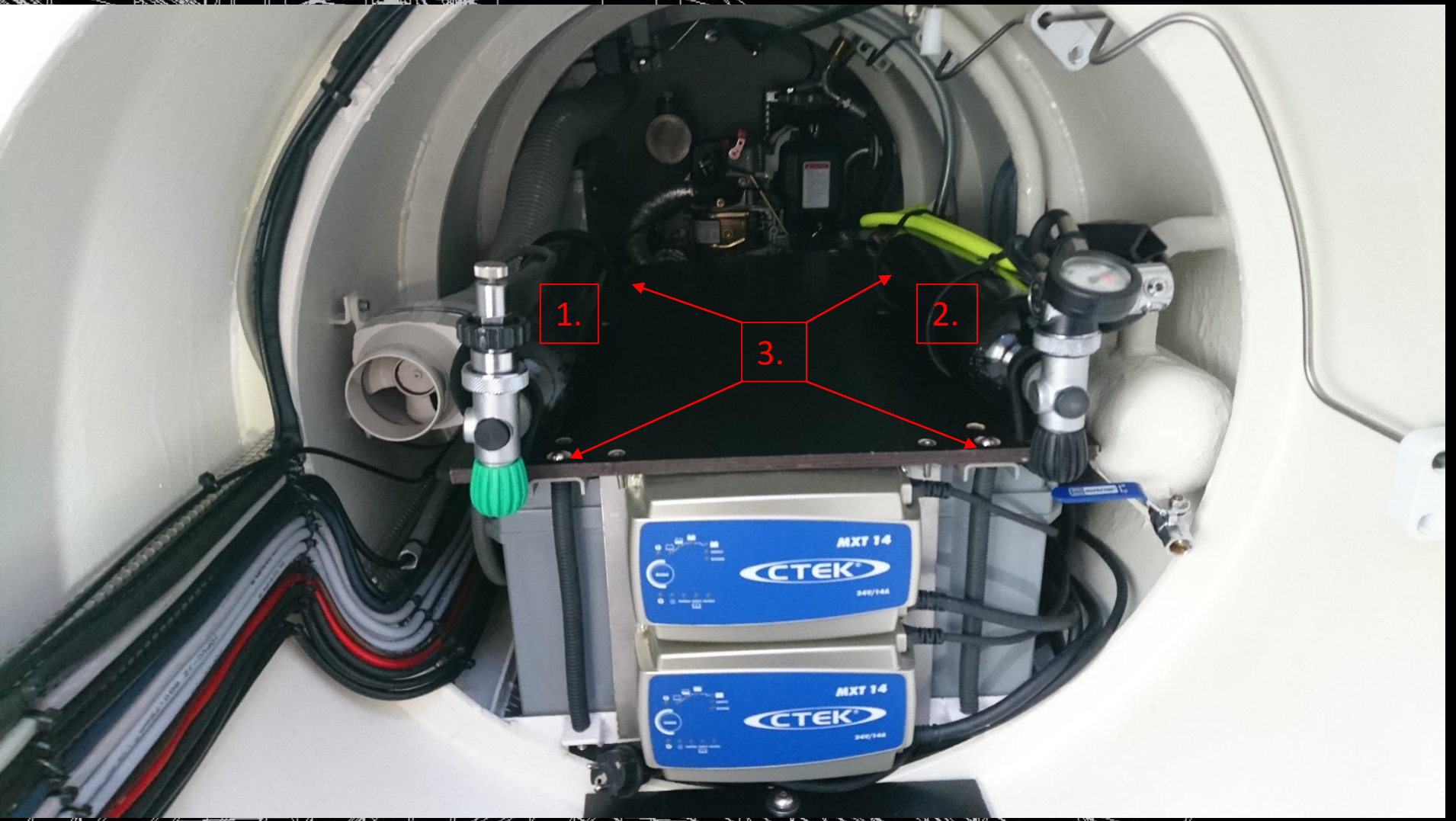
- Shut of ignition(diesel engine)
- Close exhaust valve
- Check pressure (main tanks)
- Check pressure(secondary pressure tanks)
- Be sure to close the hatch
- Use periscope to verify you are out of range of other traffic
- Check pressure(oxygen tank)
- Check pressure(bailout tank)
- Release air from ballast system using bow and stern ballast relief valve
- Use depth meter to control the dive
- Always use a reliable gas analysing system
- Use the inclinometer to control the angle of the vessel(never increase 5°)
- Use ballast blow valve if you dive to fast or being negative
- Blow bow and stern blow valve to surface the vessel.
- Be sure the ballast tanks are full of air before opening the hatch
- Dive safe



10. Maintenance

- Battery removal
- Engine removal
- Motor removal
- Compressor removal
- Oil and lubrication
- Through hull sealing asembly

Battery removal, step by step



1. Remove oxygen tank
2. Remove bailout tank
3. Remove battery top cover nuts(4x M8) and bolts holding the chargers.

Battery removal, step by step

1. Remove rubber isolation(protect from short Circuit)

Battery removal, step by step

”Short circuit could lead to fire and massive danger”

1. Shut of main switch
2. De attach charger cables.

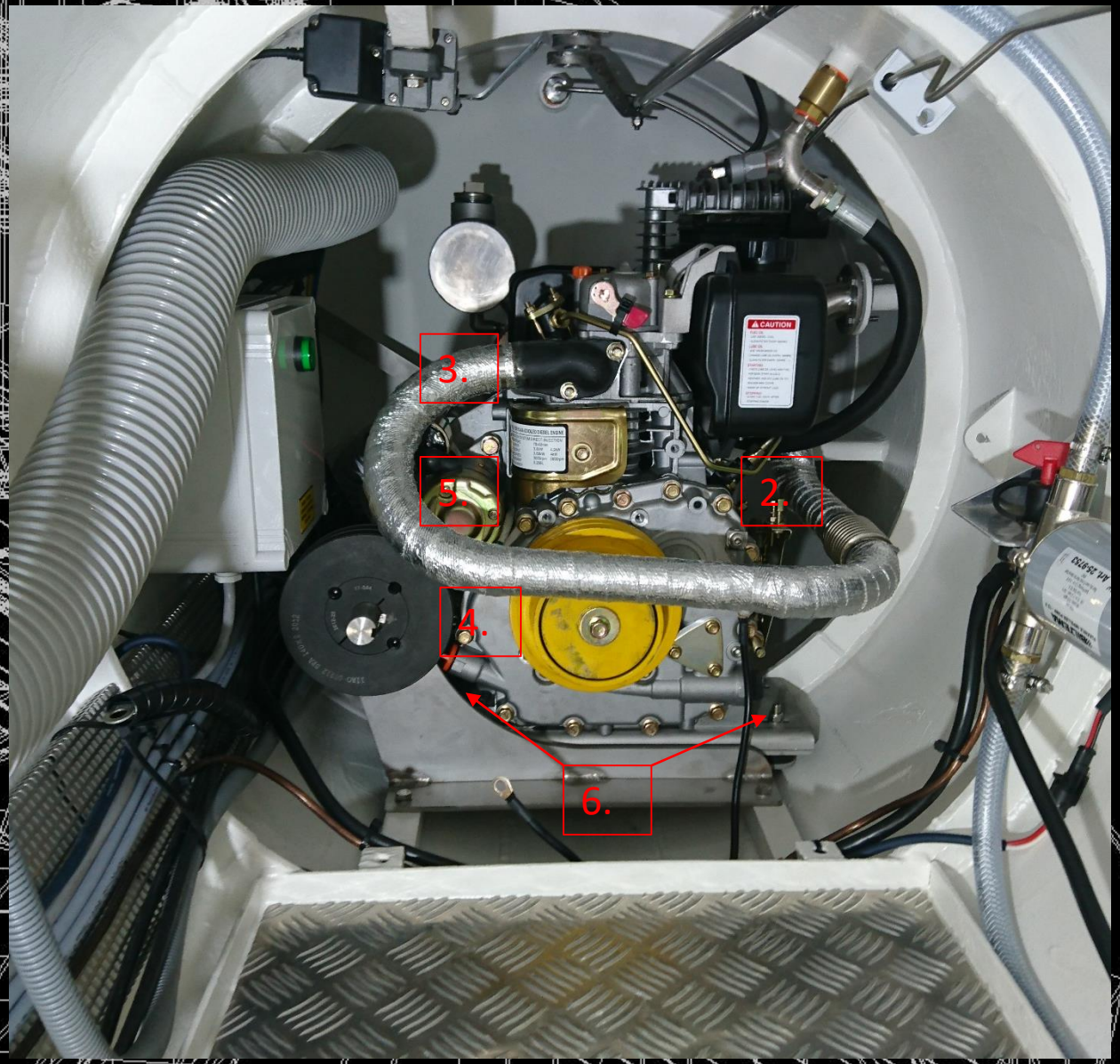
3. De attach ground cables one by one. Be sure to isolate them.
4. De attach +cables one by one, be sure to isolate them one by one.

Battery removal, step by step

Batteries are heavy, dont hurt your back ☺

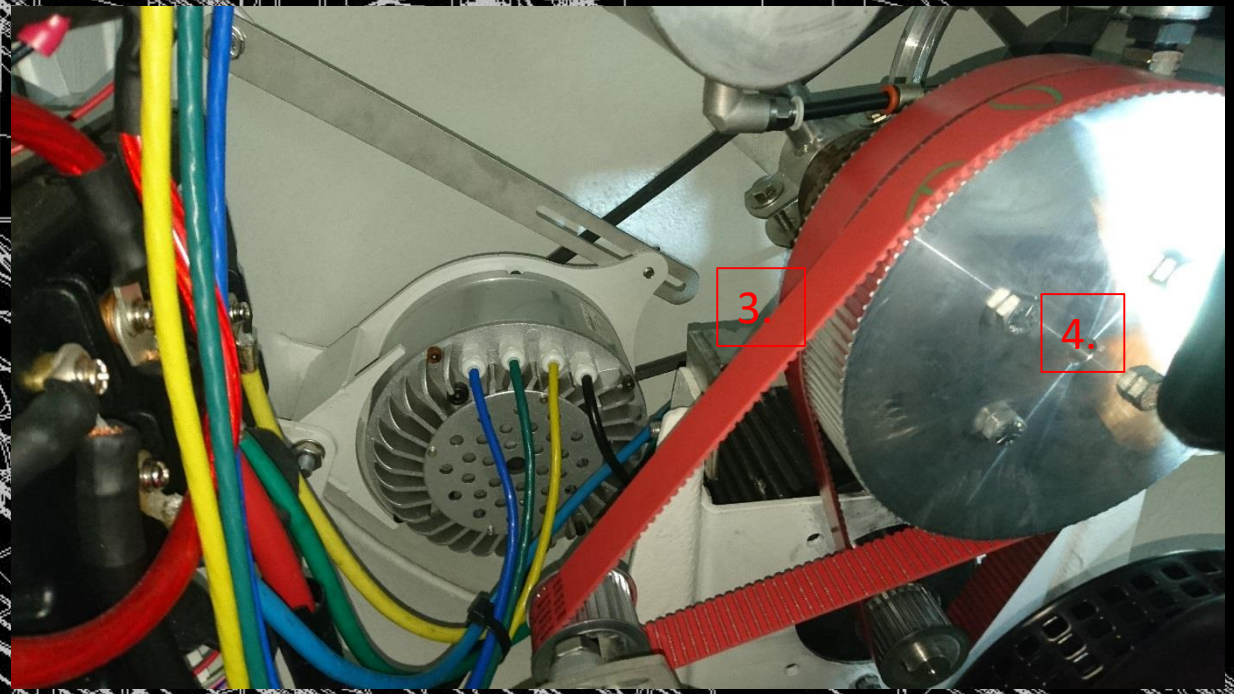
- Remove batteries one by one.

Engine removal, step by step

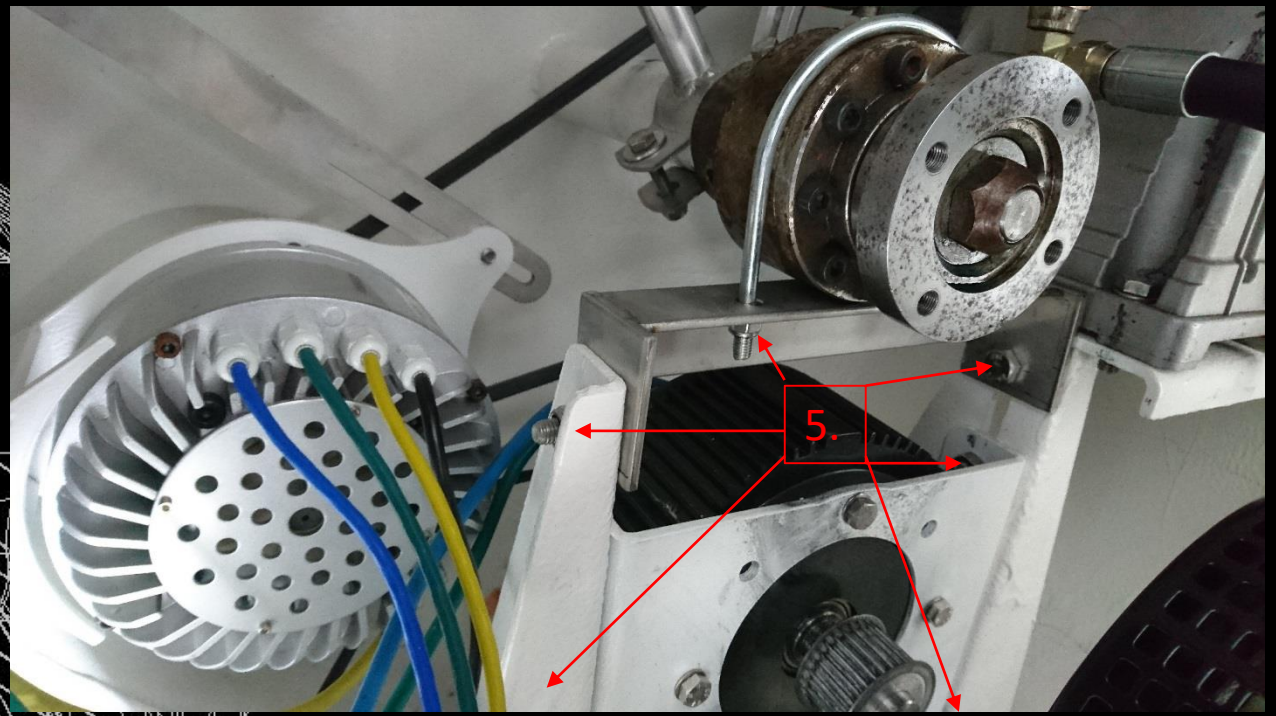


1. Remove batteries(previus step)
2. Remove throttle cable
3. Remove exhaust
4. Remove belt
5. Remove wiring
6. Remove engine(4x M8)

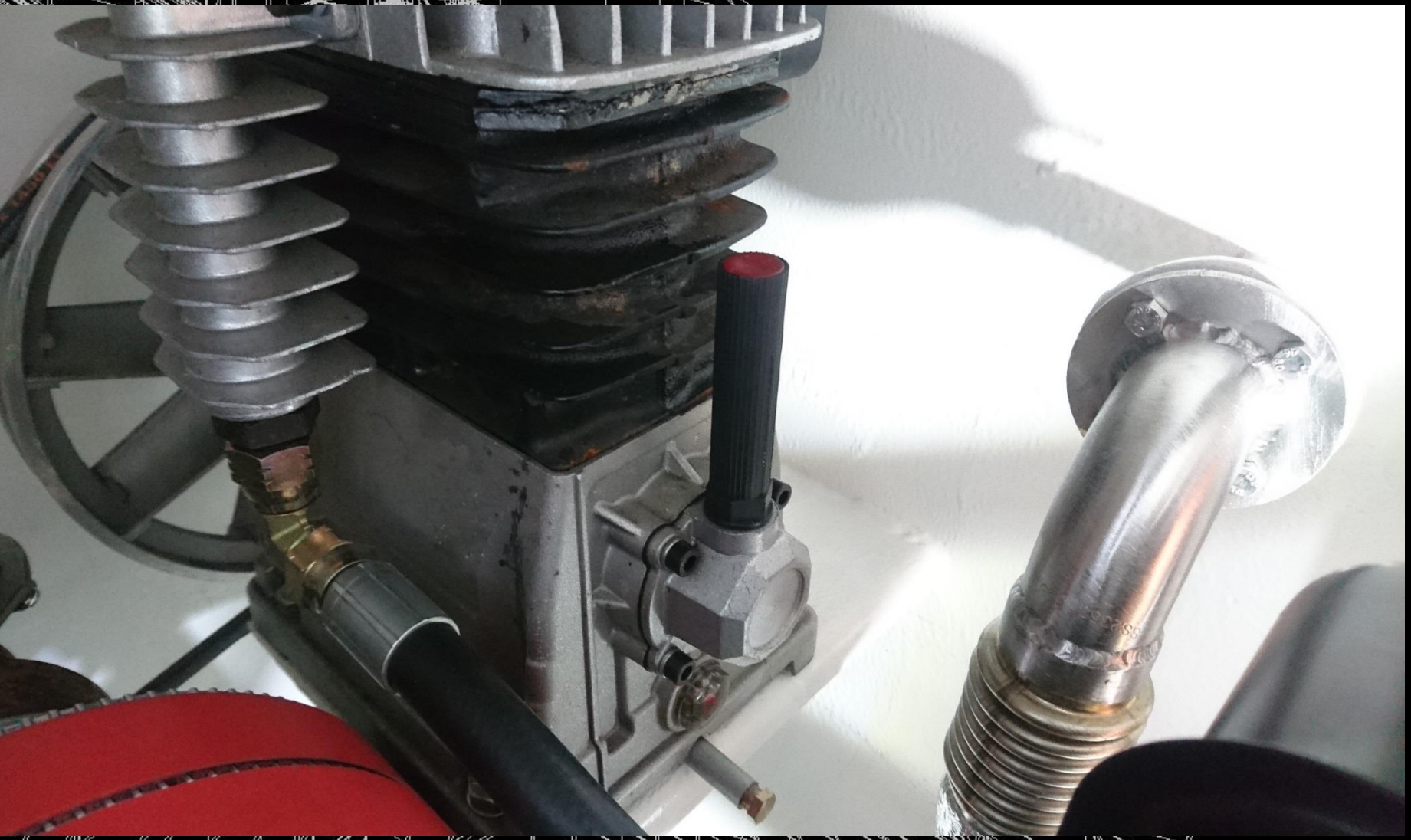
Battery removal, step by step



1. Remove batteries(prevuis step)
2. Remove engine(previus step).
3. Remove drivebelts
4. Remove sprockets
5. Remove motor bolts and bracket(6xM10).



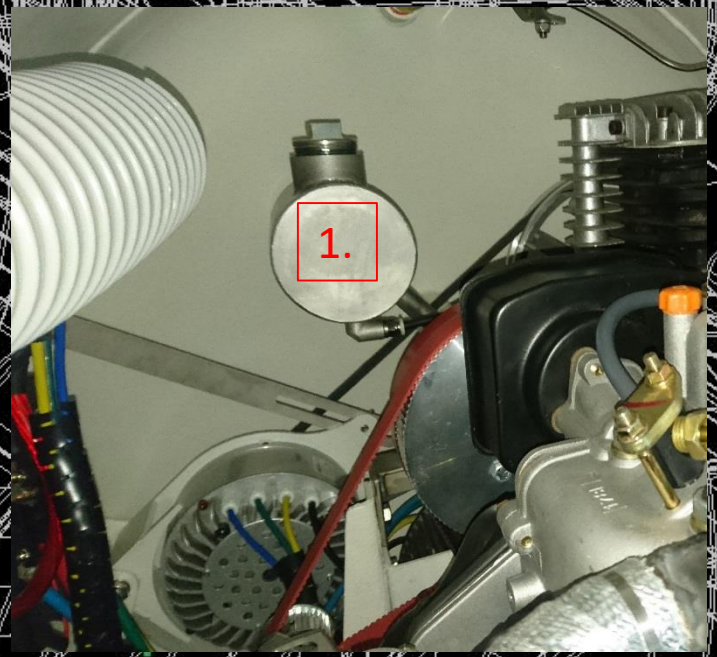
Compressor removal, step by step

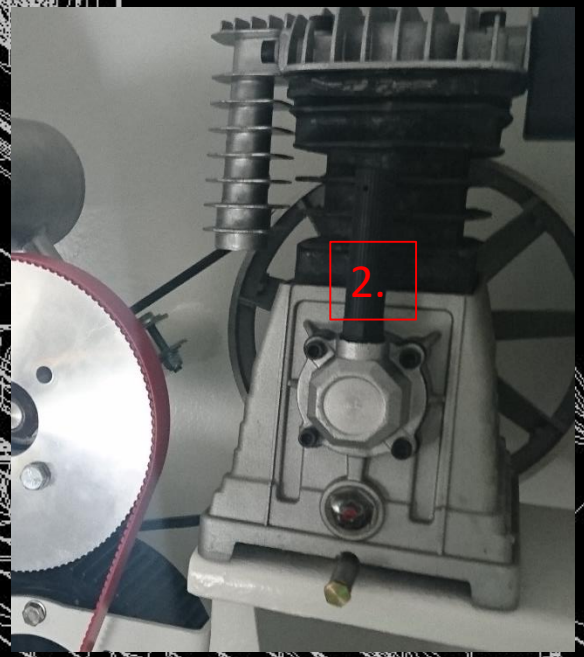


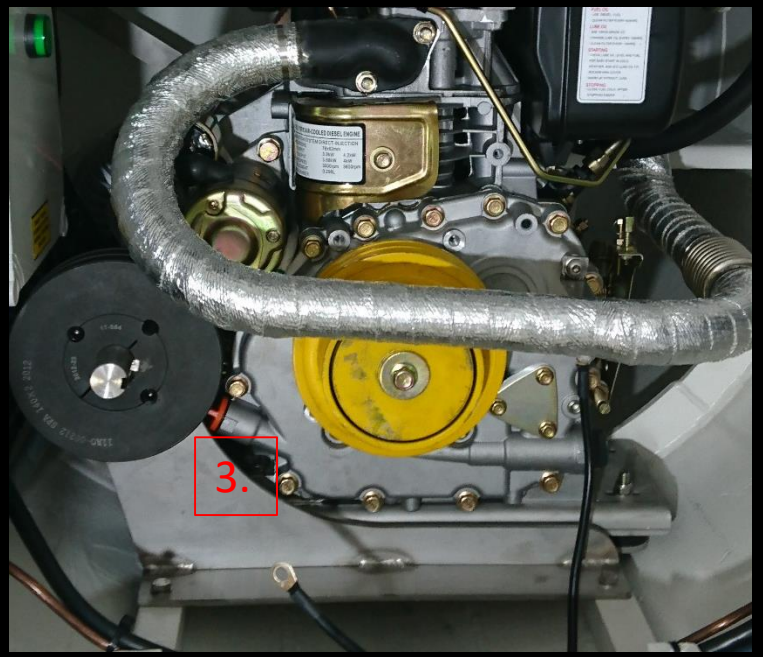
1. Remove batteries
2. Remove engine
3. Release pressure(main tanks)
4. Remove pressure hose.
5. Remove drive belt.
6. Remove bolts(4xM10)

Oil and lubrication

1. Propeller shaft oil(Redline shochprof syntethic gear oil)
2. Compressor oil(”Compoil”SEA30)
3. Engine oil(Shell 10W-40)







Through hull sealing assembly

The sealing system consists of presicion made parts, orings and hydraulic seals.

Hydralic seals need to be raplaced after 3 years of service or when leaking.

Through hull sealing assembly

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