

JOB SAFETY ANALYSIS

Safety Information for AMNO & CO 2015

General Categories:

TASK	POTENTIAL HAZARDS	CONTROLS
1. Using a 3-axis CNC machine	<p>1.a. Physical injury from mechanical machinery</p> <p>1.b. Hearing damage from loud noise</p> <p>1.c. Vision impairment from flying chips or machining fluid</p> <p>1.d. Chemical damage from machining fluid</p> <p>1.e. Physical damage from sharp edges that result from the machining process</p> <p>1.f. Damage to the machine from improper use</p>	<p>1.a.i. Make sure the machine doors are fully closed before operation</p> <p>1.a.ii. Ensure that a qualified supervisor is present</p> <p>1.a.iii. Be familiar with emergency procedures</p> <p>1.a.iv. Know location of, and be prepared to use the emergency stop (red button)</p> <p>1.b/c.i. Wear proper Personal Protective Equipment (PPE) at all times (ear and eye protection)</p> <p>1.d.i. Properly clean finished parts and properly dispose of cleaning products</p> <p>1.d.ii. Wash hands carefully after making contact with machining fluid.</p> <p>1.d.iii. Do not touch face or skin while machining.</p> <p>1.e.i. Deburr/sand finished parts to eliminate sharp edges</p> <p>1.f.i. Preview/simulate machining code in HSMWorks before using the machine</p>
2. Using hand tools (hacksaws, hand drills, files, screwdrivers, hammers, etc.)	2.a. Physical injury such as from sharp edges, blades, drill bits or heavy objects	<p>2.a.i. Make sure tool users are qualified to use hand tools</p> <p>2.a.ii. Make sure tool users use required PPE</p> <p>2.a.iii. Avoid carelessness and do not work when tired</p> <p>2.a.iv. Use the right tool for the task</p>
3. Using power tools (power drills, sanders, soldering irons, etc.)	3.a. Physical injury such as from sharp edges, blades, drill bits or heavy objects	<p>3.a.i. Make sure tool users use required PPE</p> <p>3.b.i. Make sure tool users are</p>

	<p>3.b. Physical injury from improper use</p> <p>3.c. Physical injury from fumes (such as from soldering)</p> <p>3.d. Potential chemical contamination from substances such as lead solder</p>	<p>qualified to use power tools</p> <p>3.b.ii. Avoid carelessness and do not work when tired</p> <p>3.c.i. Use proper ventilation at all times</p> <p>3.c.ii. Use proper PPE at all times</p> <p>3.d.i. Use Reduction of Harmful Substance (RoHS) compliant lead solder, or lead-free solder</p> <p>3.d.ii. Wash hands after use of solder and avoid unnecessary contact with skin and face</p>
4. Using 3D printing technologies	<p>4.a. Fumes and ultrafine particle emissions from melting plastics</p> <p>4.b. Fire risk from high temperatures</p> <p>4.c. Physical injury risk (burns from hot parts)</p>	<p>4.a.i. Use proper ventilation at all times</p> <p>4.b.i. Do not use a 3D printer in close proximity to flammable materials</p> <p>4.b.ii. Have precautionary materials nearby, such as fire extinguishers</p> <p>4.b.iii. Do not operate a 3D printer unattended</p> <p>4.c.i. Wait five minutes after a print is finished before removing it from the printer</p> <p>4.c.ii. Never touch the extruder head during the heating, printing or cooling processes</p>
5. Electrical safety	<p>5.a. Fumes/fires that may result from electrical shorts</p> <p>5.b. Static discharge</p>	<p>5.a.i. Double check power connections</p> <p>5.a.ii. Use proper</p> <p>5.b.i. Always be properly grounded when working with electronics</p>
6. ROV operation in the water	<p>6.a. Potential shorts from improperly sealed connections</p> <p>6.b. Tripping hazards from cables leading into the water</p>	<p>6.a.i. Use both silicone and heatshrink for all connections, both submerged and at the surface</p> <p>6.a.ii. Use isolated power supplies in circuits</p> <p>6.a.iii. Always use Ground Fault Circuit Interrupters</p>

		<p>(GFCIs) when operating near water</p> <p>6.b.i. Warn company members and the public of potential hazards</p> <p>6.b.ii. Put strain relief on all cables and secure systems at the surface</p> <p>6.b.ii. Develop and use a tether management protocol</p>
7. General ROV design and construction	7.a. Potential physical hazards to others and the environment	<p>7.a.i. Implement danger labels for moving parts and sharp edges</p> <p>7.a.ii. Cover/eliminate sharp edges</p> <p>7.a.iii. Use a 25A fuse with 25cm of the power source on the positive line</p> <p>7.a.iv. Put strain relief on all cables and secure systems at the surface</p> <p>7.a.v. In case of large or heavy systems or equipment, use a cart or other form of safe transportation</p> <p>7.a.vi. Design thrusters and propellers to be both inboard and shrouded at all times</p> <p>7.a.vii. Develop and use a safety checklist/protocol</p>
8. Lifting and back safety	8.a. Physical injury from lifting heavy or unwieldy objects 8.b. Potential vehicle damage	<p>8.a.i. In case of large or heavy systems or equipment, use a cart or other form of safe transportation</p> <p>8.a.ii. Always lift from the legs</p> <p>8.a.iii. Never lift a large object with only one person</p>
9. Working at other sites	9.a. Physical damage to an unfamiliar environment	<p>9.a.i. If the site has a supervisor, alert them to the potential hazards and get approval for site usage</p> <p>9.a.ii. Show the supervisor safety features and procedures</p> <p>9.a.iii. Be alert for unexpected testing conditions</p>

10. Performing unscheduled maintenance	10.a. Hazards from poor solutions	10.a.i. Stay calm and focused 10.a.ii. Don't rush into inferior solutions
11. <i>Additional notes</i>		

Site Tasks (Working at Other Sites)

TASK	POTENTIAL HAZARDS	CONTROLS
1. Unloading and unpacking of ROV and support systems	1.a. Back injury from the lifting of heavy shipping crates 1.b. Tripping hazard from packing material	1.a.i. In case of large or heavy systems or equipment, use a cart or other form of safe transportation 1.a.ii. Always lift from the legs 1.a.iii. Never lift a large object with only one person 1.b.i. Always keep work environment clean and free of clutter
2. Pre-operation inspection	2.a. Cuts and laceration from items such as plastics that have shattered during transportation	2.a.i. Always use safety glasses and work slowly but methodically. Do not assume systems are okay without checking them first
3. Dry equipment operations test	3.a. Electrical fire from damaged components 3.b. laceration from potentially moving broken components	3.a.i. Thorough visual electrical inspections, especially of high power components 3.b.i. Check the integrity of components through the application of small amounts of force with the intent to discover broken items
4. Wet equipment operations test	4.a. Risk of electric shock from close proximity of	4.a.i. Always use a GFCI and fuse

	<p>electricity and water, wires that may have become exposed during transport</p> <p>4.b. Risk of accidental human immersion at unfamiliar launch sites</p>	<p>4.a.ii. Always verify the power source is outputting the correct voltage</p> <p>4.b.i. Wear life jacket equipment in particularly hazardous conditions (surface conditions with high wind, rain, etc.)</p>
5. Potential unscheduled maintenance	5.a. Bodily injury resulting from stressful, high stakes situations	<p>5.a.i. DO NOT RUSH. A good solution is better than a poor quick one.</p> <p>5.a.ii. Always have high quality spares on hand and ready to go at a moment's notice</p>
8. Product demonstration (3)	<p>8.a. Tripping hazard from improperly routed tether and control cables</p> <p>8.b. Electric shock</p> <p>8.c. Human immersion in extreme (unfamiliar) environments</p>	<p>8.a.i. Prior to product demonstration construct a mental or physical plan on the locations of particular equipment with the specific location in mind</p> <p>8.b.i. Use GFCI and fuse within 25cm of the battery terminations</p> <p>8.c.i. Wear life jacket equipment at particularly hazardous locations. (surface conditions with wind, rain, etc.)</p>
9. Packing of ROV systems	<p>9.a. Back injury from the lifting of heavy shipping crates</p> <p>9.b. Tripping hazard from packing material</p>	<p>9.a.i. In case of large or heavy systems or equipment, use a cart or other form of safe transportation</p> <p>9.a.ii. Always lift from the legs</p> <p>9.a.iii. Never lift a large object with only one person</p> <p>9.b.i. Always keep work environment clean and free of clutter</p>
10. <i>Additional notes</i>		

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Required Training:

1. Experience with computer controlled manufacturing and other machining techniques
2. Experience with all hand and power tools prior to their use
3. Pool practice sessions are more or less mandatory, as important safety and product information changes day to day

Required Personal Protective Equipment (PPE):

1. Safety glasses and closed toe shoes for all work on or around the ROV and its peripheries, no matter the circumstances
2. Hearing protection for use with power tools and loud machinery
3. Gloves and masks for use with potentially hazardous substances

Other Information:

When unsure, consult MSDS (Material Safety Data Sheets) for unfamiliar substances/materials

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