


6945-050/070

USER MANUAL FOR SUBSEA DIAMOND WIRE SAW Ø630 & Ø770mm

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1 General Information

This manual describes how to handle, operate and maintain the DWS Ø630 and Ø770 mm. The DWS is a cutting machine made for cutting pipes and structure made up of various materials.

With minor modifications to the claw system, the DWS' can also cut objects smaller than the dimensions listed in the specification table in section 2.1 & 2.2. Likewise, the DWS can also be set up to cut other objects than circular, such as chains etc. IKM Technology can provide adapted DWS/Claw interfaces on short notice.

The DWS can be attached to a pipe using its claws and cut through pipes by running the hydraulic motor. It is designed to be handled by an ROV with hydraulic supply and controlled by its manipulator.

For the 6945-070 DWS model, we recommended to fit buoyancy elements to compensate for the weight of the DWS. We also recommend use of a Subsea Lifting Platform/Basket and Hot Stab system to launch/recover the 6945-070 DWS model. IKM Technology can provide tailor made solutions and equipment for this method of launch and recovery.

The DWS clamp/claw should always be clamped onto what will be the fixed or secured side of the cut-object after the cut is complete.

If the DWS is performing a cut on a vertical object and the lower part is the fixed side after cut is complete; then the clamp system shall be installed on the underside of the DWS.

See figure 1 below.

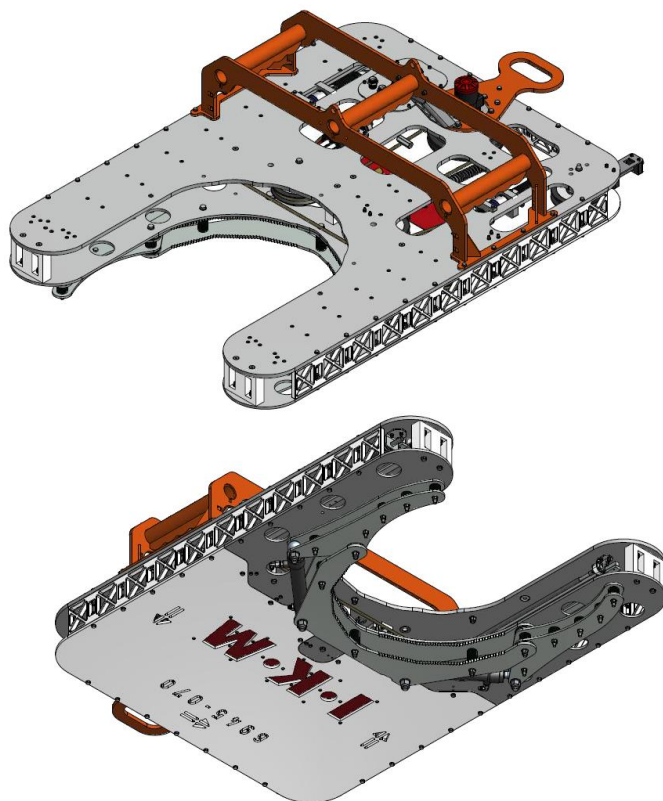



Fig. 1 : Clamp system overview

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1.1 Abbreviations


Abbreviation	Explanation
BSP	British standard pipe
CCM	Cubic centimeter
CW	Clockwise
Deg.	Degrees
DWS	Diamond Wire Saw
JIC	Joint industry council
kg	Kilo gram
LPM	Liter per minute
mm	Millimeter
N m	Newton meter
Req.	Requirement
ROV	Remotely Operated Vehicle
∅	Diameter

Table 1-1 Table of Abbreviations

1.2 References

Document No.	Document Title	Rev.	Issued	Can be found
IKM-1047903	DIAMOND WIRE SAW Ø525 - Ø630 - 6945-050	04	07.02.18	Appendix A
IKM-1047904	DIAMOND WIRE SAW 30" MAX Ø770 - MIN Ø615 - 6945-070	03	07.02.18	Appendix B
6945-P&ID-001	P&ID FOR DIAMOND WIRE	02	07.02.18	Appendix C

Table 1-2 Table of References

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1.3 Document Revision Sheet

Document Revision Sheet		
Revision	Date	Notes
01	07.04.16	Original version
02	07.04.16	Updated maximum cutting diameter
03	19.05.16	Section 7, 8 and 9
04	28.06.16	Re-issued for use
05	07.07.16	Re-issued for use
06	10.11.16	Properties updated
07	31.08.17	Re-issued for use
08	07.02.18	Updated for modifications and upgrades of feed system
09	13.02.18	Re-Issued for use (Properties and description updated)
10	12.05.20	Re-Issued for use

Table 1-3 Table of Revision Changes

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2 Technical Specification

The DWS is designed for use by ROV and for various cutting where a diamond wire surpasses the use of conventional rotating blades.

Hydraulic supply is by means of ROV controlled hydraulic supply.

NB. For successful and efficient cutting the rotation direction and the wire itself needs to be oriented correctly/matched. Both the DWS and diamond wire has directional marking.

Main components for DWS are frame, grabber bars, motor, wire wheels, feed system, claw/clamp system and diamond wire.

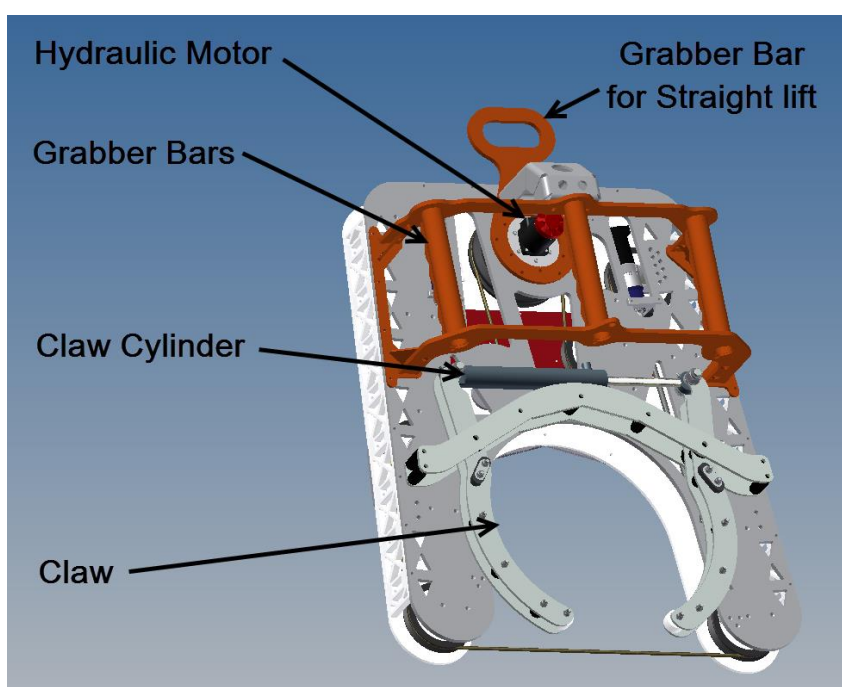



Fig. 2 : Overview of main components


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2.1 Technical Data table for DWS Ø630

Description General	Description Detailed		Value	Unit
Dimensions	Structural Dimensions (L x W x H)		1628 x 1190 x 516	mm
	Cutting diameter		MAX: 630	mm
			MIN: 523	mm
Weight	In air / in water		162 / 105	kg
Hydraulics	Rec. flow	Drive Motor	Min.45 /Max 60	L/min
	Max pressure	Drive Motor	185	Bar
		Feed Motors	210	Bar
		Clamp Cylinder	210	Bar
	Connections*	Drive Motor	3/4"	BSP
		Feed Motor	3/8"	BSP
		Clamp Cylinder	3/8"	BSP

*All hoses are marked. Hydraulic connections can be modified to fit most JIC and BSP couplings.

It is important to specify that the cutting dimensions in the table above are with standard configuration/claws. With minor modifications the saws can basically cut all objects smaller than the dimensions mentioned in the table.

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2.2 Technical Data table for DWS Ø770

Description General	Description Detailed		Value	Unit
Dimensions	Structural Dimensions (L x W x H)		1870 x 1370 x 515	mm
	Cutting diameter		MAX: 770	mm
			MIN: 615	mm
Weight	In air / in water		239 / 159	kg
Hydraulics	Rec. flow	Drive Motor	Min.45 /Max 60	L/min
	Max pressure	Drive Motor	185	Bar
		Feed Motors	210	Bar
		Clamp Cylinder	210	Bar
	Connections*	Drive Motor	3/4"	BSP
		Feed Motor	3/8"	BSP
		Clamp Cylinder	3/8"	BSP

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3 Safety

3.1 General - Operations

Only authorised people and qualified personnel should work on the system and take suitable precautions to prevent any potential injuries. Always adhere to authorised working practices and use the correct tools for the job. To facilitate this, make sure that these are available before commencing the test.

Ensure that the working area is kept clear and uncluttered.

3.2 General - Hydraulic

Do not work on pressurised systems. Hydraulic systems contain a large amount of stored energy when pressurised, therefore the system (including any accumulators) should be de-pressurised, and the power pack switched off, prior to working on the system. Exceptions to this would be system adjustments to components requiring the presence of pressure and/or flow.

Any personnel authorised to work on the system must have a complete understanding of the operation of the hydraulic system, so that they will be aware of any system liable to remain pressurised or hazardous in any other way. Ensure that all personnel are clear of any mechanical/hydraulic system likely to move if pressure to system actuators is released or applied.

Do not attempt to tighten any leaking fittings whilst under pressure. A hose/fitting could rupture, leading to injury from flying components and/or oil jets.

Regularly inspect fittings and pipe-work for mechanical damage. If any damage is found, the item must be repaired or replaced as necessary before pressure is applied to the system. Do not allow damaged fittings to remain in service.

Take care when inspecting, commissioning, repairing or maintaining the system to avoid jets of oil issuing from open orifices; pipe ends etc. if pressure is applied. Particular care should be taken to protect the eyes.

Hydraulic components may be slippery when covered in oil. Ensure that adequate protective clothing and footwear is used.


Any moving component should be treated with caution when the system is pressurised during operation, and especially during on-deck testing and repair. Keep clear of all moving components, and take all necessary precautions to avoid injury when working on these systems by preventing movement of any components likely to cause injury.

3.3 General - Mechanical

Ensure that all the relevant guards are in place before applying power to the system. The power must be turned off and any potential movement prevented before removal of any guard.

Beware of and keep clear of all moving components. Do not work on the system whilst power is applied, or if there is any potential for components to move.

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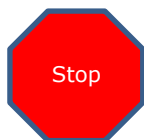
Ensure that all load bearing components are adequately and regularly inspected. If damage is found the component must be repaired/replaced as necessary. Do not allow damaged components to remain in service.

Always ensure that items are correctly and adequately supported before removal, and that authorised lifting equipment and procedures are used.

Note: trying to lift heavy components in an awkward position by hand without the assistance of correct lifting equipment, or lifting any component without adopting the correct stance, can lead to serious injury.

Ensure that when working within or underneath the machine that your presence is known to your supervisor. If working underneath the machine, always ensure that there are no loose or unsupported assemblies, components or tools above.

3.4 Special caution



The DWS can cut through all possible objects if started in vain. It is utterly important to keep the tool disconnected until it is intended to be used and also keep safe distance during testing.


Rotating Machinery - Caution when operating and testing the tool as the DWS may damage personnel and equipment if it is not secured properly.

Note! The DWS might cut through a human leg in seconds.

Keep clear from the diamond wire as it may grab onto clothes etc.

High pressure (210bar) - safety glasses and protect skin from hydraulic oil if any leakage should occur.

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4 Operational Description

The following description is a generic description of preparation and use of the DWS. Customers are advised to adapt the following information to their own specific operations and specific work area.

4.1 Preparation on the vessel prior to operations

- Unpack all parts and check for transport damages.
- Verify that all parts on equipment list are present.
- Check that the clamps are mounted on the correct side of the DWS to ensure it is clamped on to the fixed side of the cut-object after the cut is complete.
- Install ROV handle in the required position.
- Check that the compensator is $\frac{3}{4}$ full. If not; refill and make sure to bleed all air out. The compensator shall be filled with gear oil Texaco Geartex EP-C SAE 80W-90 or equivalent.

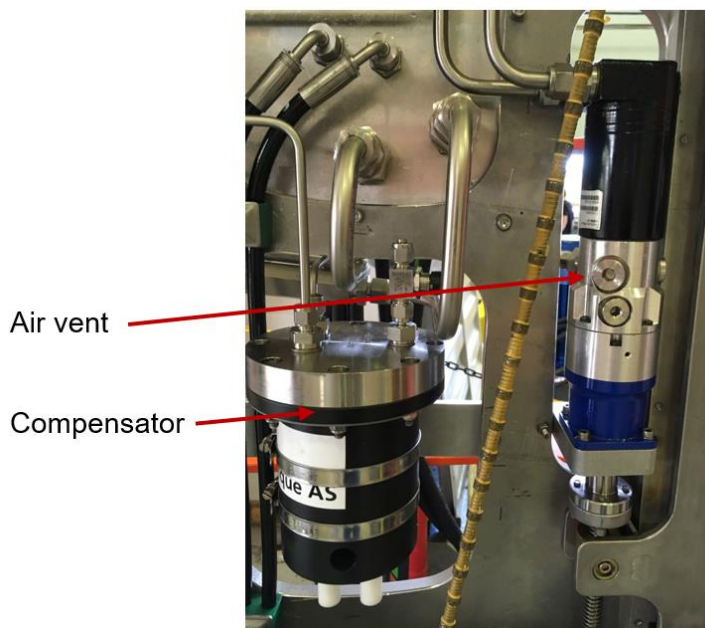


Fig. 3 : Air vent / Comp. access

- Connect all DWS hydraulic hoses as appropriate. All connections is marked, and can be seen in Fig. 4 : Hydraulic hose connection panel.

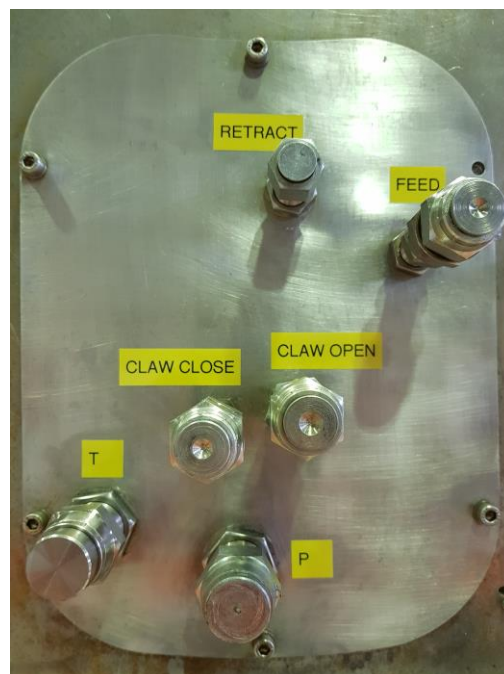



Fig. 4 : Hydraulic hose connection panel

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- Verify that the ROV hydraulic supply is correctly adjusted.
- Verify correct hydraulic connections; Motor Drive function must be connected to a high-flow rated valve, (typical more than 50 l/min flow capacity under load). Clamp and feed functions are typically connected to low-flow valves.
- If DWS is used with stab systems: Dual Valve-stab is used for the main motor. Quad (4P) stab is used for clamp and feed function.
- If the host ROV do not have built-in flow measurement for the valve operating the main motor, an external flowmeter should be installed in the circuit to monitor the hydraulic flow. Monitoring and maintaining correct hydraulic flow during cutting is a key objective for successful cutting.
- Feed flow rate can be restricted with valve shown in picture below. This is set to fully open by default, and feed is controlled by the Tool/ROV operator in small increments.

Feed adjustment

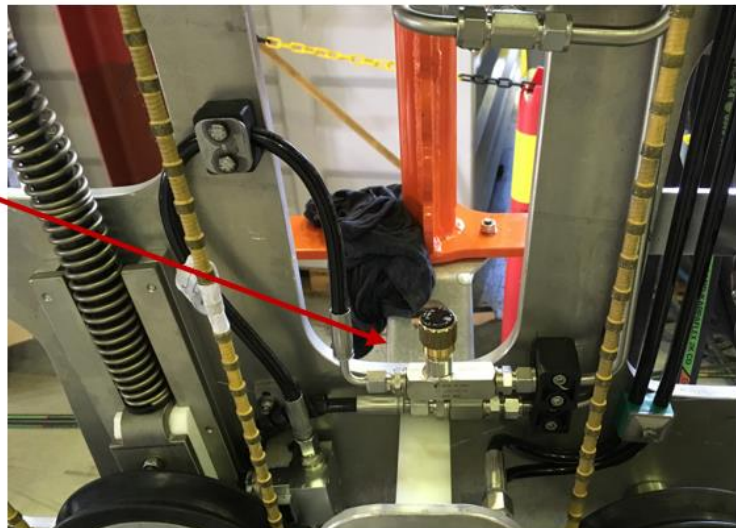



Fig. 5 : Feed flow adjustment

- Perform function test of tool functions; Clamps, Feed and motor. Note that rotation of main motor is set to operate in only one direction as the diamond cutting wire will only work as intended when moving in the right direction over the object to be cut. A directional valve in the hydraulic circuit will prevent motor to turn in opposite/"wrong" direction.
- Max rotation speed, ("free-running"), of the main motor/cutting wire should only be done for short/brief moments on deck.
- If the DWS, (Ø630), is carried from deck with the ROV secured in manipulator, additional hang-off securement point/bracket against the ROV framework should be used in addition to manipulator during launch and recovery.
- It is not recommended to launch the DWS Ø770 model with ROV from deck. This tool should be operated via stab systems and launched by crane or in a subsea lift basket. Additional buoyancy for easier handling by the ROV is recommended.
- Commence operation as per operator's procedures.

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4.2 How to operate DWS for successful cutting - PLEASE READ THIS !!!

For successful cutting with diamond wire, the wire needs to act as a file against the object to cut. The tricky part is to operate the feed-function to make the wire engage with enough but not too much - force/pressure against the object to be cut.

Excessive feed/force will *not* increase the cutting speed, but are more likely to damage the wire lead wheels or break/snap the diamond wire.

To maintain a suitable wire pressure against the object, observing the hydraulic flow to the main drive motor is an essential parameter to watch during cutting.

It is difficult to advise a specific “correct” flow, because of the many variables that may occur in different settings, (type of ROV/control valve, stab-systems, hoses length and size, dimension/shape and material of the cut object etc.).


A good approach is to read the flow at full wire speed before the wire engages against the object and use this as a reference point.

The flow can typically be +/- 55 l/min with the wire “free spinning”.

Gently operate the feed function to engage wire against the object and apply pressure/force to reduce the flow with +/- 5 l/min from free-spinning. Let the wire work - *be patient* - until flow is increasing again - then operate the feed function again in small steps to reduce flow.

And repeat. And repeat. And repeat.....

Another parameter to observe is the hydraulic pressure to the tool. Very often the pressure reading will drop plus oscillate and pulse when the wire is free spinning. If this is the case, the pressure will typically increase plus become more stable as the feed function pushes the wire against the object.

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4.2.1 Wire tension/pressure illustration

Observing the diamond wire angle over the object during cutting is also a very good indicator of correct applied force/feed. Aim to let the wire run over the object in a smooth bow-shape.

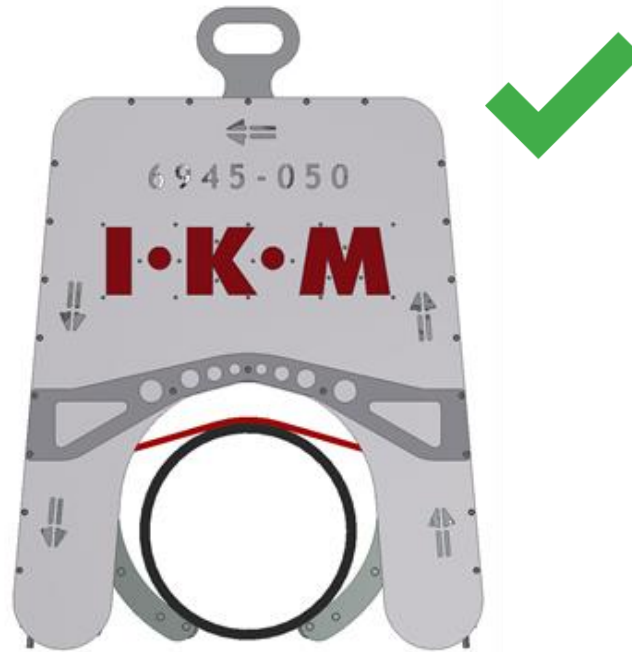


Fig. 6 : Correct tension



Fig. 8 : Insufficient tension

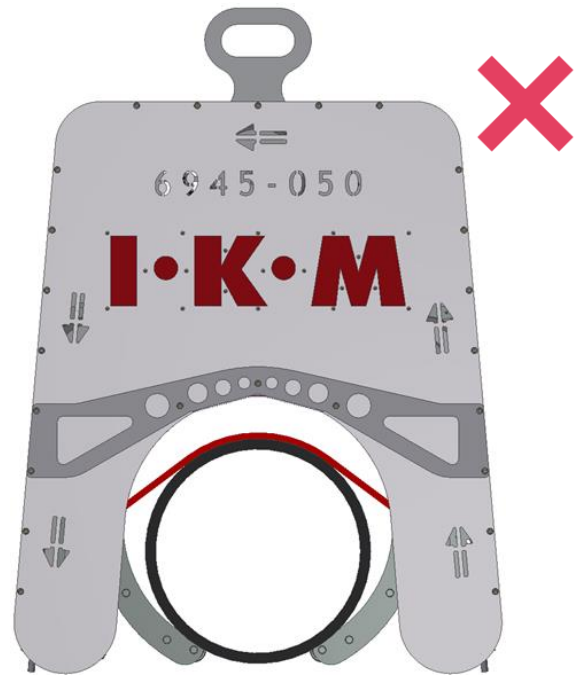



Fig. 7 : Too much tension

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4.2.2 General rules and advice

Do **NOT** hold on to the DWS with the ROV manipulator during cutting. Once the tool is clamped on the object and confirmed secure; leave the “Clamp Close” function activated and let go of the tool.

Generally, a hydraulic pressure of 185 Bar will be sufficient to perform successful cutting.

However, if the object to be cut is very challenging, (pinching/stalling wire), pressure may be increased to 210 bar. Do not free spin wire at this pressure.

4.2.3 Diamond Wire Lifetime versus Efficiency

The efficiency of the diamond wire will drop dramatically towards the end of the wire lifetime.

The manufacturer advises that 80% of the lifetime is used in 20% of time. The remaining 20% lifetime will take 80% of the time.

4.3 Step by Step Procedure

4.3.1 General

Perform SJA/Toolbox talk for the operation as required by client/ROV contractors own procedures.

4.3.2 Operation

The following steps are to be regarded as guidelines for operation. Operator of the tooling must adapt the steps into their own operations procedure.

- **Did you read section 4.2? If not - do it now.**
- **Interface towards ROV manipulators:**
 - Only Grabber Bars or Grabber Bar for straight lift to be used by the ROV manipulators.
 - These are the only ones painted orange.
 - Do not grab tool on any other items/locations with the manipulators.

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- Before cutting:
 1. Open Clamps fully.
 2. Retract feeding mechanism.
 3. Lift by “Grabber Bar for Vertical Lift” for positioning onto horizontal oriented pipe.
 4. Lift by “Grabber Bars” for positioning onto vertical oriented pipe.

- Install DWS on pipe/object:
 1. Secure pipe to be removed to avoid damage on equipment.
 2. Grab saw by its lifting points.

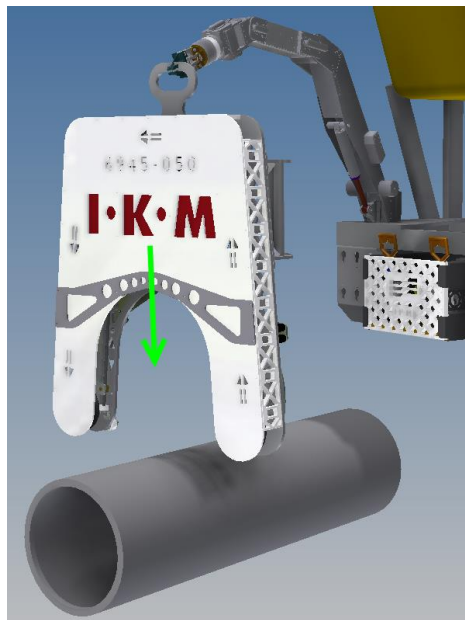



Fig. 9 : Cut on horizontal oriented pipe

3. Place U-shape on saw on top of cut object.
4. Activate Claw Cylinder so the Claw grab onto the pipe. The Claw shall be placed on the fixed side of the cut. Ensure claws are mounted on the correct side of the DWS in regards to orientation.

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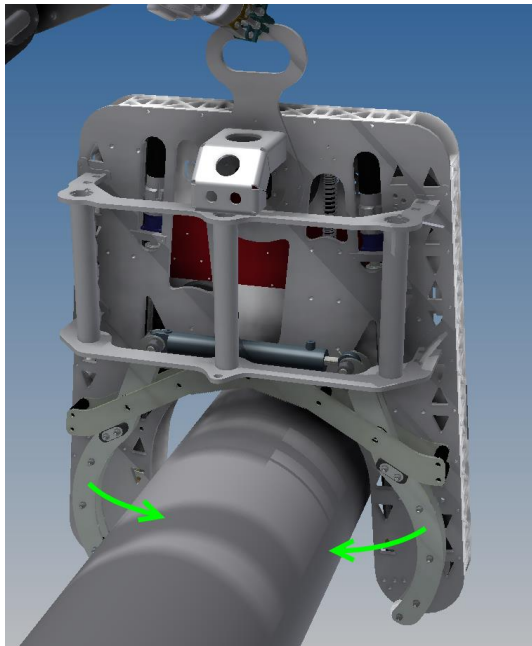


Fig. 11 : Engagement of claw cylinder

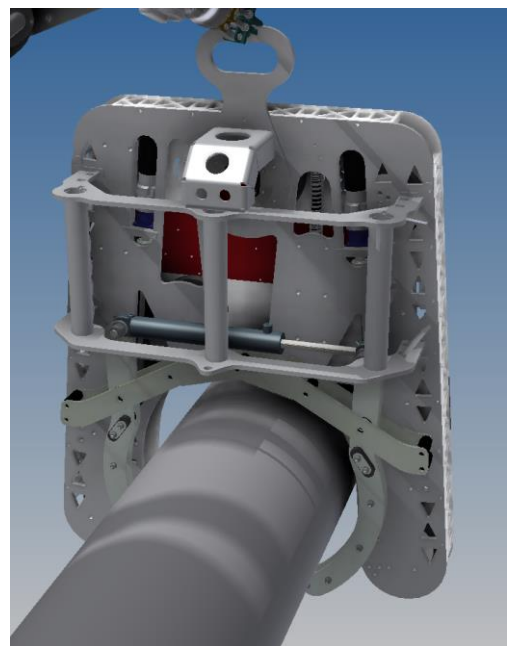



Fig. 10 : Claw closed

5. ROV to release manipulator from grabber bar.
6. Start Drive Motor to start the running of the diamond wire.
7. Operate feed function as described in “How to operate DWS for successful cutting - PLEASE READ THIS !!!”
8. Let the diamond wire cut completely through the cut-object. Verify that the cut wire is actually 100% through the cut-object




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9. Retract feeding mechanism. Keep Drive motor running while retracting feed in a controlled manner. Observe closely that the diamond wire does not snag or get caught by the separated object.
 - **If wire gets stuck when retracting cut wire:**
 - Switch direction of the Feed Motors to “feed” to release it while main drive motor is still activated. Once diamond wire start running at high speed it should be free and feed function can be attempted retracted again. Repeat as required.
 - **If not able to release diamond wire from cut object:**
 - Stop main drive motor and cut the wire. Gently pull it out of the tool and replace with new cut wire on deck.
10. Stop Drive Motor when cut wire is confirmed retracted and confirmed clear of the cut
11. ROV to grab onto a grabber bar.
12. Open the Clamps.
13. Lift off the DWS.
14. The DWS is now ready for a new cut or to be recovered.

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5 Maintenance

5.1 After Operation

- Inspect tool for damage after use
- Clean tool with fresh water
- Check for hydraulic leaks. Cuts or sharp bends indicates that the hoses should be replaced.
- Check/Fill Gear Housing with grease after use (Fig. 13 : Grease nipples and plug location);
- Plug to be removed before greasing
- Housing is filled when grease expand through plug hole
- Attach plug after greasing.
- Grease all support wheels. Grease will escape through bottom shaft/wheel flange when full.
- Apply a thin layer with external corrosion protection.
- In case of field repairs, please consult the attached manufacturer's information.

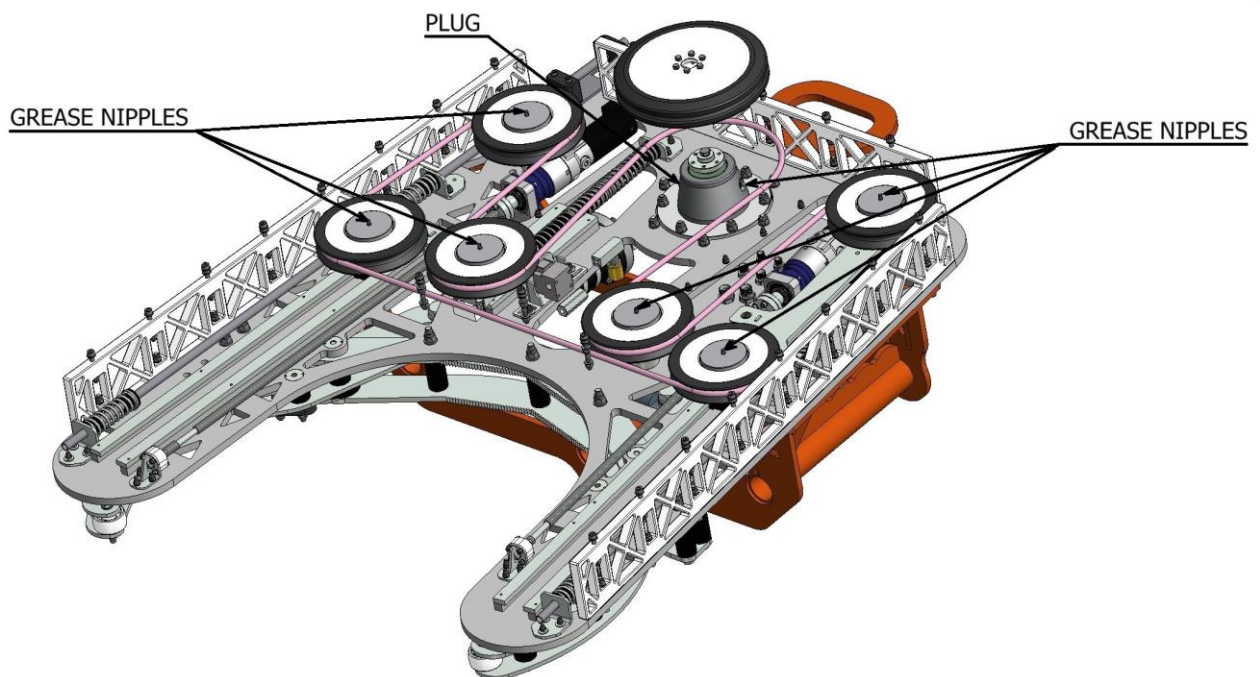


Fig. 13 : Grease nipples and plug location

When the diamond wire is worn out, replace with new wire.

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5.2 Wire Replacement

5.2.1 Wire wear indicators

- Decrease in cutting efficiency/ increase in time is an indicator that the wire is going towards its lifetime and needs to be replaced.
- Excess wear can be observed by inspecting and comparing a used and a new wire
 - A key indicator is lack of abrasive grain protrusions and missing grains on the wire
 - Feel for roughness/smoothness by hand.

5.2.2 Wire removal

1. Place Saw with ROV grabber bar down.
2. Drive Feed Motors until feeding mechanisms are fully retrieved.
3. Disconnect/shut off hydraulic power for the saw to avoid damage on personnel or equipment.
4. Remove all covers on the underside of the DWS.
5. Pull back spring loaded wheel and pull out the wire. The wire is now free/released and can be pulled out.

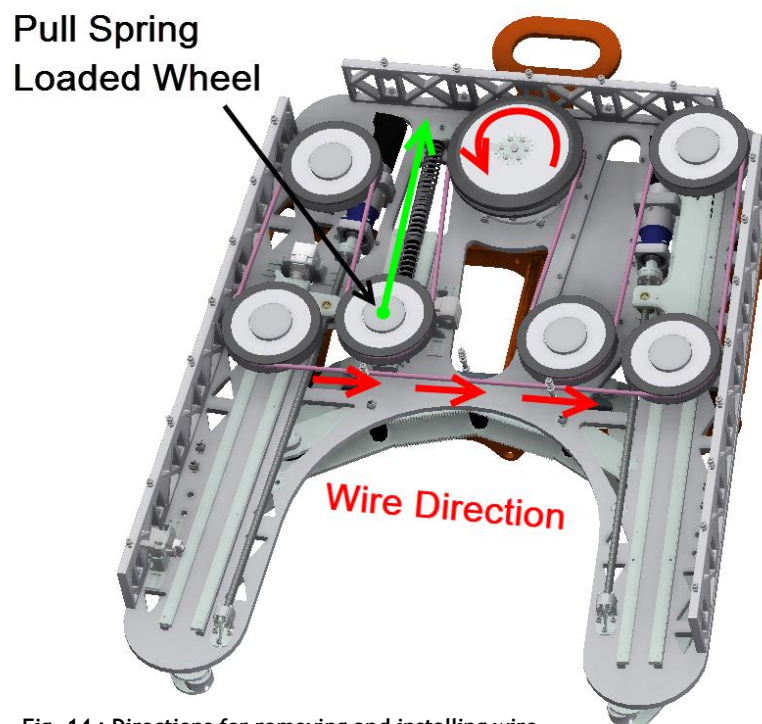



Fig. 14 : Directions for removing and installing wire


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5.2.3 Wire installation

1. The rotation direction and the wire itself needs to be oriented correctly. Both the DWS and diamond wire has directional marking.
2. Place new wire around every wheel except one (not the spring loaded wheel) with wire direction as shown on Fig. 14 : Directions for removing and installing wire.
3. Pull back spring loaded wheel by pulling the diamond wire and place the wire onto the remaining wheel. Remove all covers on the underside of the DWS.
4. Re-install covers.

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6 Spare Part List

- Diamond wire, For 6945-050: IKM-1047900, For 6945-070: IKM-1047901
- Hydraulic hoses and connections.
- Nuts and bolts.
- 1 x Drive Motor Unit 7644-011
- 2 x Hydraulic cylinder 4856 (For 070-model)
- 1 x Hydraulic cylinder DVLRS-50-25-340 (For 050-model)
- 1 x Feed Motor unit 6945-051
- 3 x Wire Support Wheels 6945-101,
- 1 x Flow Control Valve 672878 QV-06/1, IKM-1047833


Please see attached drawings for a complete spare part list, Appendix A and B.


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7 Appendix A


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8 Appendix B

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9 Appendix C