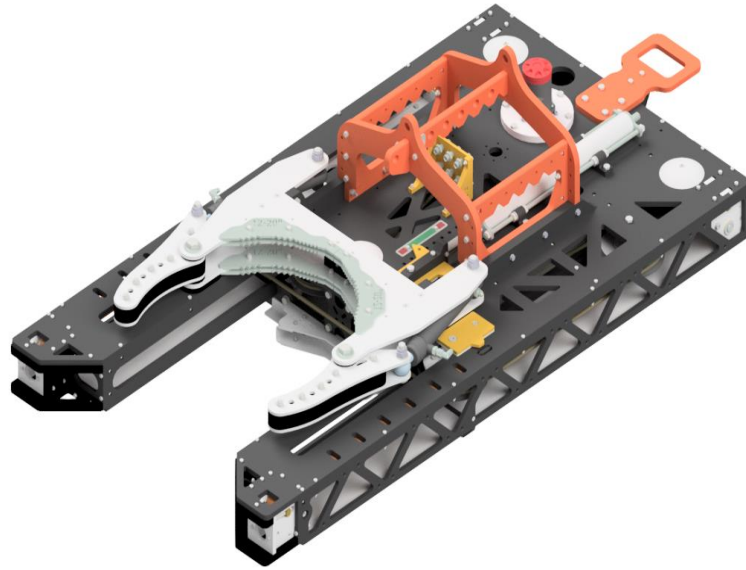


SUBSEA DIAMOND WIRE SAW

250-510mm


USER MANUAL




Rev.	Client Rev.	Issue Date	Description	Prepared by	Checked by	Approved by
01d	-	16.07.2024	Issued for review	TO		
01c	-	13.04.2023	Issued for review	AR	TL	TL
01b	-	05.06.2022	Issued for review	AR	KG	KG
01a	-	21.04.2022	Issued for review	AR	KG	KG

Document Title:

SUBSEA DIAMOND WIRE SAW USER MANUAL

 IKM IKM Subsea AS	System:		Area:		TAG:		
	Document No.: 55166001-IKM-O-MA-002					Rev.: 01d	
	Client Document No.: NA					Client Rev.: NA	
	<i>Note: Where not applicable use NA</i>						
Contract No.: Insert	CTR No.: NA	Project Code	Originator Code	Discipline Code	Document Code	Sequence Number	Total No. of Pages: 43

SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 2 of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

Section Title / Document Title	User Manual Section	Format	Revision	Notes/Comments
<i>Introduction</i>	1	<i>pdf</i>	<i>01d</i>	
<i>Main Data</i>	2	<i>pdf</i>	<i>01d</i>	
<i>Safety</i>	3	<i>pdf</i>	<i>01d</i>	
<i>Operation Manual</i>	4	<i>pdf</i>	<i>01d</i>	
<i>Maintenance Manual</i>	5	<i>pdf</i>	<i>01d</i>	
APPENDIX	6	<i>pdf</i>	<i>01d</i>	
<i>Spare Parts List</i>	A	<i>pdf</i>	<i>01d</i>	
<i>Hydraulic Schematic</i>	B	<i>pdf</i>	<i>01d</i>	
<i>DWS GA-Drawing</i>	C	<i>pdf</i>	<i>01d</i>	




SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 3 of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

Table of Contents

1. General Information	5
1.1 Abbreviations	5
2. Main Data.....	10
2.1 Main Components	10
2.2 Technical Specifications	11
3. Safety	12
3.1. General.....	12
3.1.1. Operation.....	12
3.1.2. Hydraulic.....	12
3.1.3. Mechanical.....	13
3.1.4. Special Caution	13
4. Operation Manual	14
4.1 Preparation on the vessel before operations.....	14
4.2. How To Operate DWS for Successful Cutting	15
4.2.1. Wire Tension.....	16
4.2.2. General Rules and Advice.....	16
4.3. Cutting Procedure	16
4.3.1. General	16
4.3.2. Operation.....	16
5. Maintenance Manual.....	19
5.1. Post Operation.....	19
5.2. Wire Replacement.....	20
5.2.1. Wire Wear Indicators	20
5.2.2. Wire Removal	21
5.2.3. Wire Installation.....	26
5.3 Drive Chain.....	30
5.3.1 Main Adjustment	33
5.3.2 Second adjustment	35
5.3.3 Chain Replacement	37
5.3.4. Chain Lengths	39
6. APPENDIX.....	40
APPENDIX A	41
APPENDIX B	42

SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 4 of 43	 IKM Subsea AS
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

APPENDIX C43

SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 5 of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

1. General Information

This manual gives an overview of how to handle, operate and maintain the DWS 250-510mm. The DWS is a cutting tool made for cutting pipes and structures composed of different materials.

Optional parts for the claw system are available if objects with smaller dimensions than specified in Table 2.1 are to be cut. Additionally, the DWS can also be configured to cut other objects than circular such as chains, etc.

IKM Subsea provides adapted DWS/Claw interfaces for the DWS standard range see Figure 1.3. The DWS is also equipped with a manometer, monitoring the pressure. See Figure 1.4 for the correct manometer hydraulic connection.

The DWS is attached to the desired cutting object using its claws conducting the cutting operation using a hydraulic motor, which spins the diamond cut wire. It is designed to be handled by an ROV with a hydraulic supply, using the manipulator to position the DWS on the desired cut location.

For the DWS 250-510mm it is recommended to fit buoyancy elements to compensate for the weight of the DWS. It is also recommended to use a Subsea Lifting Platform/Basket and a Valve Stab system to launch/recover the DWS. IKM Subsea can provide tailor-made solutions and equipment for this launch and recovery method.

Note! The DWS clamps/claws shall 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 conducting a vertical cutting operation, where the lower part of the cut object is fixed, then the DWS must be oriented upside down, with the side containing the see-through covers facing upwards. To facilitate handling in this orientation, a second handle must be installed. Please see Figure 1.1.

Figure 1.2 & Figure 1.3 shows an overview of the clamp system.

1.1 Abbreviations

Abbreviations	
BSP	British Standard Pipe
CCM	Cubic Centimeter
CW	Clockwise
DWS	Diamond Wire Saw
JIC	Joint Industry Council
LPM	Liter per Minute
ROV	Remotely Operated Vehicle

Table 1: Table of Abbreviations

Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022
Valid From:	16.07.2024	Rev.nr:	01d
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS




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Figure 1.1: Second handle installed for vertical cutting

SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 7 of 43	 IKM IKM Subsea AS
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
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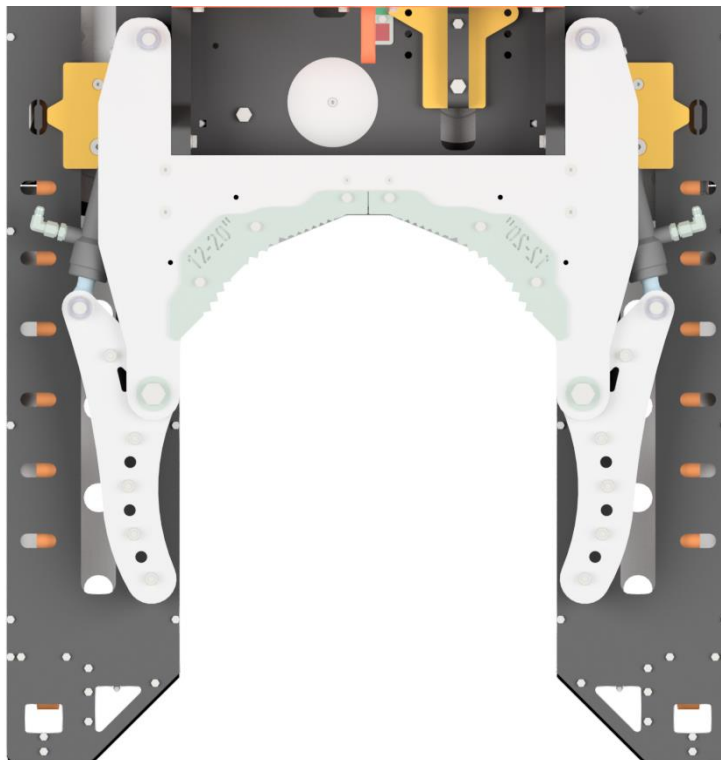
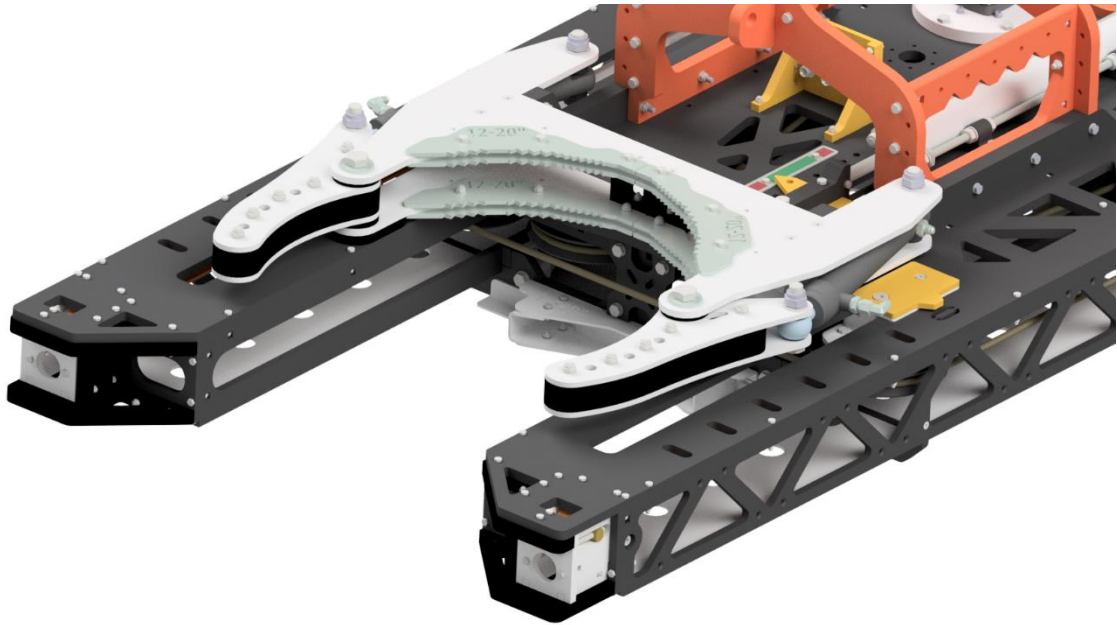



Figure 1.2: Clamp system overview

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SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 8 of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

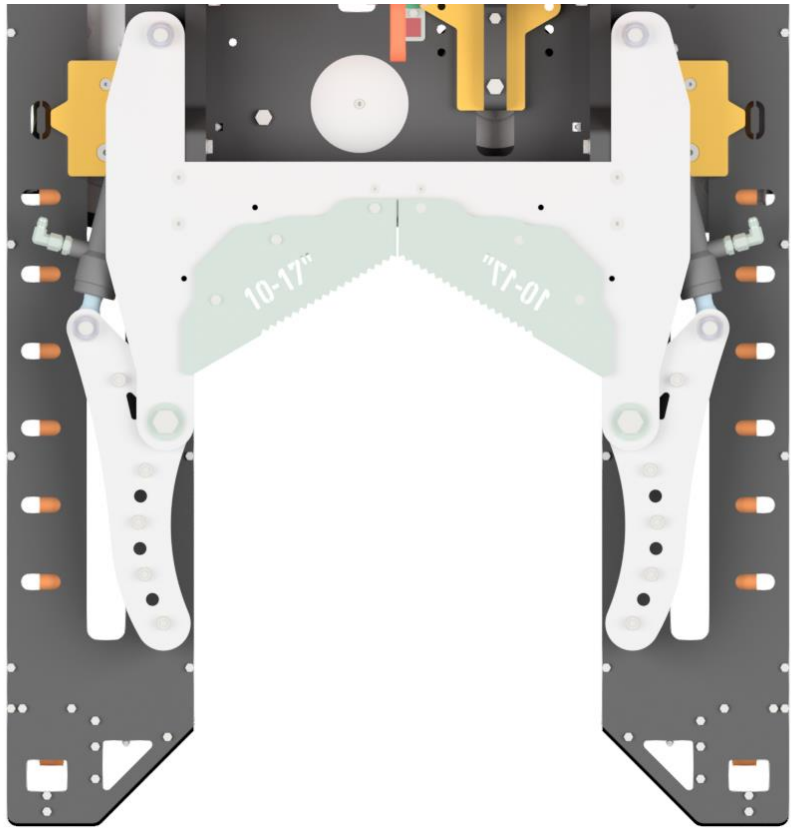



Figure 1.3: Clamp system add on overview

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SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 9 of 43	 I·K·M IKM Subsea AS
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
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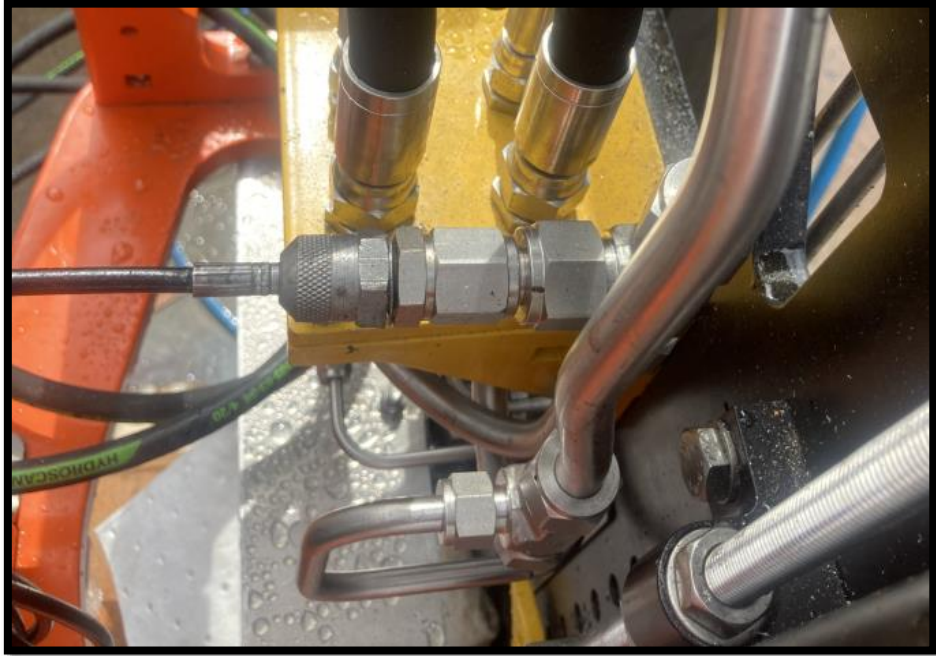



Figure 1.4: Manometer hydraulic connection

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SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 10 of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
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2. Main Data

The DWS is designed for conducting various cutting operations where conventional rotating blades are insufficient

The hydraulic supply is through the ROV-controlled hydraulic supply.

Note! For successful and efficient cutting the direction of rotation and the wire itself needs to be oriented correctly. The direction of rotation is marked on both the DWS and the diamond wire.

2.1 Main Components

The 250-510mm DWS has the following main components:

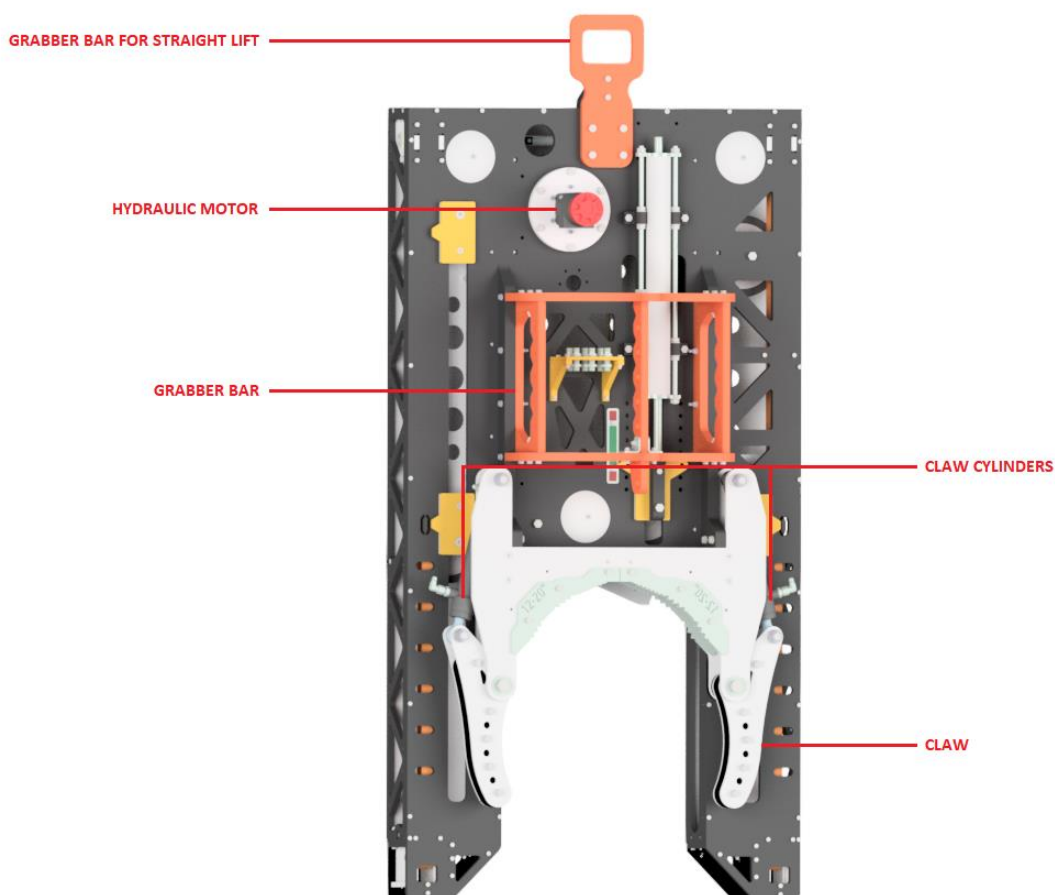



Figure 2.1: Overview of main components

SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 11 of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

2.2 Technical Specifications


The technical data for the 250-510mm is given below in Table 2.1.

Specifications	
Type	Subsea Diamond Wire Saw
Model	Ø250 – 510 mm
Part Number	IKM – 6011345
Dimensions L X W X H	1937 X 1020 X 556,5 mm
Cutting Diameter Min/Max	250/510 mm
Motor	46 cc
Motor Connection	2x 3/4" JIC
Feed Connection	2x 9/16" JIC
Clamp Connection	2x 7/16" JIC
Working Pressure	185 Bar
Hydraulic Flow Min/Max	50-55 LPM
Weight in Air	240-270 kg
Weight in Water	160 kg
RPM Max	750 – 950
Number of Hydraulic Connections	6 Hoses (Three Functions)

Table 2.1: Technical specifications

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

It is important to specify that the cutting dimensions in Table 2.1 are with standard configuration. As mentioned in Chapter 1, optional parts for the claw system are available if objects with smaller dimensions than specified in Table 2.1 are to be cut.

SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 12 Of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

3. Safety

3.1. General

3.1.1. Operation

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

Ensure that the working area is kept clear and uncluttered.

Personnel who install, use, and maintain the unit must familiarize themselves with the user manual and familiarize themselves with the instructions, especially the safety instructions. The user manual must be stored by the maintenance manager in a dry and temperature-stable environment. This manual must always be available for consultation during installation, use, and maintenance.

3.1.2. Hydraulic

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

Any personnel authorized 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 pressurized or hazardous in any other way. Ensure that all personnel are clear of any mechanical/hydraulic system likely to move if the 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 pipework 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 are used.

Any moving component should be treated with caution when the system is pressurized 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.

SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 13 Of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

3.1.3. 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 the 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.


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 authorized 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 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.

3.1.4. Special Caution


	DANGER	<p>-GENERAL DANGER</p> <p>-RISK OF DEATH OR SERIOUS PHYSICAL INJURY</p> <p>-RISK OF MINOR PHYSICAL INJURY</p> <p>-RISK OF DAMAGE TO EQUIPMENT</p>
---	--------	---

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 a 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 (185bar) - safety glasses and protect skin from hydraulic oil if any leakage should occur.


SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 14 Of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

4. Operation Manual

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

4.1 Preparation on the vessel before operations

- Unpack all parts and check for transport damages.
- Verify that all parts on the equipment list are present.
- When using the DWS for a vertical cut in which the lower part of the cut object is regarded as the stationary part after cutting, it is important to install the ROV handle on the underside of the DWS. Please refer to Figure 1.1.
- Verify that the ROV hydraulic supply is correctly adjusted to minimum, 185 bar.
- Verify correct hydraulic connections; the Motor Drive function must be connected to a high-flow rated valve, (NG-10 valve, typically between **45-55 l/min** flow capacity under load). Clamp and feed functions are typically connected to low-flow valves.
- Perform function test of tool functions: Clamps, feed, and motor. Note that rotation of the 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 the motor to turn in the 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, is carried from the deck with the ROV secured in the manipulator, an additional hang-off securement point/bracket against the ROV framework should be used in addition to the manipulator during launch and recovery. However, we advise against using this deployment method because we believe that the weight of the DWS is too high and there is a significant risk of damaging both the DWS and the ROV.
- It is not recommended to launch the 250 – 510 mm DWS model with ROV from the 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.

SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 15 Of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

4.2. How To Operate DWS for Successful Cutting

The parameters for achieving efficient cutting Subsea are as follows:

- Main Drive Motor: 185 bar
- Flow: 45-55 l/min

Start by free-spinning cut wire subsea and note flow-value displayed as a reference a point – 45 l/min is estimated for now as an example and refence point.

If ref-value = 45 l/min: Aim to always let the DWS cut with a flow between 40 and 45 l/min. (Adjust values below as required)

Use the flow-reading as a "speedometer" when engaging DWS cut wire against object;

- Flow = 40 L/min: DO NOT run feed function. (Wait for flow increase).
- Flow = 44-45 l/min: Feed slowly, (small "steps"), until flow drops to 40 l/min.

NOTE: Feed rotates very slowly and with very little movement - may be hard to see subsea. Be gentle/careful.

Pre-tension on cutting wire:

This DWS model has a much higher pre-tension on the wire than many other models on the market. Therefore, be aware that the "arc" in wire over the object during cutting will be much smaller than what you may have experienced before. (Figure 4.1 may be slightly misleading).

Cutting for topside/deck operation:


- Main Drive Motor: 165-185 bar
- Flow: 55 l/min

The DWS comes with an "Auto-Feed" function that ensures the wire's proper angle and speed (rpm) throughout the cutting process. Normally, the wire motor's parameters will be set at 165-185 bar, while the flow through the wire motor will be 50-55 l/min.

The feed will automatically adjust itself.

In case the feed function ceases during a cut and the wire pressure drops to 120 bar or less for an extended period, attempt to halt the feed, initiate the retract process, and restart the feed again.

This can assist in resolving any issues of the valve gets stuck due to debris or particles in the oil.

SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 16 Of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

4.2.1. Wire Tension

An illustration of correct applied tension is shown in Figure 4.1.

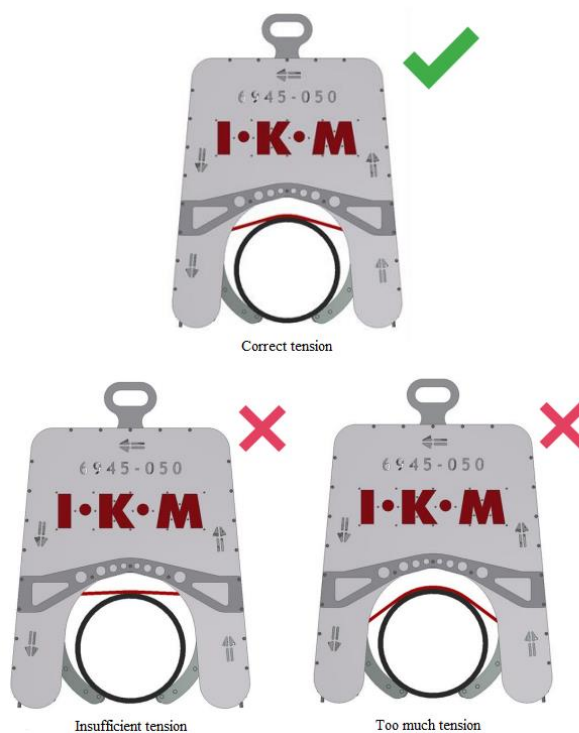


Figure 4.1: Wire tension illustration

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

4.3. Cutting Procedure


4.3.1. General

Before an operation, always perform a SJA/Toolbox talk as required by the client/ROV contractor’s procedure.

4.3.2. Operation

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

Example lined out in section 4.3.2.1. is illustrated for a cut on a horizontally orientated cutting object. Adapt to vertically oriented cutting object as required.

SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 17 Of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

4.3.2.1. Interface toward ROV manipulators and cut objects.

Interfaces towards the ROV manipulators is as follows:

- Only grabber bars and grabber bar for a straight lift to be used by the ROV manipulators.
- Both grabber bars are the only items painted orange.
- Do not grab the tool on any other items/locations with the manipulators.

Before cutting do as follows:

1. Open clamps fully.
2. Retract feeding mechanism.
3. Lift by grabber bar for a vertical lift for positioning onto the horizontally oriented cutting object.
4. Lift by grabber bars for positioning onto a vertically oriented cutting object.

To install the DWS on the cutting object do as follows:

1. Secure the cutting object to be removed to avoid equipment damage.
2. Grab saw by its lifting points.

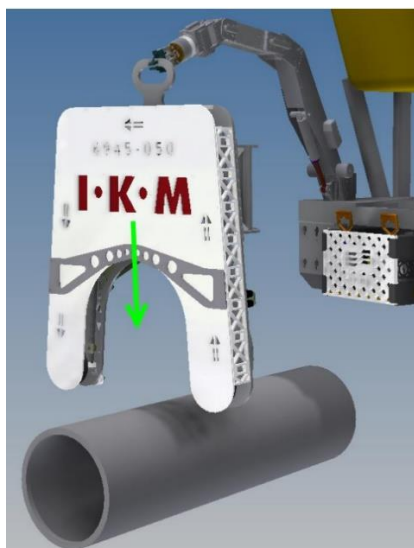



Figure 4.2: Cut on horizontally oriented cutting object

3. Place the tool on top of the cutting object as shown in Figure 4.2.
4. Activate the claw cylinders and secure the saw onto the cutting object. The claw shall be placed on the fixed side of the cut. Leave the claw function activated to “CLOSE” throughout the cutting process.

SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 18 Of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
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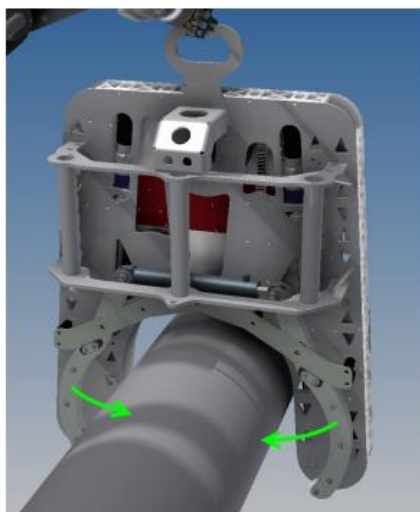


Figure 4.3: Engagement of claw cylinder

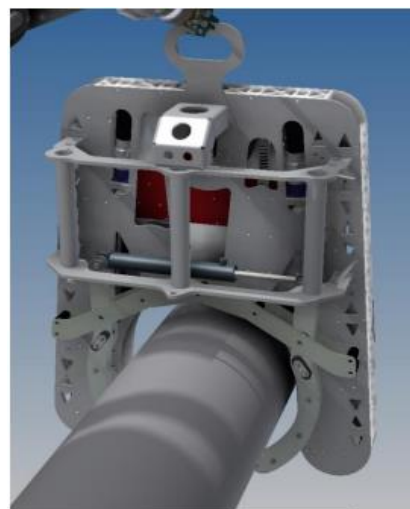



Figure 4.4: Claw in closed position

5. Carefully release ROV manipulator-grip from the grabber bar. Ensure DWS is stable and firmly secured on to the cut object by the activated DWS claws.
6. Start the hydraulic motor and check that the wire is running.
7. **Feed Operation/Control, (Please read section 4.2):** Start by free-spinning cut wire at max RPM and note flow-value displayed as a reference a point – 45 l/min is estimated for now as an example and refence point.
 IF ref-value = 45 l/min: Aim to always let the DWS cut with a flow between 40 and 45 l/min. (Adjust values below as required)
 Use the flow-reading as a "speedometer" when engaging DWS cut wire against the object;
 - Flow = 40 L/min: DO NOT run feed function. (Wait for flow increase).
 - Flow = 44-45 l/min: Feed slowly, (small "steps"), until flow drops to 40 l/min.
8. Let the diamond wire cut completely through the cutting object. Verify that the diamond wire is all the way through the cutting object.
9. Retract feeding mechanism. Keep the hydraulic motor running while retracting the DWS cut wire in a controlled manner. Be cautious and make sure that the diamond wire does not snag or get caught by the separated object.

If not able to release the diamond wire from the cut object, stop the hydraulic motor, and cut the wire. Gently pull the wire out of the DWS and replace it with a new diamond wire on deck.

10. Stop the hydraulic motor when the diamond wire is confirmed retracted.
11. Grab the grabber bar using the ROV.
12. Open the clamps.
13. Lift off the DWS.
14. The DWS is now ready for a new cut or to be recovered.

SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 19 Of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

5. Maintenance Manual

5.1. Post Operation

1. Inspect the DWS for damage after use.
2. Clean the DWS with fresh water.
3. Check for hydraulic leaks. Cuts, sharp bends, and cracks indicate that the hoses should be replaced.
4. Check/fill motor housing with grease after use. See Figure 5.1 for grease nipples and plug location.
5. Plug to be removed before greasing.
6. Housing is filled when grease expands through the plughole.
7. Attach plug after greasing.
8. Inspect the wheels after each cut, especially the 2 lower ones.
9. Grease all support wheels. Grease will escape through the bottom shaft/wheel flange when full.
10. Apply a thin layer with external corrosion protection.
11. In case of field repairs, please consult the attached manufacturer's information.

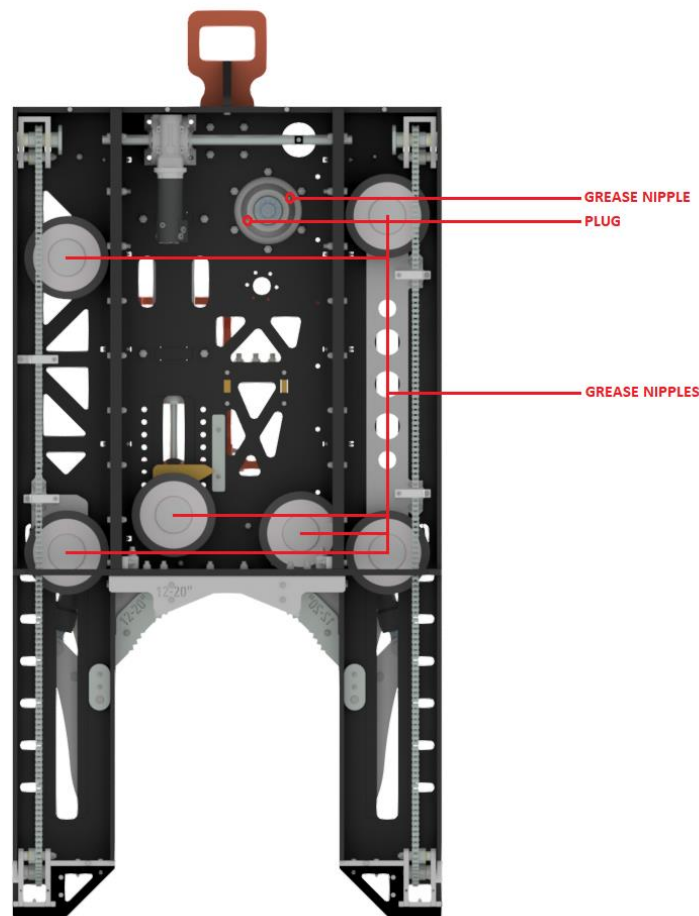



Figure 5.1: Grease nipples and plug location

SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 20 of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

5.2. Wire Replacement

Note! To perform a wire replacement a special spring compression tool is required. The spring compression tool is shown below in Figure 5.2. When loosening the tool, make sure that the threaded rod does not twist, as this can cause the rod to pop out of place.

PARTS LIST					
ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	MASS
1	1	10224-1077	PIPE Ø35 x 5mm	Aluminium, 6062-T6	0.22 kg
2	1	10224-1078	THREADED BAR M16	El Zink	0.38 kg
3	1	10224-1079	WASHER	Stainless Steel, AISI 316L	0.04 kg
4	2	DIN 934 - M16	Hex Nut	El Zink	0.03 kg

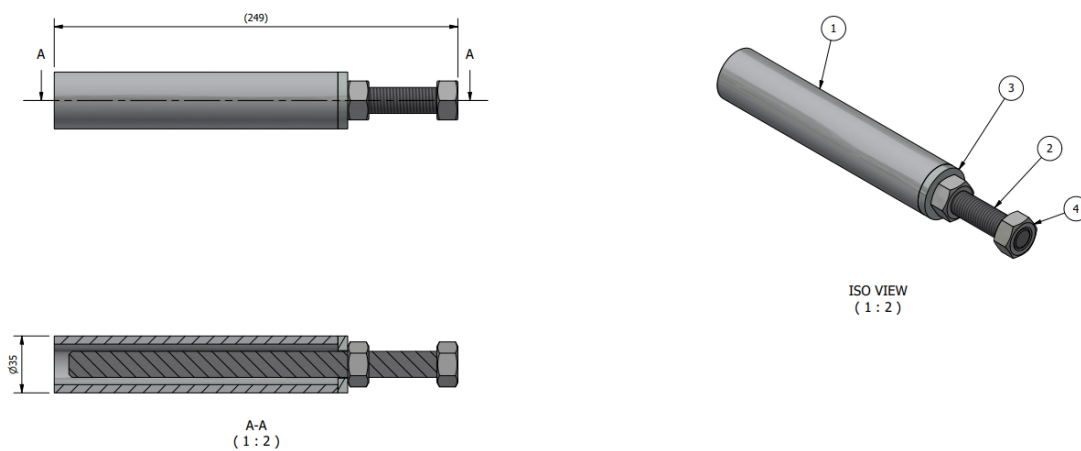



Figure 5.2: Spring compression tool

5.2.1. Wire Wear Indicators

A decrease in cutting efficiency or an increase in cutting time is an indicator that the wire needs to be replaced. You can observe excessive wear by inspecting and comparing a used wire with a new wire.

A key indicator is the lack of abrasive grain protrusion and missing grains on the wire. You can also feel the surface by hand. Less friction, more wear.

SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 21 of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

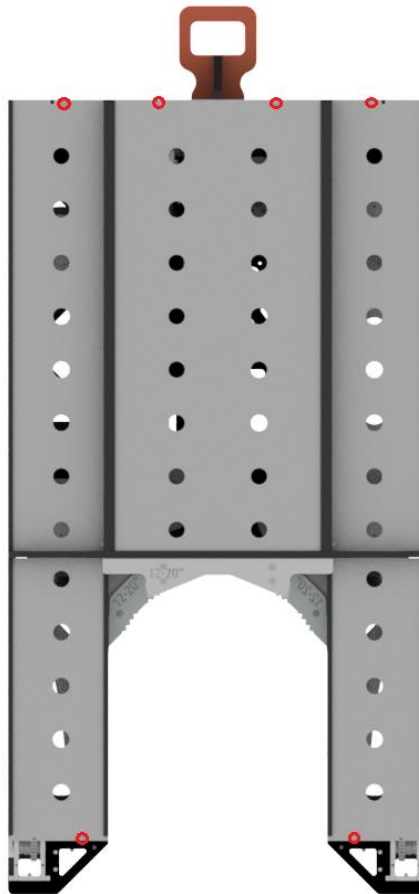
5.2.2. Wire Removal


Prior to removing the wire please do as follows:

1. Place DWS with grabber bar down.
2. Fully retract the feeding mechanism.
3. Disconnect/shut off hydraulic power to avoid damage to personnel and/or equipment.

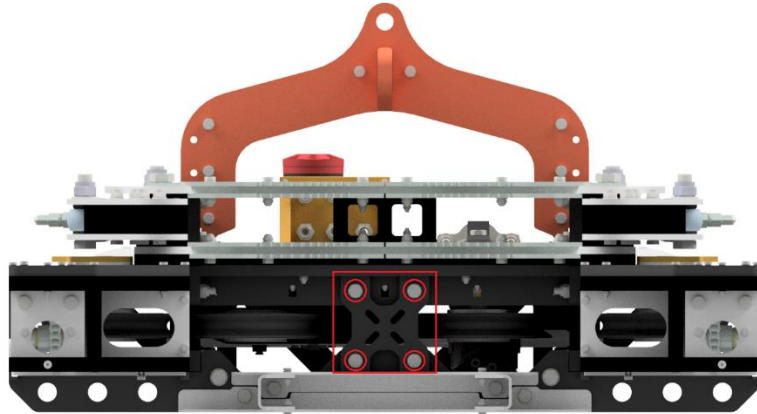
For wire removal, please follow these steps:

1. Unscrew six M6 bolts and remove the protection covers.




SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 22 Of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

2. Unscrew four M10 bolts and remove the brace.

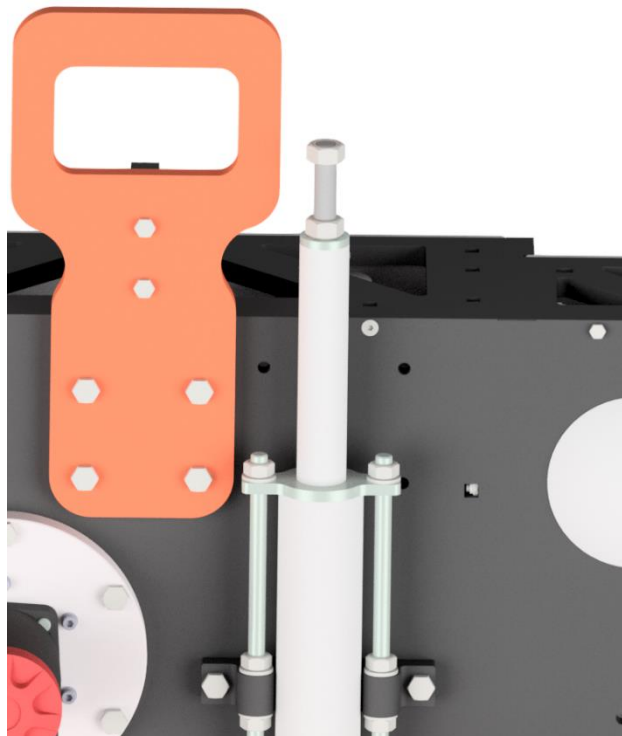
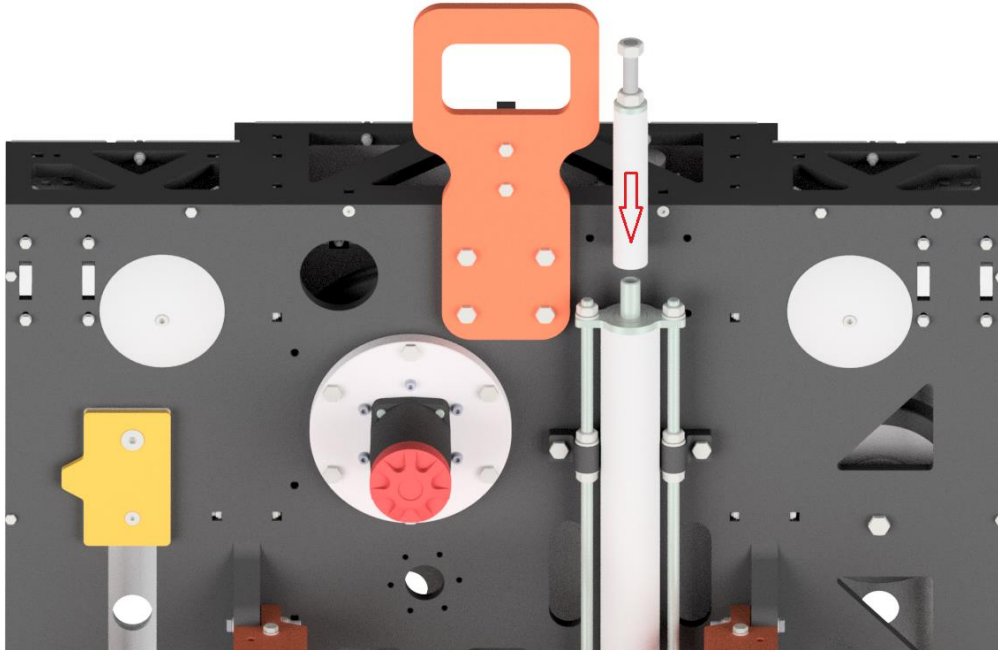



3. Rotate four chain guides by 90 degrees from their horizontal orientation to a vertical position.



SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 23 Of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

4. Mount the special spring compression tool on the tensioner.

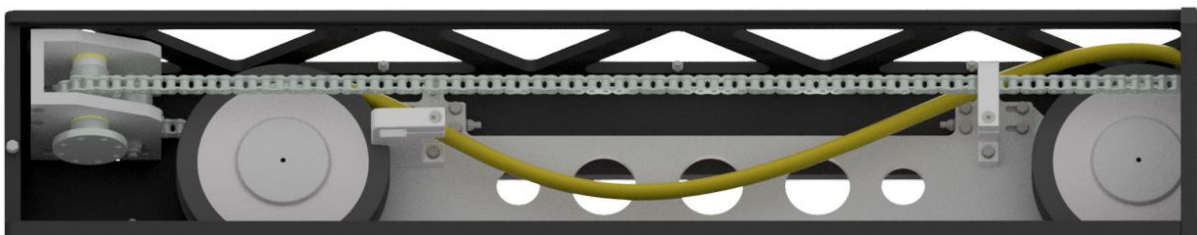



SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 24 Of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

5. Insert the threaded rod into the tensioner by screwing in bolt 1, then turn the second nut in a clockwise direction to loosen the tension on the wire.

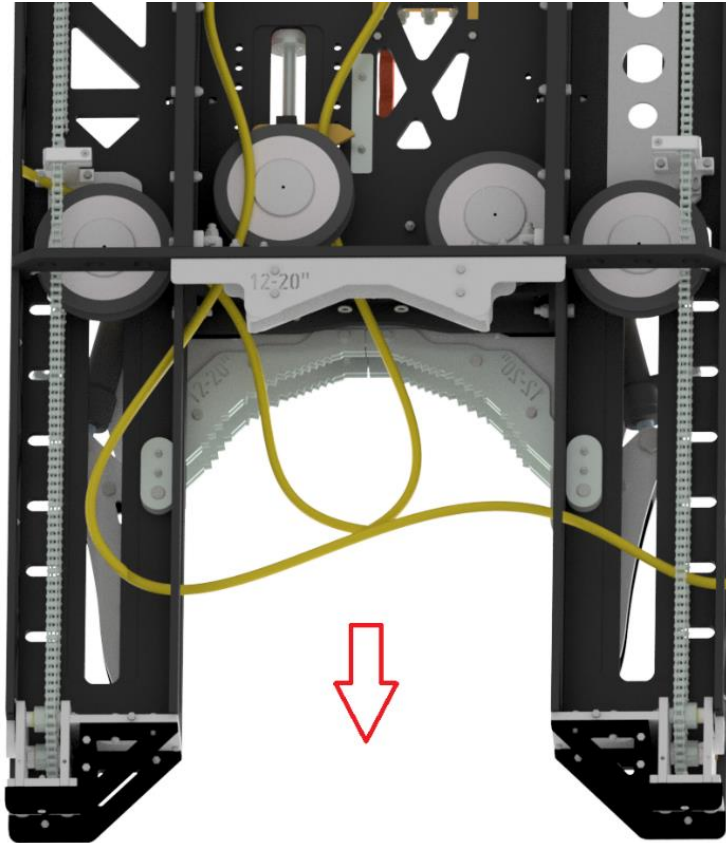



6. Guide the wire under the chain.



SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 25 of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

7. Pull and remove the wire gently.



SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 26 of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

5.2.3. Wire Installation

Note! Before every wire installation please check and grease all support wheels.


- Inspect the wheels after each cut, especially the 2 lower ones.
- Grease all support wheels. Grease will escape through the bottom shaft/wheel flange when full. Ref figure 5.1.

For wire installation please follow the steps below:

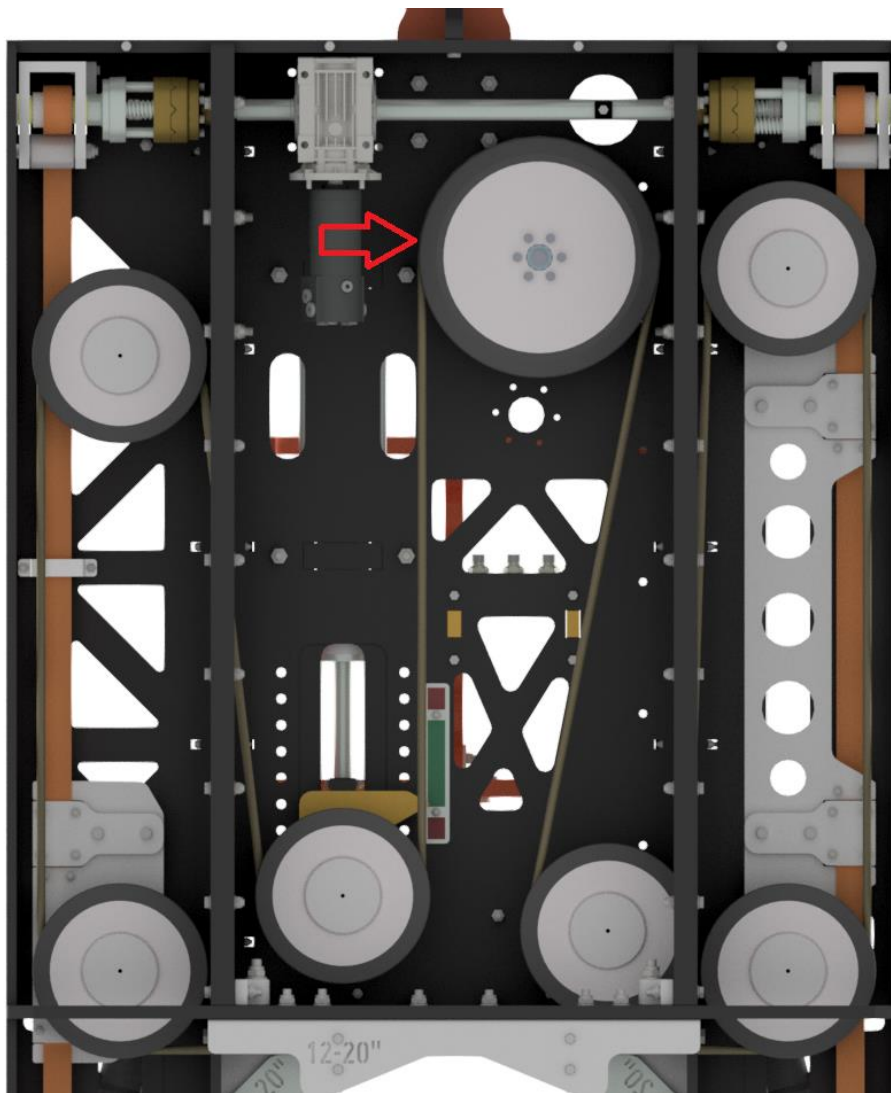
1. Ensure that the rotational direction and the wire itself is oriented correctly. Both the DWS and the diamond wire have directional markings.




Figure 5.3: Rotational direction

SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 27 of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

2. Place the new wire around each of the wheels, start with the main drive wheel. The wire should look like illustrated below:




SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 28 Of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

3. Turn the nut in the special spring compressor tool in a counterclockwise direction, while holding the bolt to tension the new wire.



4. Unscrew the threaded rod and remove the tool.
5. Rotate back the four chain guides by 90 degrees from their vertical orientation to a horizontal position.
6. Reinstall the brace and secure it with four M10 bolts.
7. Reinstall covers.

SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 29 of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

Note! Do **NOT** loosen the bolts on the spring tension system shown in Figure 5.4 as the system is pressurized. Opened by unauthorized personnel may cause injury to personnel and/or damage to equipment.

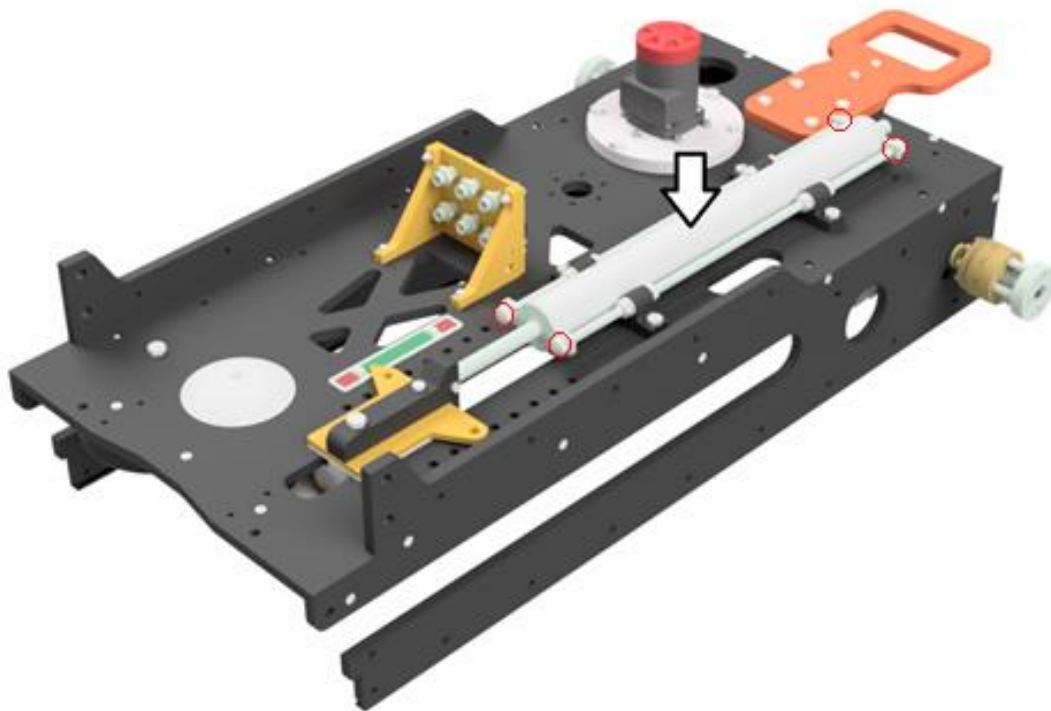



Figure 5.4: Spring tension system


SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 30 of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

5.3 Drive Chain

This section provides all the necessary information and guidance to properly maintain the DWS drive chain. Topics related to chain adjustment methods, and recommendations for replacing worn-out links are covered.

Please ensure that the chain remains taut to prevent it from hanging loosely. A straight and tight chain is ideal, as shown in the picture below:

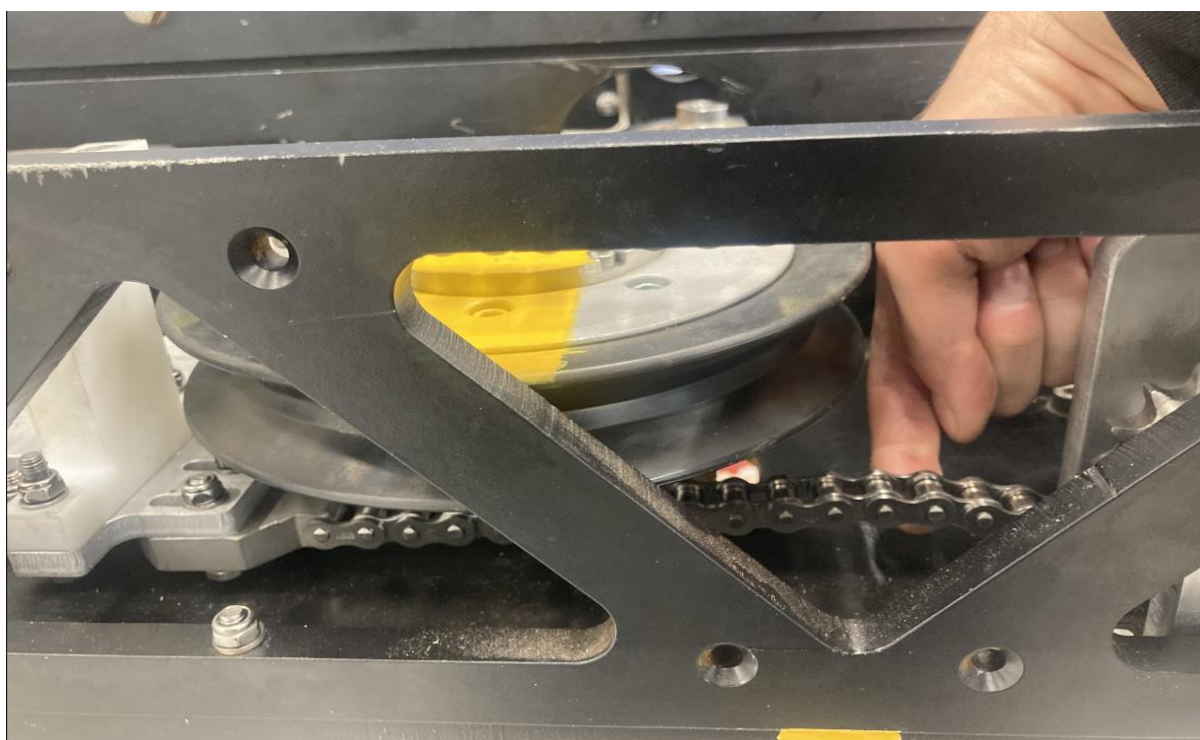



SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 31 of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

As shown in the picture below, an excessively slack chain is readily noticeable:




When the feed reaches the end stops, some slack may develop on the underside of the chain. Please refer to the image below for a visual representation.



SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 32 of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

During full retraction, some slack on the upper side of the chain is expected. Please see the picture below for an example:



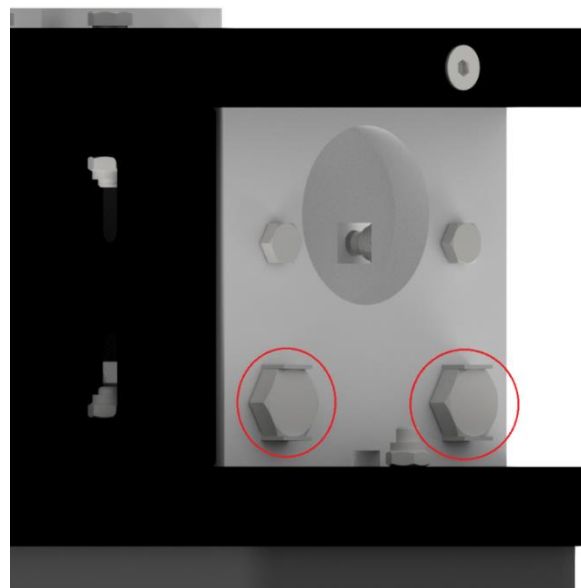
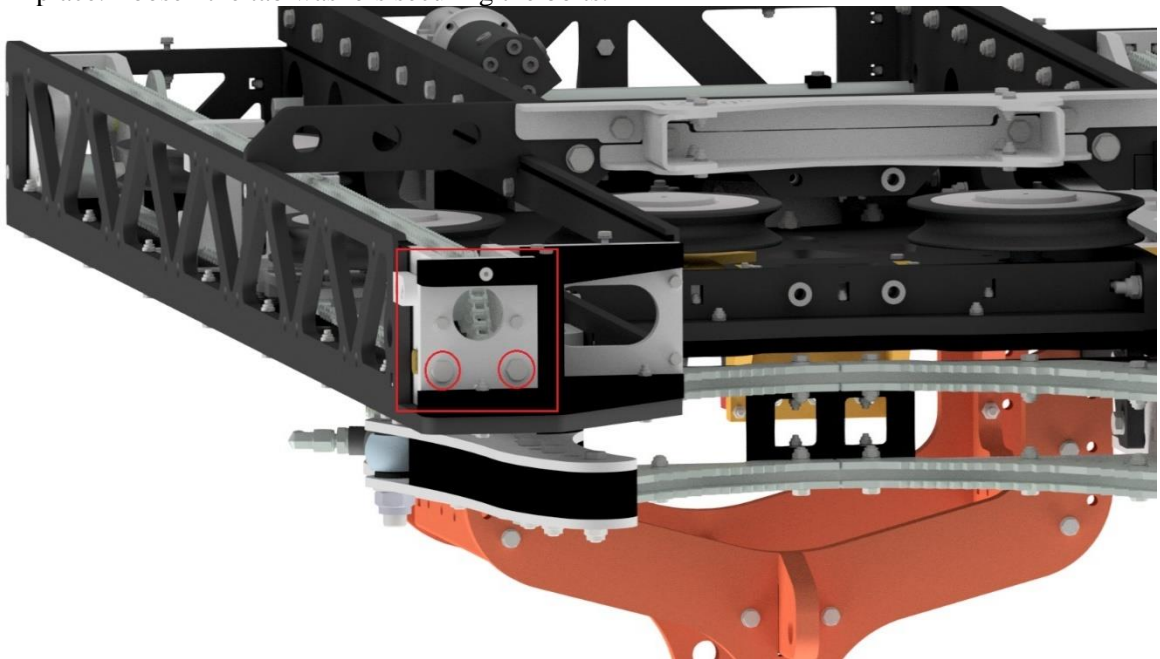
SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 33 Of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		


5.3.1 Main Adjustment

Over time, the roller chain may become loose or tight, causing performance issues. Adjusting the roller chain is a crucial maintenance task that ensures proper functionality and prolongs the lifespan of the chain.

Main adjustment steps are as follows:

1. Loosen the tab washers: Locate the Two M10 adjuster bolts that holds the front sprocket unit in place. Loosen the tab washers securing the bolts.



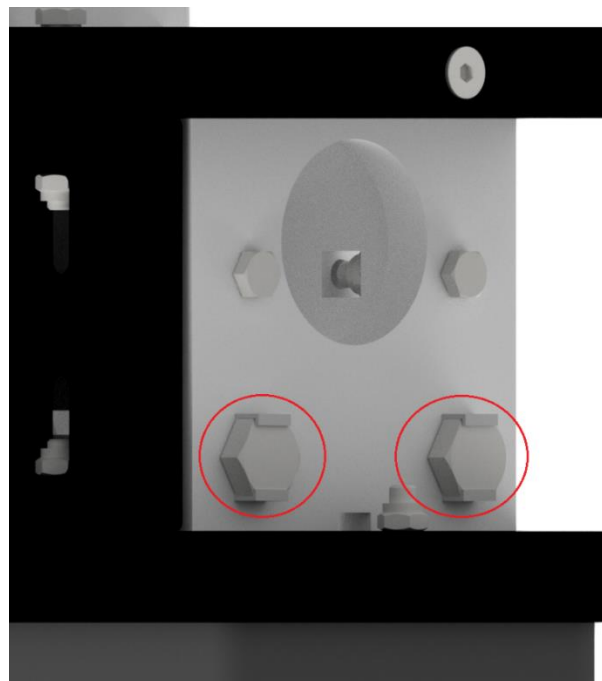
SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 34 Of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

2. Adjust the tension: Move the sprocket unit forward or backward to adjust the tension of the chain.


Note! Turning the M10 bolts in clockwise direction tightens the chain, whereas turning them counterclockwise will result in the chain becoming looser.

3. Run the feed function to fully extended position and verify the slack in the chain.

4. Run the retract function to fully retracted position and verify the slack in the chain.

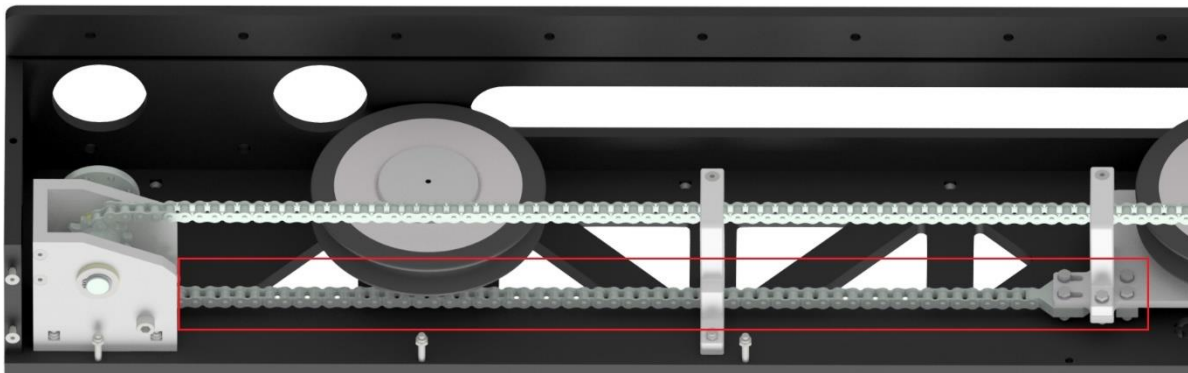


5. Secure the bolts with the tab washers.

SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 35 Of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

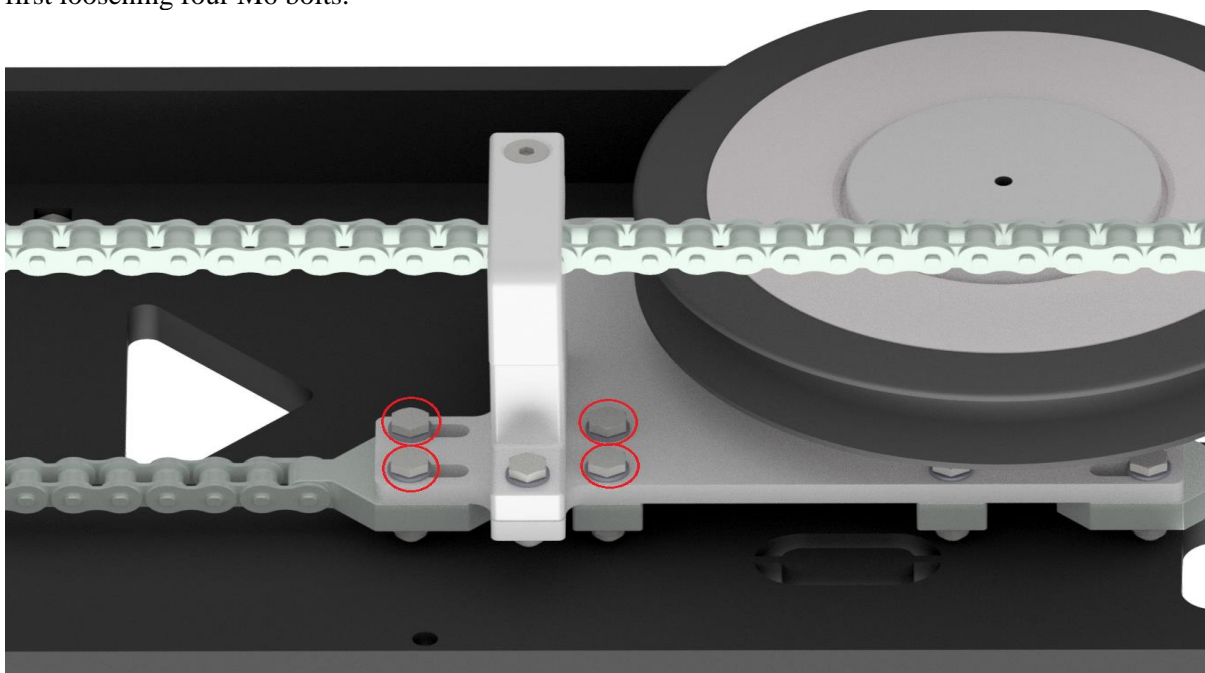
5.3.2 Second adjustment

A second adjustment is needed if the deflection of the lower chain is not within specifications.




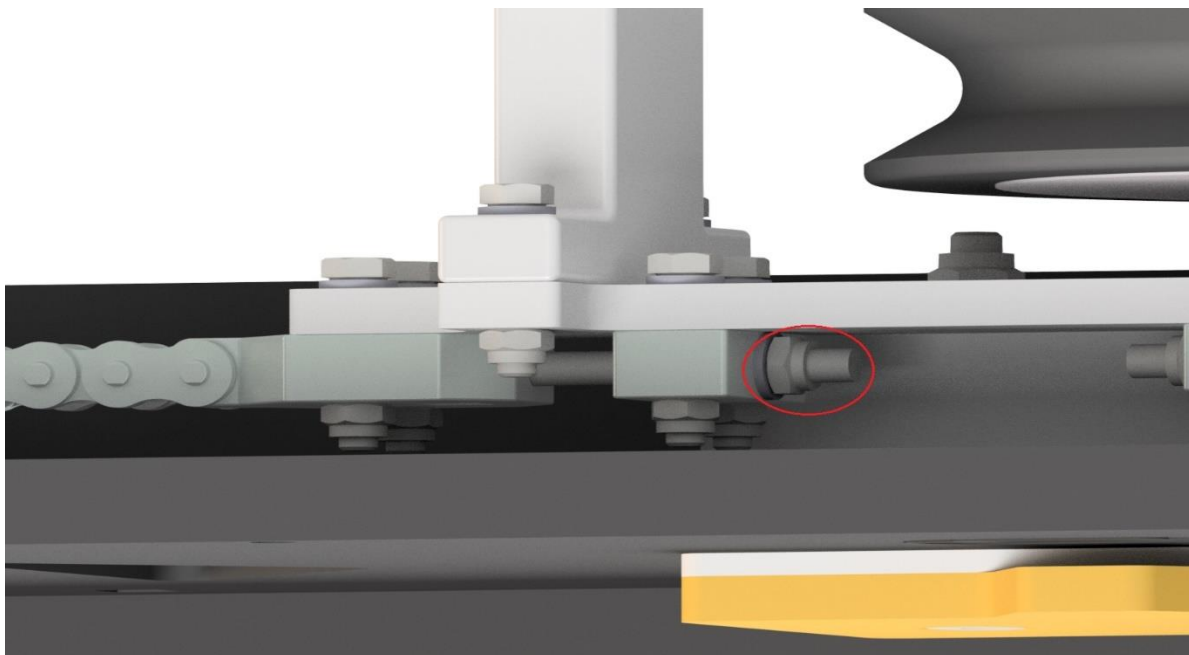
Second adjustment is conducted as follows:

1. Locate one M6 adjuster bolt that holds the chain in place. Loosening the M6 adjuster bolt requires first loosening four M6 bolts.




The adjuster bolt is located beneath the four M6 bolts:

SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 36 Of 43	 IKM IKM Subsea AS
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		



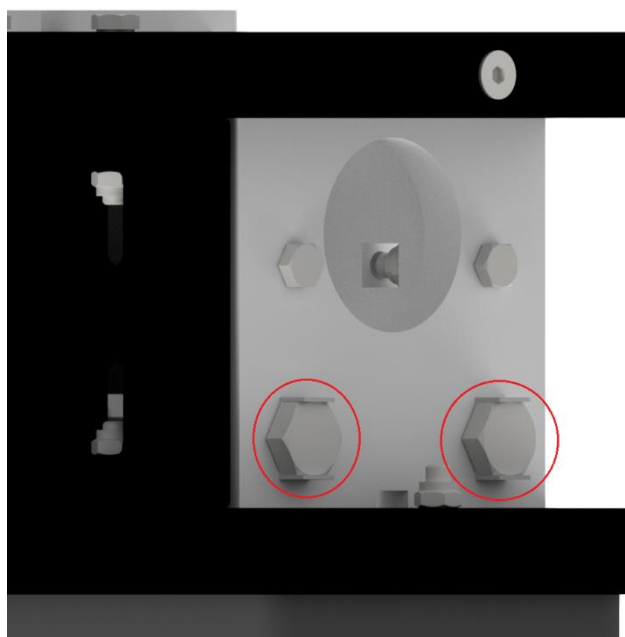
2. Adjust the tension: Move the unit forward or backward to adjust the tension of the chain.
3. Once the chain is properly adjusted, tighten the four M6 bolts to secure unit in place.
4. Verify the correct tension: Recheck the deflection of the lower chain.

SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 37 of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

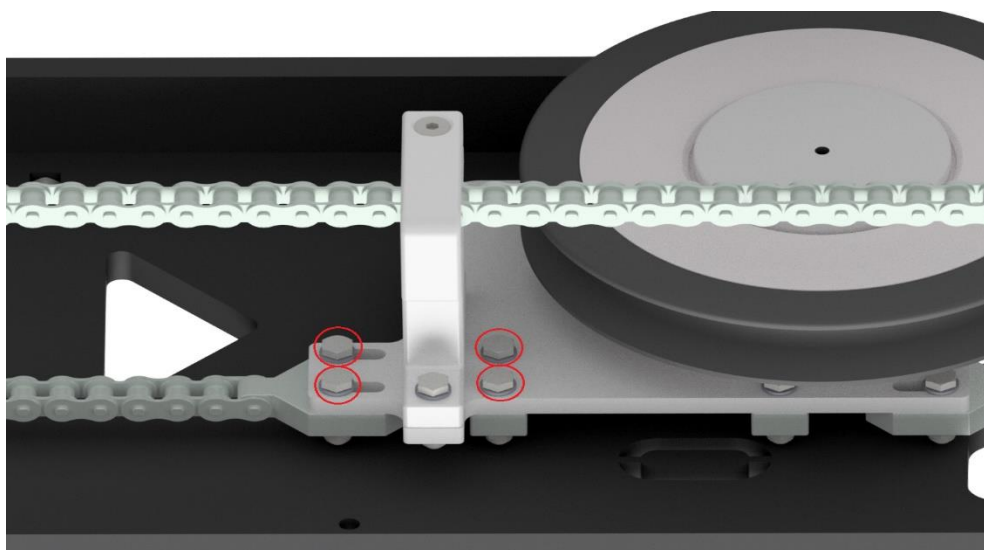
5.3.3 Chain Replacement


With prolonged use, the chain is subjected to wear and tear, which may eventually lead to failure. This section provides an overview of the steps to follow when replacing the chain to ensure optimal performance and reliability of the DWS.

1. Run full retract of the feed function.
2. Remove the tab washers securing the M10 bolts on the front sprocket.

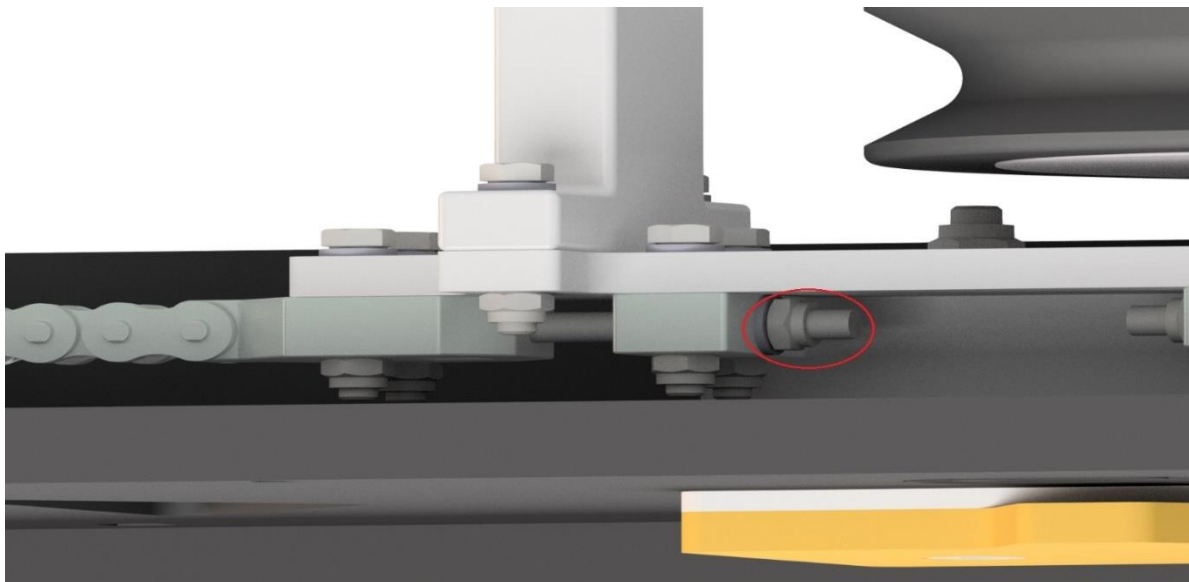


3. Unscrew the M10 bolts counterclockwise to loosen the chain.
4. Locate four M6 bolts as described in section 5.3.2: Loosen the bolts.

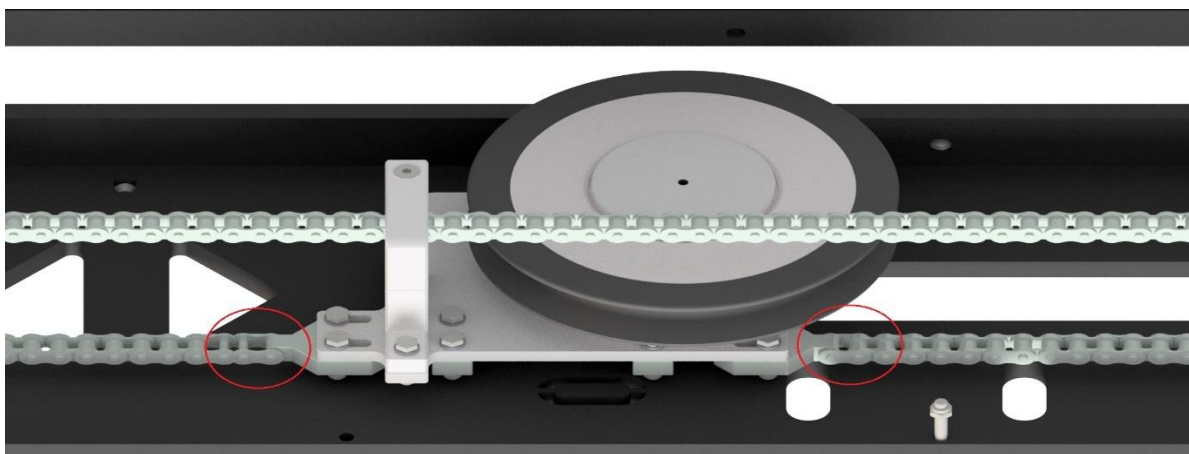


SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 38 Of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

5. Locate the adjuster bolt beneath the four M6 bolts as described in section 5.3.2: To release tension on the chain, turn the bolt in a counterclockwise direction.




6. Remove chain locks: Locate the chain locks securing the chain in place and remove.



7. Remove old chain: Gently guide the chain out of the chain guides and sprockets.


8. Guide in new chain: Make sure that both rails and wheels for the feed are fully retracted. This is important because both rails and wheels must run completely in sync downwards during the cutting process.

9. Assemble in reverse order.


SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 39 of 43	 IKM Subsea AS
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

5.3.4. Chain Lengths

The lengths of the chains on the DWS differ: The chain located on the left-hand side has a measurement of 345 cm, while the one situated on the right-hand side has a measurement of 307 cm.

SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 40 of 43	 IKM Subsea AS
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		


6. APPENDIX

SUBSEA DIAMOND WIRE SAW USER MANUAL			Page 41 of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022	
Valid From:	16.07.2024	Rev.nr:	01d	
Author:	Arbnor Rexhepaj	Position:	Subsea Engineer	
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS	


APPENDIX A

Standard spare parts
2 support wheels
1 drive wheel
Feed function spare chain-locks + additional part of chain
Main motor

Extended spare parts
2 support wheels
1 drive wheel
Feed function spare chain-locks + spare full chain length for longest chain
Gripper cylinder x1
Main motor assembly complete
Feed motor and gearbox

SUBSEA DIAMOND WIRE SAW USER MANUAL			Page 42 Of 43	 IKM Subsea AS
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022	
Valid From:	16.07.2024	Rev.nr:	01d	
Author:	Arbnor Rexhepaj	Position	Subsea Engineer	
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS	

APPENDIX B

SUBSEA DIAMOND WIRE SAW USER MANUAL				Page 43 Of 43	
Doc.ID:	55166001-IKM-O-MA-002	Created:	21.04.2022		
Valid From:	16.07.2024	Rev.nr:	01d		
Author:	Arbnor Rexhepaj	Position	Subsea Engineer		
Approved by:	Thomas Lauritzen	Firm:	IKM Subsea AS		

APPENDIX C