



# KOVACS ICE CORING SYSTEM

## Operations and Maintenance Manual

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## 1.0 PURPOSE

- 1.1 The purpose of this document is to provide the operator with an overview of the Kovacs Ice Coring System.

## 2.0 SCOPE

- 2.1 This document applies to the operations and maintenance of the Kovacs Ice Coring System.

## 3.0 REFERENCES

- 3.1 1008-0014 – SSEC Project Safety Plan
- 3.2 8501-0017 – Deployment Hazards Awareness

## 4.0 DEFINITIONS

- 4.1 **IDP** – NSF Ice Drilling Program
- 4.2 **Operator** – Any person involved in the assembly and use of the Kovacs Ice Coring System
- 4.3 **QAS** – Quality Assurance and Safety group
- 4.4 **SSEC** – University of Wisconsin-Space Science & Engineering Center

## 5.0 RESPONSIBILITIES

- 5.1 **IDP Management** is responsible for ensuring that operators of IDP drilling equipment are provided with accurate, up-to-date operating procedures.
- 5.2 **IDP Engineering** is responsible for the creation and maintenance of this manual.
- 5.3 **Drilling Equipment Operators** are responsible for ensuring that the procedures described herein are followed and safety warnings adhered to.
- 5.4 **SSEC QAS** is responsible for ensuring that the proper procedures for document creation, review, approval, maintenance and updating are followed.

## 6.0 CONTENT

- 6.1 The following pages contain basic operation instructions and Frequently Asked Questions for the Kovacs ice coring system as provided by Kovacs Ice Drilling Equipment and edited by IDP.
- 6.2 The pre-shipment inspection and inventory checklist can be found in Appendix A

## 7.0 OPERATOR'S MANUAL

### 7.1 Introduction

- 7.1.1 The Kovacs Ice Coring System drill system is a small lightweight, portable drill system. It is designed to take core from firm and many kinds of solid ice.
- 7.1.2 IDP owns two types of Kovacs Ice Coring Systems:
- The Mark II will collect a 90 cm core.
  - The larger Mark V collects a 140 cm core.
- 7.1.3 The Kovacs Ice Coring System produces roughly a ½-meter long core sample.
- 7.1.4 The standard Kovacs Ice Coring System Kit contains everything needed to take a core sample to a depth of 6 meters.
- 7.1.5 The Kovacs Ice Coring System may be hand or power driven. If power is required, a battery powered hand drill can be supplied by IDP.

### 7.2 Inspection

- 7.2.1 If possible, before leaving for the field, inspect the Kovacs Ice Coring System to make sure all the parts, tools and spares are present and in good condition. An inventory form (Appendix A) will be included in the kit to assist you in this inspection.
- 7.2.2 It is also recommended that drilling equipment operators assemble the drill to familiarize yourself with the assembly and function of all components.



Figure 1: Kovacs Mark II Kit

### 7.3 Operation

7.3.1 The operation instructions in this section describe how one would take core samples from firn ice.

#### 7.3.2 Drill Site Preparation

- When drilling on a sloped surface, consider cutting a shelf into the slope large enough for the drilling operation. Place barriers uphill from the drill site to minimize the chance of contamination.
- If possible, erect tarps to shade the core handling area to prevent the sun from heating up the drill and melting the core samples.
- Keep insulated core boxes close at hand for safe storage of the core. Consider burying filled core boxes in the snow for extra protection. If core boxes are not available, bagged core samples can be buried in the snow for safe keeping until core boxes arrive.

#### 7.3.3 Drilling a Core

- Ensure cutter head is properly set up. Verify that:
  - Core dogs actuate properly.
  - Cutters are installed.
  - Depth screws are adjusted in from shipping so that the cutters are exposed and penetrate properly.
- Connect the drive head coupler and attach either the t-handle or direct drive adapter if using a cordless drill.
- Turn the drill clockwise, applying minimal downward pressure on the drill. Continue drilling until the drill has penetrated ½ meter.

**TIP! Do not over drill! If you see ice chips piling on top of the drive adapter you are over drilling. This may cause the drill to become stuck in the hole!**

- Stop turning the drill, attach the T-handle and grasp the T-handle with both hands. Pull up slightly to engage the core dogs then give a sharp jerk upward to break the core from the bottom of the hole.

**TIP! Do not gradually apply force, as this will only serve to compact the chips in the flights and stick the barrel.**

- Remove the drill from the hole.
- Remove drive head coupler and push the core sample, from the cutter head end of the core barrel, out of the core barrel using a push rod.
- The core must be supported by a core tray to prevent breakage. IDP can supply a core tray upon request.

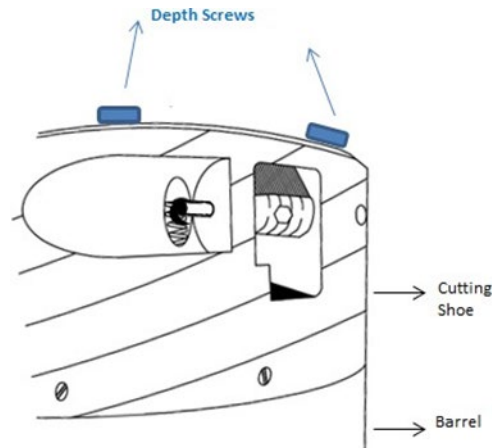
**TIP! Clean the snow and ice off the cutter head, cutters, and core dogs/collet before every run. Ice and snow may pack and cause poor performance.**

- Continue coring in this manner until the desired depth is reached. Troubleshooting information can be found in the next section.

## 8.0 KOVACS CORING SYSTEM FREQUENTLY ASKED QUESTIONS

### 8.1 Q: HOW CAN I PROTECT THE CUTTING BLADES DURING SHIPPING?

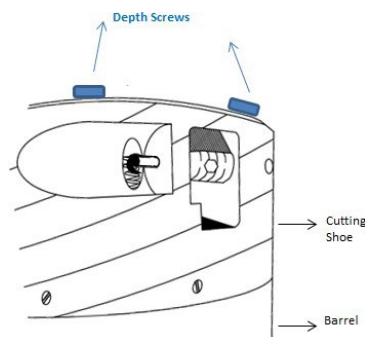
**A:** Extend the 4 depth screws at the base of the cutting shoe to a length that extends beyond the exposed cutting blade length. This will help protect the blades from banging against the side of the field case during shipping.



### 8.2 Q: CAN I ADJUST THE AGGRESSIVENESS OF THE CUTTING BLADES?

**A:** Yes. The 4 depth screws at the base of the cutting shoe can be shortened to allow for more exposure of the cutting blades which will result in more aggressive cutting. In sea ice the depth screws can be shortened. For brittle ice you may obtain a better quality core by lengthening the screws.

We recommend you return the 4 depth screws to the extended length to protect the cutting blades during shipping.



### 8.3 Q: THE DRIVE HEAD COUPLER IS WOBBLY WHEN ATTACHED, IS THAT NORMAL?

**A:** A small degree of movement is necessary to reduce stress of the system during core barrel rotation.

**8.4 Q: HOW DO I REMOVE THE CORE FROM THE BARREL?**

**A:** The ice core will slide out of the core barrel without much effort. The procedure is to pull the barrel up out of the hole and remove the bottom most connector pin. Pull up on the coupler plunger to disengage the drive head coupler from the core barrel. Tilt the barrel to allow the ice core to slide out. A slight push from the cutting shoe end of the barrel may be needed. Be prepared to catch the core and place it on your processing board. The only time the core may be difficult to extract is if water drops have been allowed to freeze on the inside wall of the core barrel. This will cause a restriction. Never try to remove a core from the cutting shoe end.

**8.5 Q: WHY IS THE ICE CORE FRACTURING INTO WAFERS?**

**A:** When coring in hard ice it may cause wafering in the core barrel. The clearance between the ice core and the inside of the barrel could make a difference. If the operator moves the core barrel sideways during coring, the inside wall of the barrel may bump against the ice core causing it to break. With that said, cold clear lake ice, like the ice found in the brittle zone between ~500-700 meters in ice caps, is very brittle and will often undergo stress relief fracturing that cause ice core wafers.

To prevent wafering fractures we suggest the following procedures:

- Change the standard blades to the wide blades (included with your purchase) to increase the clearance between the barrel wall and the ice core.
- Slow drill speed.
- Extend the length of the 4 depth screws in the cutting shoe to make a less aggressive cut.

**8.6 Q: WHY AM I HAVING TROUBLE RETRIEVING THE ICE CORE SAMPLE?**

**A:** This is likely a Dog tension problem or perhaps there is ice/freezing interfering with the Dogs and Dog Springs. Some hydrophobic grease and tightening of the Dogs should prevent the core from slipping. If you are drilling in soft ice or surface temperatures are above freezing, then there is a possibility of the Dogs getting “sticky” – especially after the first couple of cores.

For additional information see FAQs “What is the proper dog tension” and “How do I adjust the Dog tension.”

**8.7 Q: HOW DO I PREVENT THE CORE BARREL FROM FREEZING IN THE SEA ICE DUE TO WATER RUSHING THROUGH THE HOLE?**

**A:** Quickly pull the core barrel out of the borehole - as soon as you cut through the ice - before the ice chips and water mixture freezes. You will need to be alert and react quickly.

**8.8 Q: WHAT DO I DO WHEN WATER IS FREEZING ON THE INSIDE AND OUTSIDE OF THE CORE BARREL?**

**A:** The water/ice will have to be removed before you attempt to take another core. The frozen water could obstruct the core from moving up into the barrel and chips from moving up the flight.

**8.9 Q: WHAT DO I DO WHEN WATER IS FREEZING THE CUTTINGS TO THE CORE BARREL?**

**A:** When coring in the spring and surface melt is occurring, melt water trickles into the borehole. This causes the cuttings, which are cold, to freeze together and stick to the barrel. Always try to core from a high spot on the surface to avoid this since melt will tend to drain down-slope from the borehole.

**8.10 Q: HOW DO I PREVENT THE CORE BARREL FROM BECOMING LODGED IN THE ICE?**

**A:** If you over-core, and cuttings build up on top of the core barrel, you may compact this material when you pull the barrel out of the hole causing retrieval to be difficult. This could lead to the barrel becoming stuck.

**See the notes on the inside of the field case.**

**8.11 Q: WHAT IS THE PROPER DOG TENSION?**

**A:** Proper Dog tension is key to retrieval of a quality core sample. If the tension is too strong the Dog may cut into the core sample's circumference by up to half its proper diameter.

If you're coring in soft ice/snow the Dog tension should be decreased to allow the Dogs to be easily pushed in and not cut into the core. In hard ice the tension should be increased so that the Dog bites into the ice at time of retrieval.

For additional information see the FAQ "How do I adjust the Dog tension."

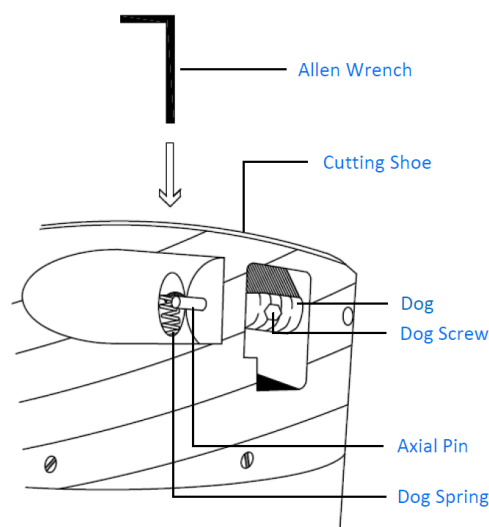


Figure 2: Dog system components

**8.12 Q: HOW DO I ADJUST THE DOG TENSION?**

**A:** The procedure for adjusting the Dog tension to the appropriate level is a delicate one learned by trial and error. Follow these procedures to adjust the Dog tension:

1. Loosen the Dog Screw.
2. Reposition the Dog on the Axial Pin in such a way as to increase or decrease the spring tension.
3. Tighten the Dog Screw.

NOTE 1: Be sure that the Axial Pin “hook” is positioned DIRECTLY IN THE CENTER of the Dog Spring. If it isn’t it may cause the Dog to stick in the retracted position.

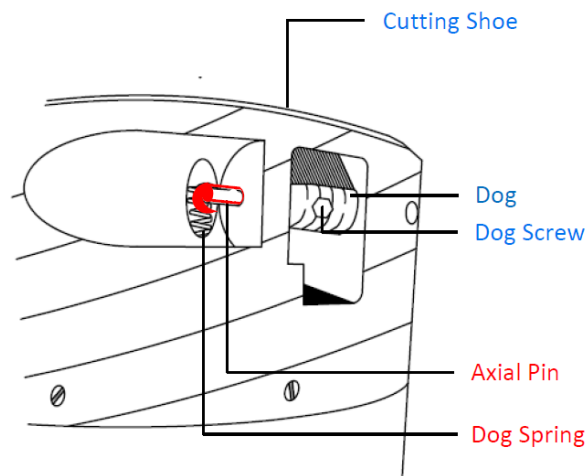
NOTE 2: In rare situations you may need to make a minor adjustment to the height of the screw that rests below the Dog Spring. Use the allen wrench to adjust this screw that in turn will adjust the height of the Dog Spring. NOTE: this screw sits UNDER the spring.

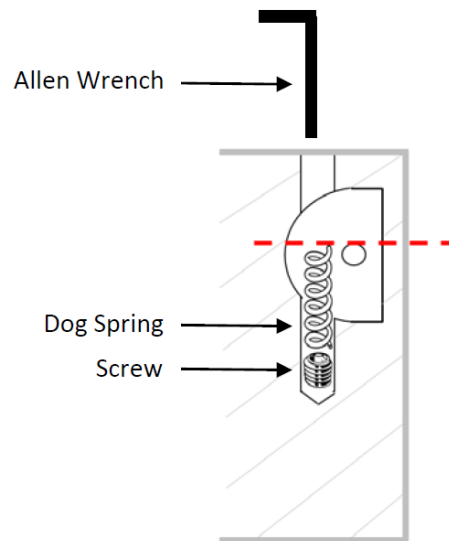
NOTE 3: See FAQ “What is the proper Dog tension” for the ideal tension to use in your particular situation.

**8.13 Q: WHY ARE MY DOGS STICKING IN THE “RETRACTED” POSITION?**

**A:** This can be because ice chips have built up in the Dog Spring. Be sure this area is kept clear.

This may also be because the Axial Pin “hook” is getting caught in the Dog Spring. This can be corrected by changing the height of the Dog Spring. The top of the spring should be even with the top of the Axial Pin hole.





Adjust the screw so that the top of the spring is even with the top of the Axial Pin hole.

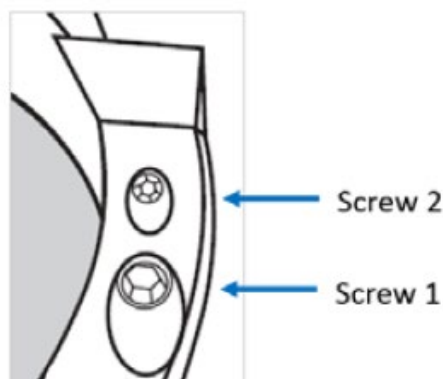
**8.14 Q: HOW DO I ADJUST/REPLACE THE CUTTING BLADES?**

**A:** Follow these directions to be sure your cutting blades are positioned in the cutting head correctly. Using an allen wrench:

1. Secure screw #1 until you start to feel tension
2. Secure screw #2 until snug
3. Finish securing screw #1 until snug

When finished, use the Coring Blade Measuring Tool to check for proper blade placement. Refer to FAQ “How do I use the Coring Blade Measuring Tool” for more information.

NOTE: It’s critical that your blades protrude from BOTH the inside and outside diameter of your cutting shoe.



**9.0 APPENDIX A: INSPECTION PROCEDURES AND PACKING LIST**

- 9.1 Upon arrival of any parts in Madison, IDP staff will:
  - 9.1.1 Clean, test, and store all components.
  - 9.1.2 Check-in kit on the Hand Auger Inventory spreadsheet.
  - 9.1.3 Remove any parts that are out of spec or broken from inventory and replace them with new spares.
- 9.2 Prior to any parts leaving Madison, IDP staff will:
  - 9.2.1 Pack the kit per the PI’s field request.
  - 9.2.2 Fill out a Fit Checklist and Inventory Checklist and include a paper copy in the kit.
  - 9.2.3 Update the Hand Auger Inventory spreadsheet.
- 9.3 Upon arrival of any parts in the field, field personnel will:
  - 9.3.1 Verify that all components have arrived undamaged.
- 9.4 Prior to any parts leaving the field, field personnel will:
  - 9.4.1 Clean and dry all components as best as possible.
  - 9.4.2 Use the Inventory Checklist to verify that the correct components are being returned.

**9.5 IDP Staff Fit Checklist**

<b>Season:</b>		<b>Kovacs Coring System ID #</b> _____	<b>Size:</b> Mark II	Mark V
<b>User:</b>		<b>Where Used:</b>		
<b>Content:</b>				
<b>Done?</b>	<b>Task</b>			
	Fit tee handle to all extensions			
	Fit tee handle to barrel adapter			
	Fit all extensions to each other			
	Fit all extensions to barrel adapter(s)			
	Fit barrel adapter(s) to each barrel			
	Install cutters in cutter head(s)			
	Fit core dogs to cutter head(s)			

**Inspected By:** \_\_\_\_\_

**Date:** \_\_\_\_\_

## 9.6 Inventory Checklist

<b>Season:</b>		<b>Kovacs Coring System ID # _____</b>		<b>Size: Mark II    Mark V</b>	
<b>User:</b>		<b>Where Used:</b>			
<b>Contents of the Case:</b>					
	<b>Item</b>	<b>Standard Qty</b>	<b>Qty Packed</b>	<b>Notes</b>	
1	Tee Handle	1 Each			
2	Extension Coupler	1 Each			
3	1 m Extension	5 Each			
4	Barrel Adapter	1 Each			
5	Extension Pin	8 Each			
6	1 m Barrel Assy	1 Each			
7	Cutter Head w/ Cutters & Core Dogs	1 Each			
8	Kovacs Direct Drive Adapter	1 Each			
9	Standard Allen Key Set	1 Each			
10	Small Flat Head Screwdriver	1 Each			
11	Core Tray	1 Each			
12	Small Parts Kit	1 Each			
<b>Contents of the Small Parts Kit:</b>					
13	Narrow Cutters	4 Each			
14	Wide Cutters	4 Each			
15	Cutter Shoe Screw	4 Each			
16	Cutter Screw	4 Each			
17	Cutter Set Screw	1 Each			
18	Core Dog	2 Each			
19	Core Dog Spring	4 Each			
20	Core Dog Pin	2 Each			
21	Core Dog Set Screw	4 Each			
22	Core Dog Spring Adjustment Set Screw	4 Each			

Packed By: \_\_\_\_\_

Date: \_\_\_\_\_