NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594

May 19, 2021

MATERIALS LABORATORY FACTUAL REPORT Report No. 21-023

A. ACCIDENT INFORMATION

Place	:	Corpus Christi
Date	:	August 21, 2020
Vehicle	:	16-inch propane pipeline
NTSB No.	:	DCA20FM026
Investigator	:	Andrew Ehlers

B. COMPONENTS EXAMINED

Cutterhead assembly.

C. DETAILS OF THE EXAMINATION

1.0 Technical Details of the Cutterhead Assembly and Teeth

Figure 1 shows a photograph of a new Vosta LMG cutterhead assembly. The cutterhead assembly was manufactured in the Netherlands by Vosta LMG. It was a model SC15 cutterhead assembly containing 5 blades. The blades were marked “A” through “E” by the manufacturer. Each blade contained a row of teeth. Blades “B”, “D” and “E” each were manufactured with a row of 6 teeth and blades “A” and “C” each were manufactured with a row of 7 teeth. During operation, the cutterhead assembly rotates clockwise (CW) when looking forward in the direction of dredging.

The cutterhead assembly was installed with model SC15.01 teeth, referred to as “wide chisel” teeth, according to the Vosta maintenance manual. The width of the tooth at the tip was specified as 109 millimeters (4.29 inches) and the entire tooth was specified as high alloy cast steel. Each tooth weighs about 8.5 kilogram (18.7 pounds). Welding repair of the tooth is prohibited according to the same maintenance manual.

2.0 On-site Activity

Recovery of the cutterhead assembly was per instructions in the recovery protocol developed by the NTSB (see Appendix 1). Figures 2 through 4 show various views of the cutterhead assembly after underwater recovery. For the purpose of this investigation, the teeth were arbitrarily labelled “1” through “6” (inboard to outboard) on a blade with a row of 6 teeth and labelled “1” through “7” (inboard to outboard) on a blade with a row of 7 teeth. For example, the most inboard tooth for blade “A” is referred as tooth “A1”. The distance between the outboard end of tooth “C7” and outboard end of tooth “E6” measured approximately 6.5

feet, representing the overall diameter of the cutter assembly. The axial length of the cutterhead assembly was approximately 4 feet. Table 1 indicates which teeth were intact, partially fractured, or entirely missing. Tooth “B3” fractured at the tip portion (major portion of the tip was missing).

Preliminary onsite examination by investigators revealed tooth “C1” appeared to have heavy contact and possible transfer of material at the tip portion (material appeared different compared to the tooth). The tip of tooth “E3” showed wear that was similar to the other blades and possible metal build-up. Blades “B3”, “C1”, and “E3” were submitted to the NTSB Materials Laboratory for detailed examination.

The tip portion of a tooth has an inboard and outboard edge. Blade “D” was randomly selected to determine the radial distance between the center of the cutterhead assembly and the inboard and outboard edge of each tooth. The length of grey arrows in figure 1 show examples of the radial distance between the center (longitudinal axis) of the cutterhead assembly and the inboard or outboard edge of a tooth. Table 2 shows the measured radial distance for each tooth on blade “D”.

Prepared by:

Frank Zakar
Senior Metallurgist

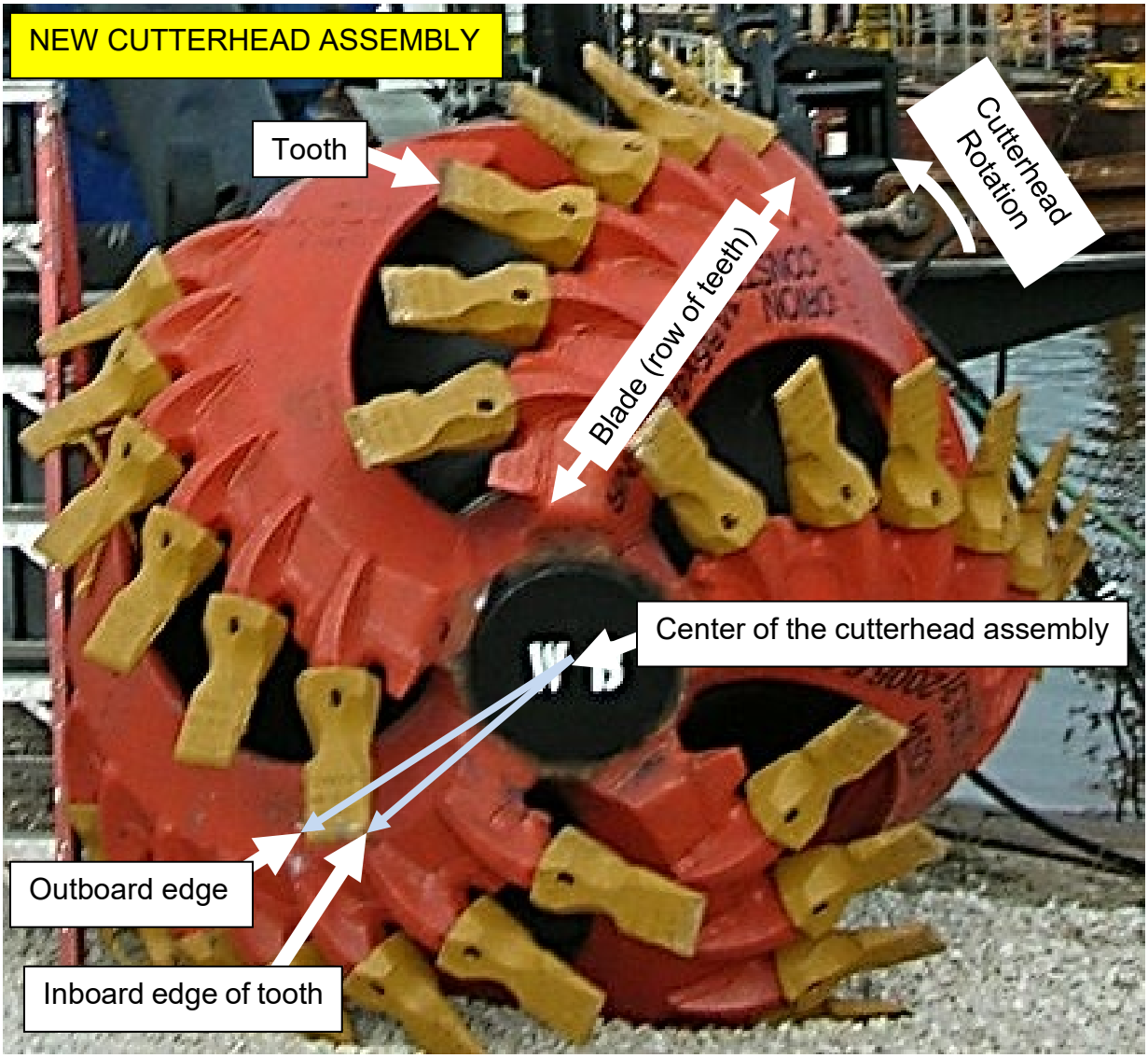

Figure 1. Front view of a new cutterhead assembly (looking aft). Courtesy of Orion. Teeth are yellow and the structural portion of the assembly is orange. The length of each grey arrow indicates the radial distance between the center of the cutterhead assembly and the inboard and outboard edge of a tooth. When looking aft, as shown in this figure, the cutterhead rotates in the counterclockwise direction.

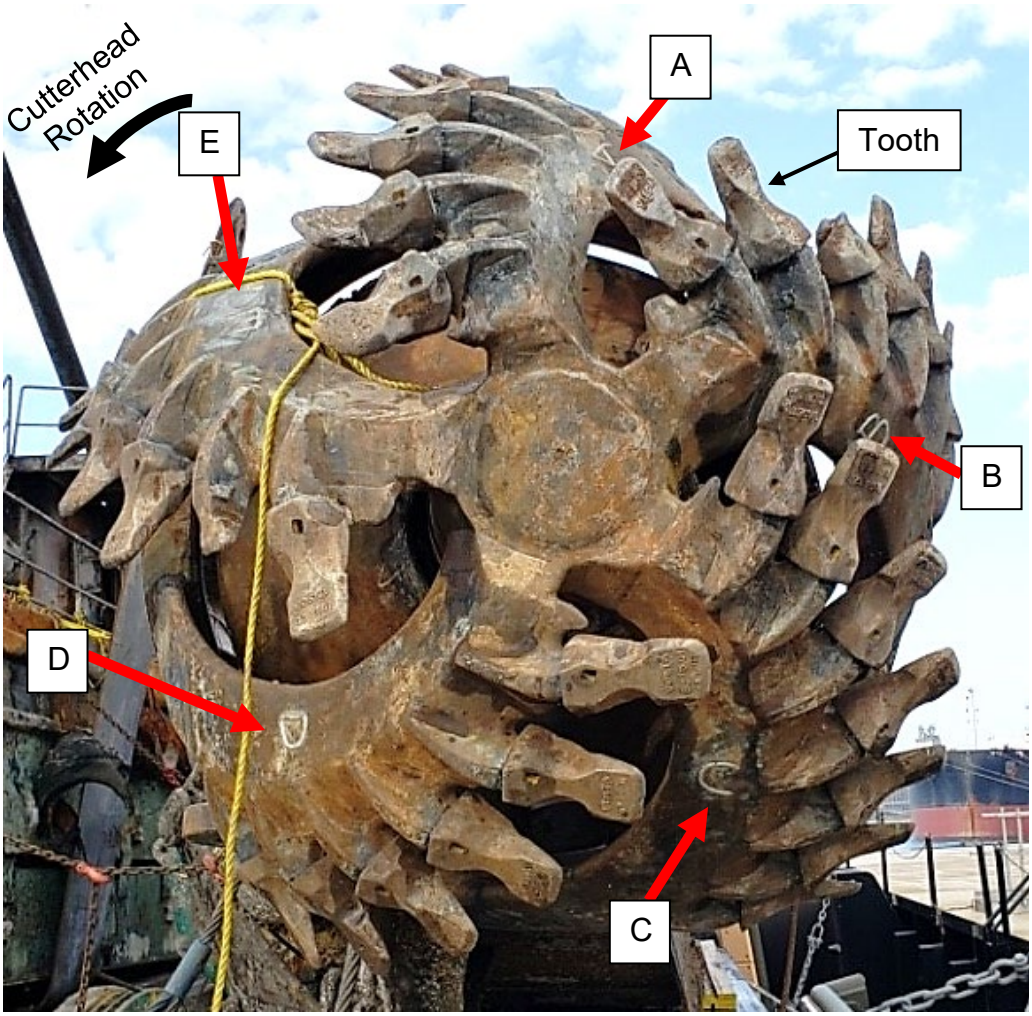

Figure 2. Front view of cutterhead assembly after underwater recovery (looking aft). The cutterhead assembly contained 5 blades, labelled by the manufacturer as “A”, “B”, “C”, “D”, and “E”.

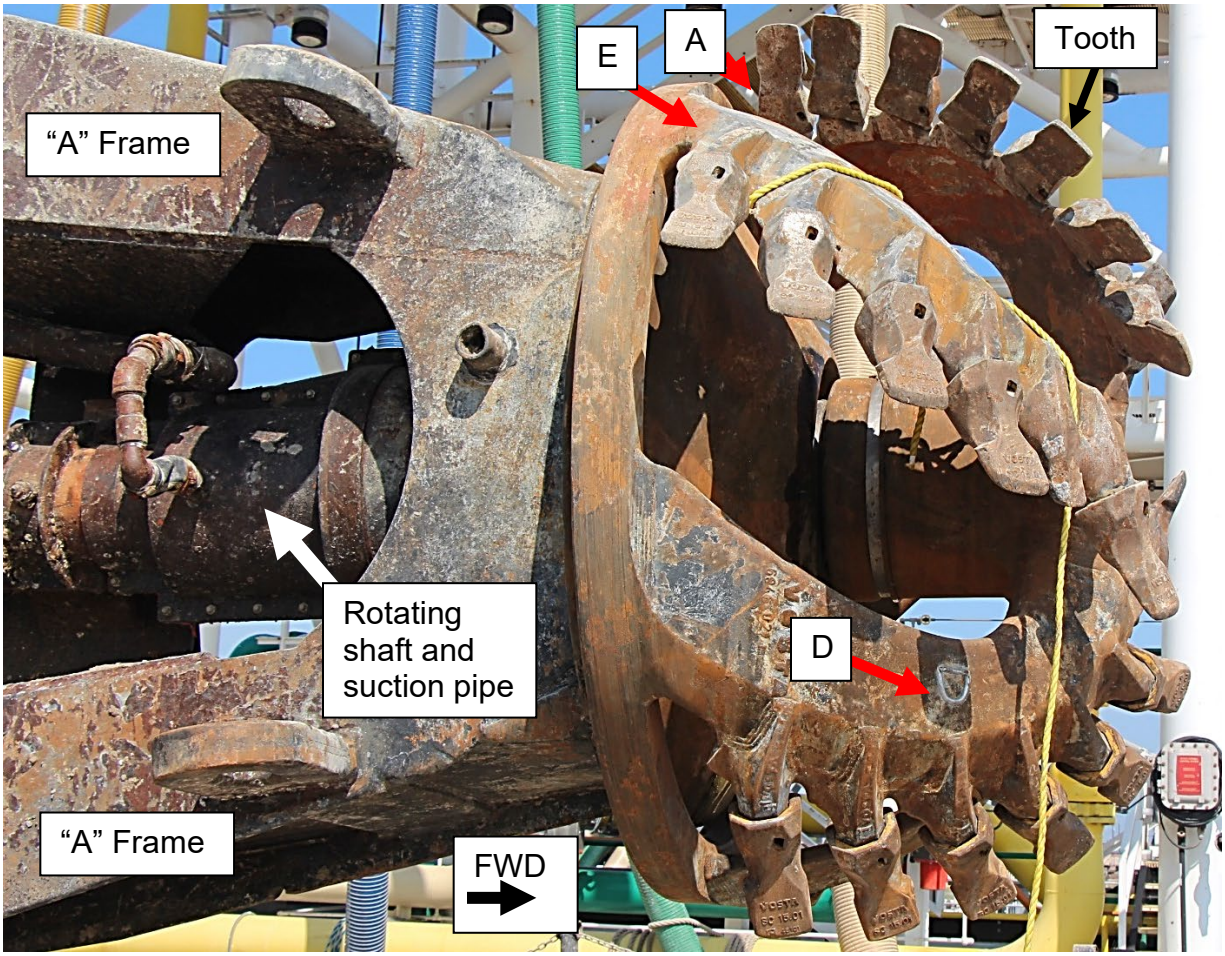

Figure 3. Top view of the “A” frame showing the side profile of the cutterhead assembly after underwater recovery. The side profile of the cutterhead assembly follows a conical-elliptical-like contour. Blades “A”, “D”, and “E” are shown in this view.

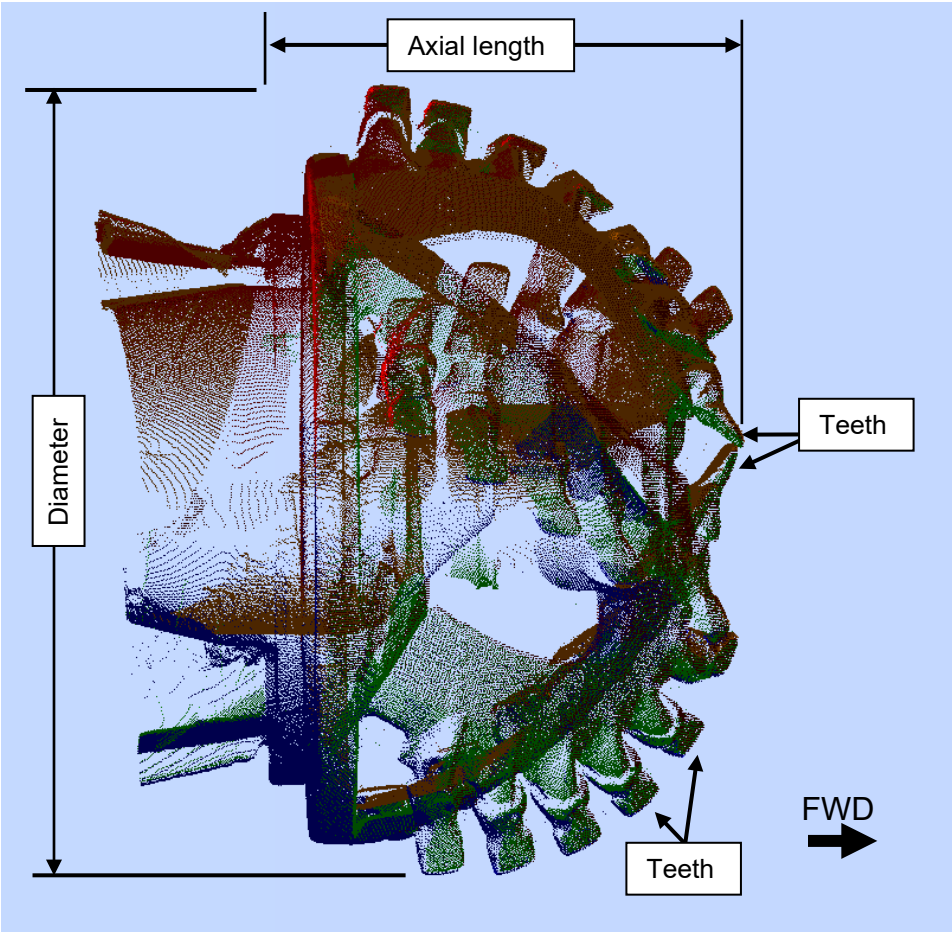

Figure 4. Reconstructed 3D image of the cutterhead assembly showing the side profile. Scanned onsite by Texas Rangers Public Safety Department using a Leica P40 laser scanner. This side view image was reconstructed by NTSB Vehicle Performance Division using SCENE software.

Table 1. On-site Condition of Each Tooth							
Blade	Tooth Number						
	1 (most inboard)	2	3	4	5	6	7 (most outboard)
A	I	I	I	I	I	I	I
B	I	I	F	I	I	I	N
C	I	I	I	I	I	I	I
D	I	I	I	I	I	I	N
E	I	M	I	I	I	I	N

NOTE: (I) denotes intact tooth; (F) denotes the tip portion of the tooth had fractured; (M) denotes a missing tooth; (N) denotes the blade was manufactured by design without a 7th tooth.

Table 2. On-site Measured Radial Distance between the Center Axis of the Cutterhead Assembly and the Inboard or Outboard Edge of a Tooth (inches)		
Blade "D"	Inboard cutting edge of tooth	Outboard cutting edge of tooth
Tooth 1 (most inboard)	18	20.5
Tooth 2	23.5	27.9
Tooth 3	30.5	34.3
Tooth 4	36.9	40.8
Tooth 5	43.9	46.3
Tooth 6 (most outboard)	49.9	52.3

APPENDIX 1

NTSB CUTTERHEAD RECOVERY PROTOCOL

(4 Pages)

National Transportation Safety Board
Corpus Christi, Texas
NTSB Accident DCA20FM026

Protocol for Recovery of the Cutter Head and Shipping Exemplar Teeth to NTSB

This protocol addresses recovery of the cutter head and selection of teeth to be shipped to NTSB. NTSB personnel will not be present on-site but will monitor the activity remotely. A "checkpoint" is identified in this document; it indicates a critical phase of the operation where information must be relayed to the investigator-in-charge (IIC) Luke Wisniewski and the Pipeline Group Chairman Paul Stancil, so that NTSB can determine whether the cutter head was properly documented, and exemplar teeth can be shipped to NTSB.

Underwater Recovery

The Orion Group will salvage the cutter head from the sunken dredge vessel.

Care shall be taken to preserve the exposed teeth. Handle the cutter head with equipment/slings that do not introduce additional damage to the cutter head and teeth.

The ladder with cutter head attached is planned to be recovered the day after the dredge is set onboard the deck barge. The cutter head will not be removed while underwater as this would extend the time to recover the cutter head.

Once the ladder with cutter head attached is recovered from the water, it will be set onboard wooden mats that are placed on the deck barge and will be set on cribbing so that the cutter head is elevated off of the deck, allowing the cutter head and teeth to be evaluated. At this time, the cutter head will not be removed from the ladder.

Activity on Deck of Barge or On-shore

As soon as practical, with a hose wash the cutter assembly with abundance of fresh water. Use compressed air to dry the assembly.

Take sufficient overall photographs of the entire cutter head (head on shots showing the entire assembly and from different angles showing all the teeth, preferably in outdoor setting. If indoor, provide sufficient lighting.

Determine which teeth are intact or fractured and complete **Table 1** (would like a Coast Guard representative to fill in table 1). Use "I" for an intact tooth or "F" for a fractured tooth. There are 5 blades (labelled "A" through "E") on a cutter head. Each blade has 6 teeth. For the purpose of this protocol, the teeth will be labelled "1" through "6" (inboard

to outboard). For example, the most inboard tooth for blade “A” will be identified as tooth “A1”.

Take close-up photographs of:

- One intact tooth and disassemble it from cutter head (note location of tooth)
- One intact tooth with possible metal transfer (metal build-up will be at the tip portion), and disassemble the tooth from the cutter head (note location of tooth)
- A broken tooth and disassemble it from the cutter head. Best if fractured end has metal transfer/metal built-up (note location of tooth).
- If all the teeth are fractured, NTSB will determine which blades to remove based on photographs submitted.

Measure the radial distance between six teeth. Refer to instructions at the end of this document **Table 2** titled “Cutter Head – Instructions for Measuring the Tooth Separation,” then fill in the table with measured values. Would like a Coast Guard representative to fill in table 2. **NOTE**: Plan to measure the distance between teeth is based on the assumption that only a few teeth have fractured. If a majority of the teeth are fractured, request NTSB to review photographs of the cutter head and make a determination on whether making measurements of fractured teeth will provide useful information! If in doubt, allow NTSB to review photos before making measurements!

The recovered cutter head can be scanned by a 3D scanner (details on process and equipment to be provided). Reflective markers can be temporarily placed on assembly for reference points, provided they are not placed over the teeth. Replicas of damaged areas, such as silicone casting, will not be permitted. Options are also available to document the condition of the cutter head by photogrammetry. These two methods of documentation are optional.

Checkpoint 1:
Send the following information to the IIC and Pipeline Group Chairman for further assessment:

- Photographs
- Measurements
- 3D scan data or photogrammetry

Based in feedback from NTSB, wrap the selected teeth with appropriate protective material (bubble wrap, cloth, etc.). The teeth can be shipped with the pipe segment if they are properly secured within the crate (they should not come in contact with the mechanically damaged portions. If the teeth are not shipped with crate, send them directly to Michael Budinski, NTSB/RE30, 490 L’Enfant Plaza East, Washington DC 20594, delivery telephone room phone (202) 314-6225.

Cutter Head – Instructions for Measuring the Tooth Separation

As shown in the attached photograph, a cutter head has 5 blades (each blade having 6 teeth). A tooth has an inboard and outboard edge at the tip.
Choose one blade (row of 6 teeth).
Mark the center of the cutter head with a visible marker.
Measure the distance between the center of the cutter head and the inboard and outboard edge of each tooth (see yellow arrows in the photograph of the cutter head).
Measure to the nearest 16th inch.
Do this for each tooth on the blade.
If a tooth is fractured and the inboard or outboard distance cannot be estimated, select the same respective tooth on another blade and then report that distance.
Fill in table 2 with measured values.

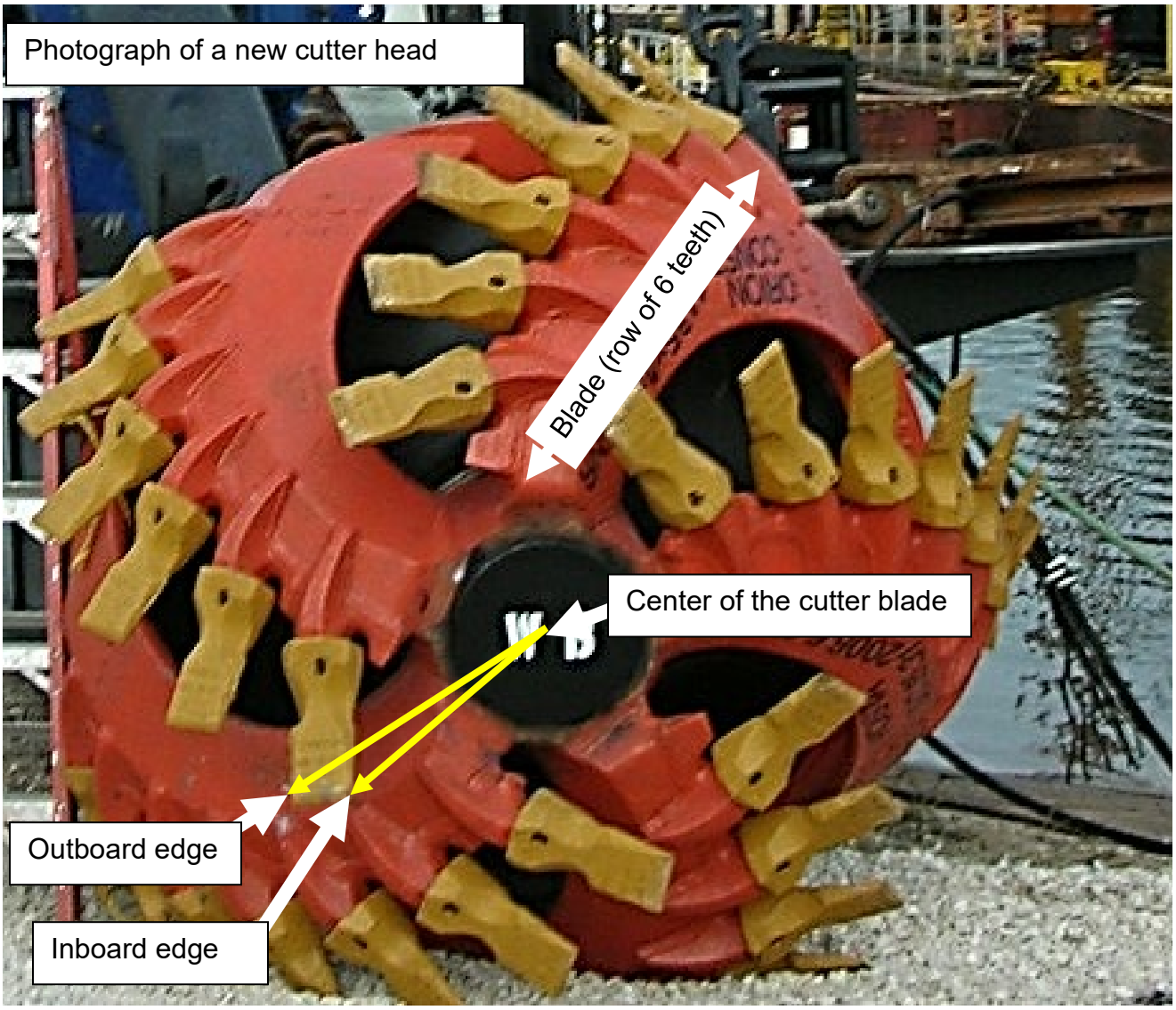

Table 1. Blade and Tooth Identification Position of Intact (“I”) and Fractured (“F”) Teeth						
Blade	Tooth					
	1 most inboard	2	3	4	5	6 most outboard
A						
B						
C						
D						
E						

Table 2. Distance of each tooth relative to the center of the cutter head (inches)		
	Inboard cutting edge of tooth	Outboard cutting edge of tooth
Tooth 1 (most inboard)		
Tooth 2		
Tooth 3		
Tooth 4		
Tooth 5		
Tooth 6 (most outboard)		