WORLD SAILING INVESTIGATION REPORT NACRA 17 INCIDENT

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Equipment Committee Chair

World Sailing

World Sailing Investigation Report

REVIEW OF NACRA 17 CLASS INCIDENT WITH SERVERE INJURY TO HAND

Working Party Terms of Reference: The objective of the review into the incident is to improve safety in Nacra 17 class racing and training by the documentation of facts found and recommendations to reduce the likelihood of a recurrence.

Working Party/Investigation Team

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1. **Incident Overview** – On 30 August 2017 while training for the coming Nacra 17 World Championships at La Grande Motte, France, the USA crew of Helm Bora Gulari and Crew Helena Scutt pitchpoled while rounding a windward offset mark during a practice race. They were on starboard tack and fully foiling as they approached the offset mark at a speed estimated to be 17 knots. The accident resulted in capsize of the boat and the partial loss of 3 fingers on the right hand of helmsman Bora Gulari.

   The day has been characterized as follows:

   Wind direction 160 degrees
   Wind strength 14-15.5 knots, measured at 2 meters with short gusts of 17 knots
   Sea state - wind driven chop, max 0.75 m
   Water depth 10m
   Sea surface temp 22-23 degrees C
   Air temp 26-27 degrees C

2. **Description of Equipment** - The boat sailed during the accident was a Nacra 17 MK2 with zee foils and tee rudders. The Nacra 17 MK2 is the equipment for the 2020 Olympic Event.

   Equipment serial numbers of the Nacra 17 sailed by the USA Team of Gulati and Scutt

   - Hull Number (HIN) NLNACZ0360D717
   - Rudder 1 Port T00301
   - Rudder 2 STBD T00210
   - Daggerboard 1 Port ZP00109
   - Daggerboard 2 STBD ZS00065
   - Trampoline 12862
   - Mast N/A
   - Sails N/A

   Appendix A are photographs of the boat. There are photos for illustration of the typical Nacra 17 MK2 to show possible impact points, fittings that are part of the boat, and then some of the specific boat that was used by the injured sailor.

   Appendix B present specifications of rigging diameter/material/configuration (strands/lay/etc).

   Appendix C describes protective clothing. Both sailors protective clothing included lifejackets, harnesses, wetsuits, helmets, footwear and gloves. The gloves were Showa Gripper 370. A specification for the gloves is included as Appendix C. Also part of Appendix C are other commercially available gloves that have been tested to some standard of cut resistance.

3. **Medical Records** – For privacy reasons the following narrative is provided that summarizes the report from the Institut Montpellertain De La Main Et Du Membre Superieur, Dr Frederic Desserre. No photographs were taken prior to medical treatment that we have been made aware of.

   a. The characteristics of the injury prior to treatment: The helmsman reports that all three parts of the fingers amputated were completely separated at the time of the injury. The glove remained on the hand and was removed at the hospital. This is confirmed by the attending physician.

   b. The helmsman describes no other injuries or muscle soreness after the incident.

   c. The medical report is limited to a brief description of the cleansing of the wounds. In follow up examinations approximately one week later the helmsman reports that he discovered that his ring finger had been pinned and splinted as if broken. The skin on the ring finger between that finger and the small finger was badly abraded. Photos are included in Appendix D.

4. **Statements**

   a. Helmsman – The day had been going well. He remembers thinking that there were not a lot of waves but that the chop was significant due to all the Coach boats. US Coach was running the short practice races. Though they often practice with video cameras on board to record the crew's activities they were not on the boat this day because they were focused on racing and crew communications rather than boat handling activities. Winds were moderate and they were not significantly overpowered. He did not remember seeing any other capsizes during the training session. There were around 15 boats out practicing.

      As they reached the windward mark they were moving fast and passing boats. He estimated that they were going maybe 17 or 18 knots. The crew passed the mainsheet to the helm and he then had both the traveler line and the mainsheet in his right hand. The traveler control line was wrapped around his right hand. He noted that the crew was releasing the control lines and he was just planning the approach to the offset mark. They were fully foiling, but stable. When they reach the offset, he begun the bearaway and the leeward hull started to go down and there was no way to recover. Next thing he knew he was in the water and there was pain in his right hand. The crew asked if he was ok and he replied, No. He saw that his fingers had been cut off and held his hand out of the water.

   b. Crew Statement – This is taken from then crew's emailed statement.

      Practice race with approximately 17 boats, run by coaches.
      It happened in at least the third practice race of the day, there were approximately 25 boats in the race immediately before this one. We had been tuning for 1.5 hours before we did one full practice race and then this race.
      Course was start, windward mark, offset, gate, windward mark, offset, finish line.
      I do not recall seeing any other capsizes.

      It happened at the first offset mark. The offset mark was at about 90 degrees to the wind.
      We started the race at the pin, foiled on starboard, tacked, foiled on port, tacked on starboard lay and started foiling again. Many boats were not foiling because of their lack of practice and the sea state that makes foiling more challenging. Speeds between us and those in traditional catamaran "hull-down" mode were comparable but foiling was for sure faster.
      We soon had two boats to leeward of us who were going slower pinching up to make layline. We were in third in the race because as they pinched up, we went faster over the top/outside of them. After clearing the mark, still foiling, I passed off the main sheet to Bora, then reduced lift on the leeward foil. I added rake on the windward foil. I do not remember exactly but I eased jib, eased Cunningham and eased rotator, our usual procedure when bearing away. That means Bora was dealing with mainsheet, traveler, and of course the tiller. On the starboard side of our boat we do not have any foot straps so neither of us were in a foot strap.

This whole summer of training we had not a single pitchpole. In fact only three or four capsizes ever. With the elevator's the boat is much less prone to pitchpoles than the old boat (this is the rudder foils). However in this case we were going very fast, and we both knew it at the time. But we had never had any drama in the bearaways so I expected it would be fine. Next thing I know the bows dug and we were both flung forward. Going from 19-22 knots to 0 very quickly.
I remember pulling my hand off the forestay but knowing I was totally fine. Then I asked Bora if he was ok, heard him say No and turned to see his bloody hand with fingers gone, although I couldn't tell exactly which or how much, I knew he was not sailing in and needed immediate help.
I saw Gabriele Bruni, Italian coach, very close and taking video. I started screaming and waving my hands until he noticed and realized a few seconds later. Within moments he was there taking Bora into the boat and I stayed with the Nacra.
I got the main down and then Santi Lange was dropped off to help me sail in. As soon as I got to shore, others helped deal with the boat and I was able to go in the ambulance with Bora to the hospital.
I do not recall who was around us at the time of the accident. I think the two boats that we rolled at the windward mark were Iker Martinez / Olga M (ESP) and a NZL boat but honestly I am not sure.
We did not have any cameras on the boat that day, nor Velociteks. Yes, uncharacteristic of us. Had tapered off the technology leading up to Worlds as we had long days and our focus was on racing communication and mindset instead of boathandling/technique/boatspeed improvements.

5. Video Review

a. The Italian Federation has provided video that was shot by the Italian Coach, Gabriele Bruni, who was also the first responder to the injured sailor. The Coach was to windward and following the US Team's progress into the windward mark and along the offset. The video ends when the Coach goes to respond to the cries for help.

b. The video can be used to identify the movements of the boat and persons on board, although the video's angle does not clearly show the sailors entering the water, and later there is interference from other boats going around the mark. This is the only video or photographic evidence that has been made available. See still frames in Appendix D.

   i. Hull movement through the incident: The hull digs in the leeward hull and begins the pitchpole at 0:53 seconds and the sailors are in the water at the forestay by 0:54. We note that the traveler is holding the mainsheet close to centerline until 0:55 when it is shown to be down to leeward indicating that it is no longer being held. The mainsheet is never eased. At 0:56 the hulls are both in the air with daggerboards and rudders showing and the bows submerged near where we know both sailors have entered the water. The hull pivots away from the sailors on the leeward hulls bow and spins away and onto its side on the leeward hull as two boats pass. By 0:58 the hull is seen on its side with both sailors near the bow, on the top side of the hull and away from the daggerboards. At 1:07 you can see a sailor holding one hand up out of the water, and at 1:19 the crew who is closest to the hull signals for help.

   ii. Trajectory of persons on board. The time from the bow submerging to the sailors being in the water near the bow is between 1 and 2 seconds. By their accounts, both sailors ended up in the water near the forestay, and outside the hulls. As the video frames are slowed it is seen that the helm's trajectory is outside of the crew and that both of his arms are flung out to the sides away from his body with his back facing forward towards the bow. The crew seems to have crouched down

prior to the pitchpole and may be more balanced during the fall, facing into the boat the entire time. Both sailors are hanging on their trapezes and swinging forward as the boat stops. The helmsman has stated that he had the traveler line wrapped around his right hand, tiller in the left, and mainsheet also in the right. He seems to pivot around his right hand so his back faces forward. He is seen passing the crew in the air swinging by his trapeze with both arms flung out to the sides. The crew's fall is more controlled. She has crouched into the hull to adjust some control lines, is more balanced as the pitchpole begins, and has fewer lines in her hands.

iii. Possible impact points are the trapeze lines and the forward stays. The video shows that during this violent part of the accident the sailors are well clear of the hull and its appendages. In examination of the boats design features, rigging and outfit during this accident investigation it was noted that the lines and wires are thin and under load, and can cause cutting in a high impact accident.

iv. The helm has identified the traveler line wrapped around his right hand as the mechanism of the injury. In watching the video it can be seen that the main is on centerline until second 0:55 of the video when it suddenly drops to leeward. The sailors are not visible at this angle but this tells us that the traveler line has come loose and we know both sailors are forward in the water.

v. In the video a number of other Nacra 17 pass by the offset mark. None of them capsize or pitchpole. This leads to the conclusion that there was a unique activity that caused this boat to pitchpole. The Nacra 17 was not outside its racing limits in these conditions.

c. Validation of personnel statements. Each sailor was interviewed by the Chairman individually right after the incident. The crew supplied a written statement by email as requested. The injured helmsman only provided a verbal statement due to his incapacity. In preparation of this report the sailors were interviewed together via telephone and the Chairman reviewed the video with them at that time. The final interview collaborated each sailor's previous statements.

6. **Shore Side Report**. The Working Party includes Hugh Styles who was on shore and part of a group of Coaches and sailors that came to the aid of the sailor once returned to shore by the Italian Coach. First aid was provided from Coach boat first aid kits. No event organization was in place at the time of the accident. There was confusion with the ambulance and the ambulance initially arrived at the wrong side of the harbor and was delayed. It is obvious that it took some time to get an ambulance to the scene because the crew reports that she caught the ambulance even after sailing the boat to shore with the help of a sailor who was transported from shore for the task. The accident happened on 30 August and the event was scheduled from 5 – 10 September.

7. **Findings**. The root cause of the injury was an unanticipated pitchpole.

a. This section offers a progression of "how" the incident occurred to focus our view of the likely cause of the injury. The incident occurred because of a pitchpole when the boat suddenly went bow down and stopped, and the momentum carried the sailors forward at a high rate of speed. Pitchpoles are a characteristic of all catamaran's. The injured helm had the traveler control line wrapped around his hand. His recollections identify the traveler line as the mechanism of the amputation. The video cannot confirm this directly from its angle of view, because the sailors are not visible. However, the video does show the traveler control holding the mainsheet car close to centerline while the sailors are being thrown forward, and falling to leeward after we know that the sailors are in the water. The mainsheet itself appears to remain

cleated throughout the capsize. There is a possibility that the helm's hand could have made contact with the trapeze line of the crew as he was flung outside of her position with his hands flung out from his sides. Either way, there is not conclusive video evidence to support an exact determination of cause. We are certain the sailor was not in contact with the boat's appendages during the violent portion of the capsize when there was the possibility of energy being present to cause this extensive an injury.

b. The video shows that the leeward hull drops and digs into the water to initiate the pitchpole right at the offset mark. That action would be caused by an unbalancing of the boat at that time. The forces on the mainsail change as the mainsail controls are being eased as stated by the crew, increasing the force on the mainsail and moving the center of effort forward, and possibly up. This would cause a greater downward force on the leeward hull, and cause the bow down attitude the boat takes as it digs in and pivots around the leeward bow during the pitchpole. The helm is not clear on whether he moved the tiller to bearaway but it is assumed that he did. This also contributes to creating an unbalance in the boat.

c. Personal Protective Equipment (PPE) was worn by each member of the crew during this accident. Both had helmets on, wet suits, lifejackets, harnesses, boots and gloves. The gloves worn are for grip only and offer no cut protection. There were no other injuries reported beyond the amputation.

d. Coaches, safety and first aid: In this case both the coach who transported the sailor to shore and Police on shore were trained in basic first aid and had supplies available. A call was placed for emergency services. The incident occurred prior to the start of the event and there were no logistics in place for this level of emergency.

8. **Recommendations** – There are many injuries that are common in sailing including bruises, abrasions, concussions and broken bones. Amputations to fingers are not common but do occur. They are not commonly thought of in dinghy racing and are more likely to occur in offshore boats with winches and higher loaded sheets. The cause of the injury was an unanticipated pitchpole. Training and sailor awareness of the inherent dangers of sailboats and high speed capsize need to be reinforced to all participants.

   a. Personal Safety Awareness – Wrapping lines around the hand should be discouraged. This lesson is taught in learn to sail and must be reinforced as the sailor's progress into higher performance boats.

   b. Personal Safety should inform the design of the boat's rigging and controls. Controls allowed in the class rules should have sufficient purchase to allow a high-performance sailor to hold the line without wrapping it around a hand. It is beyond the scope of this investigation to assign that force.

   c. Personal Safety Equipment – Sailors should wear gloves that protect against cutting by thin lines and wire under load. These are commercially available at low cost. The standard these types of gloves are tested is based on cutting with a straight edge. There are no protection standards that apply to wrapping lines around a hand.

   d. Event/Local Emergency Preparedness – Sailors and Coaches training at an event site should be made aware of safety procedures and logistics. Safety procedures should be agreed with local services prior to the training period for an event. Communication of these preparations are critical for sailors and coaches, and are the responsibility of the local hosts.

   e. On-the-Water Safety – During training, sailors depend on each other and their respective Coaches for assistance in an emergency. This culture is a good feature of our sport and creates the community that makes our sport thrive. This community should prepare itself for emergencies. Many coaches are already required by their respective MNA's to carry first aid

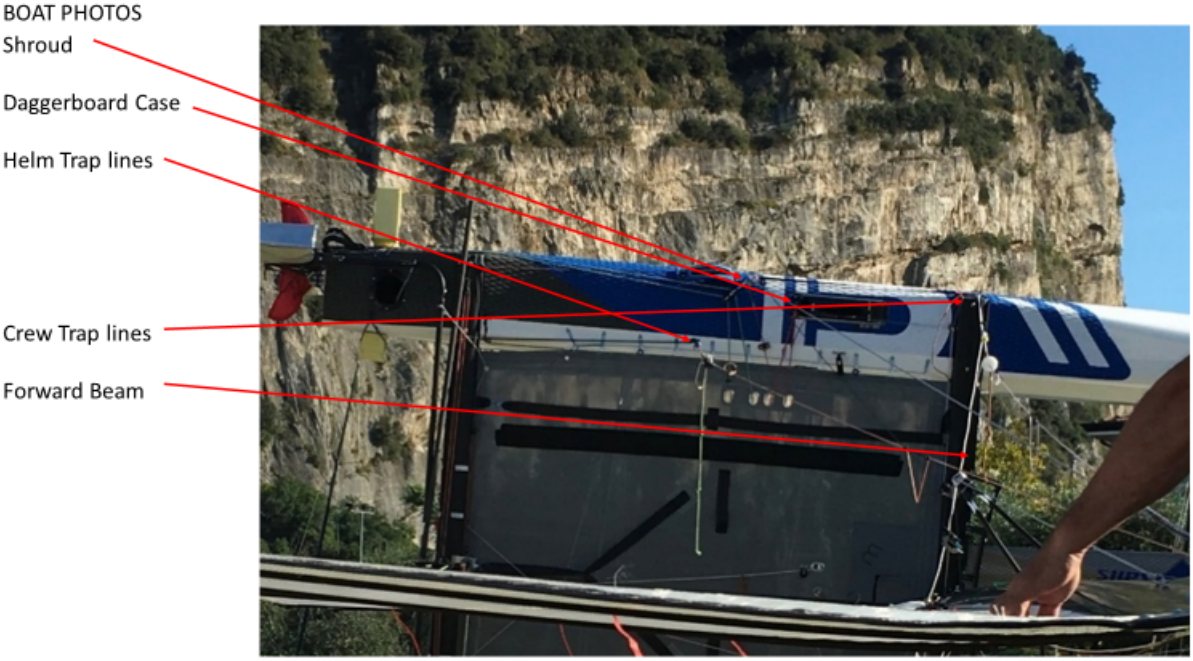
kits in their coach boats and have basic first aid training. Coach training is the prescription of their MNA's however World Sailing should strongly recommend that all coaches have some level of first aid training. Many already do. Secondly, all Coaches should be expected to carry first aid kits in their boats to assist in the case of an injury.

f. During an Event, Organizing Authorities (OA) should review emergency preparations with the World Sailing Technical Delegates. All Race Management personnel should be made aware of the logistics plans in place for injuries away from land such as who to notify in Race Management, the OA, and the local first responders. Anyone who might be involved with transporting an injured sailor from the water to meet first responders should be aware of where to go to transfer an injured sailor. This would be best accomplished in a safety brief given to all competitors, coaches, race management and support boats as soon as practical leading up to an event.

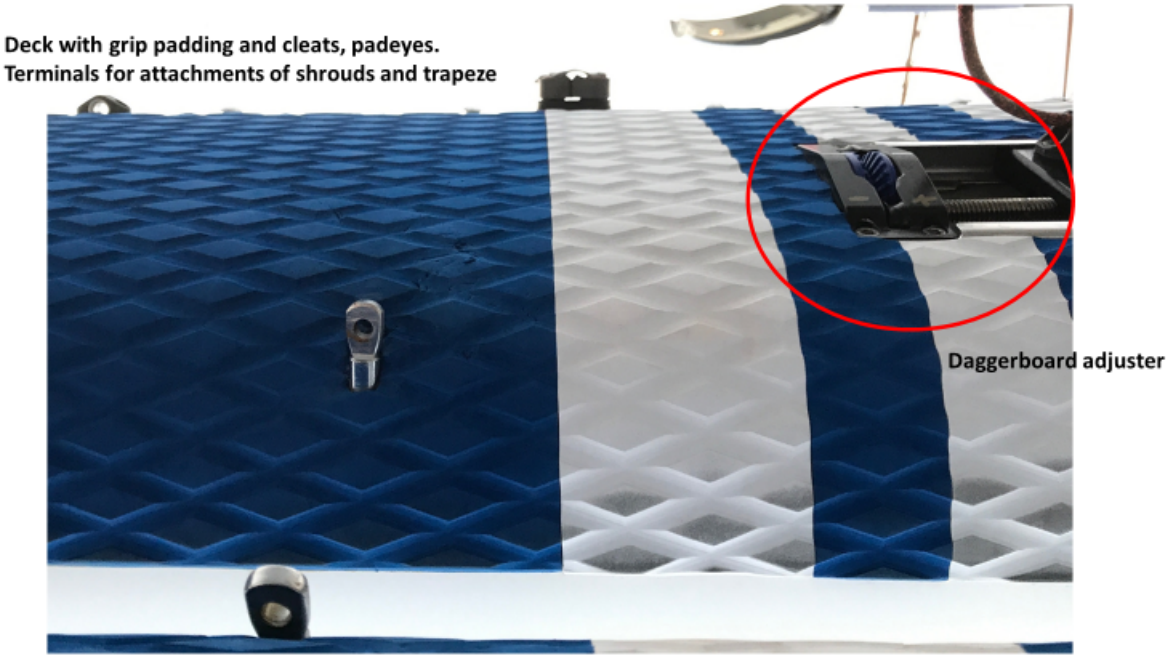
Appendix A – Photographs of the NACRA 17

NACRA 17 in the Mark 2 Configuration
Photograph is for illustration of boat

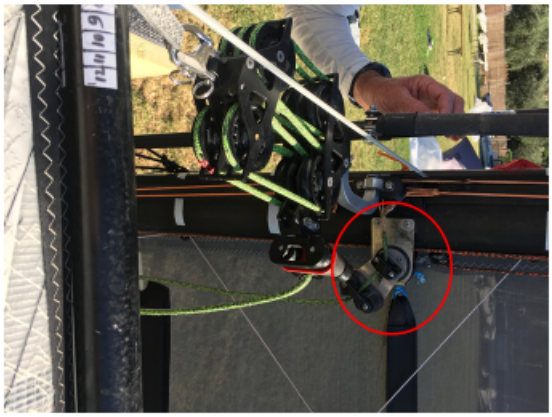
BOAT PHOTOS



Shroud base



Traveler Arrangement – 6mm control line

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NACRA
17

Appendix B – Specification of the NACRA 17

Standing rigging		Size		Material	Associated Hardware	options or restrictions
	Qty	Length[1]	Diam.			
		mm	mm			
Forestay	1	6250	4.0	Standard 1 x 19 stainless steel wire		±0.05 mm diam. wire and C.10.5 (a)
	1				Shrouds Chainplate	C.10.7(a)(2)
Bridle	2	-	-	Standard 1 x 19 stainless steel wire		Nacra Licensed suppliers only
	1				Bridle fitting NA31698	Nacra Licensed suppliers only
Shrouds	2	6810[2]	4.0	Standard 1 x 19 stainless steel wire		diam. ±0.05 mm.
	2				Sta/Master	C.10.7(a)(2)
Diamonds	2	6100[2]	4.0	Standard 1 x 19 stainless steel wire		diam. ±0.05 mm.
Bowsprit bridle	2	1580	2.5	Standard 1 x 19 stainless steel wire		diam. ±0.1 mm, length ± 5 mm
Bowsprit mid-bridle	2	1750[2]	3.0	Dyneema or polyester		±0.2 mm diam.
Tramp lace rear	1	4300[2]	-	Dyneema or polyester		±0.2 mm diam.
Tramp laces side	2	4000[2]	-	Dyneema or polyester		±0.2 mm diam.
Trapeze lines	4	-	2.5	1 x 19 stainless steel wire	open, see C.10.8 (a)(1)	±0.2 mm diam. Shall be either 1x19 stainless steel wire, Dyneema sk75/80 or polyester or a combination.
			3.0	Dyneema or polyester		

Figure 1B - Class Rule Defining Rigging Size

Appendix C – Information about Gloves and Gloves That Are Commercially Available

Standards for Cut Resistance

ASNI, ASTM, ISO and EN all have similar standards for measuring cut resistance of protective clothing.

Method of Test

In the ASTM F1790-97, ASTM F1790-05 and ISO 13997 test methods, the sample is cut by a straight-edge blade, under load, that moves along a straight path. The sample is cut five times each at three different loads. Different standards use different cut lengths, but they are all collecting similar data and rating based on cutting force (load applied) to the standard blade.

The higher the cutting force, the more cut resistant the material.

Model Showa 370 – Gripper Glove
BS EN 388 Standard

- Gripper glove ideal for mechanical work, plumbing, parts assembly, tiling and carpentry
- A lightweight and supple gripper glove with ventilated back
- Nitrile coating leaves the knuckles free whilst protecting the rest of the hand
- Characterized by its durability, dexterity and high levels of grip
- These gloves have the lowest level of CUT RESISTANCE by this standard (Level 1).

Cut Resistant Gloves of Similar Function

Oakcliff Sailing Foundation Research of Cut Resistant Gripper Gloves

- Sailors need gloves that help grip wet lines
- Sailors should be encouraged to wear gloves that prevent cuts to their hands in uncontrolled capsizes.
- Current Commercially available options tested

What Oakcliff sailors and Coaches thought:

922CR Ergodyne ProFlex 922CR
EN 388 Level 5, ASNI Level 3
$25 per pair, longest wear

Radians RWG603
EN 388 Level 5, ASNI Level 5
*Did not hold up at the crux of the thumb
$15 per pair

Heavy Duty 11-501 – EN 388 Level 4, ASNI Level 4. Ultra durable Kevlar® blend. Foam nitrile coating for secure grip.
$19 per pair

Appendix D – Photographs from the Still Frames of the Video

Stills taken from Video

Accident occurred at the bear away after rounding the windward mark, as the boat turns at the offset mark.

Pictured:
Approaching the Windward Mark – Note sailors positions, trapezing side by side with crew straddling the Shroud.

Figure D1 - Prior to Windward Mark

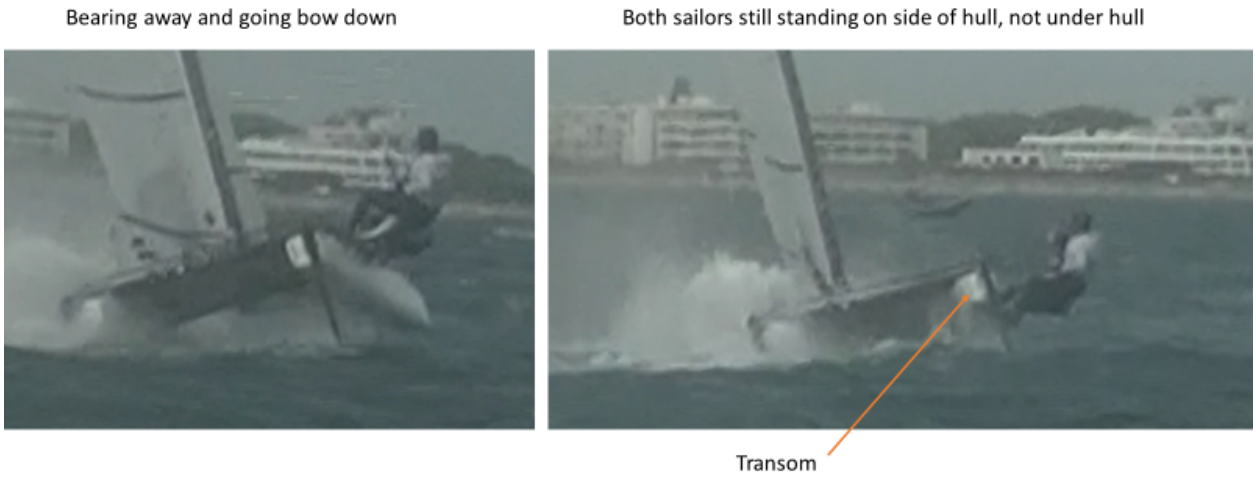

Figure D2 - Early in the Pitchpole

These freeze frames begin at 0:53 of the video

Sailors still above the water, far away from hull

Looks like skipper is now outside of crew

Figure D3 - Next Frames

The video is not clear enough for conclusive determination of what cut the sailor. The series of still frames taken from the video are over approximately one second of time.

1. Both sailors are well away from the daggerboard.

2. Both appear to be on their trapeze. Lines are not visible.

3. Helm's body is rotated with his back pointed forward and Crew appears inside the helm.

Figure D4 - Zoom In to See Helm's Position

Figure D5 - Sailors not seen, traveler up (0:54)

Figure D6 - Traveler Down (0:55)

Figure D7 - At 1:00 in the video
Sailor visible in the water

Figure D8 - Still at 1:07
Sailor with hand raised out of water.

Figure D9 – Still at 1:19
Injured Sailor with hand raised floating away from boat with crew close to boat

Palm up

Palm down

These photos are approximately
3 weeks post injury.
Note large abraded area of the
ring finger. This finger was pinned
By the Emergency Room Dr.
Indicating that the finger was
Broken during the accident.

Figure D10 - Image of Right Hand After Amputation