Head and Neck Restraint Cockpit Extrication Evaluation

Test Report

Bob Wartinger, 2015

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Disclaimer

A driver has the ultimate responsibilty for his or her safety. The UIM, WPPA/XCAT, do not recommend a particular brand or model of safety equipment and presents the data in this report as information only.

Introduction

Head and neck restraints have proven their value in lowering the risk of injury in the case of crash impacts in motorsports. Although the first development of devices is generally attributed to the need of restraining the head from forward motion in rally car head on accidents, the HANS device pioneered by Hubbard and Downing, also an "early" device, and was introduced to boat racing in the 1990's in classes where the drivers were restrained inside the cockpit. The early device had the intrinsic merits of a restraint, however, the fixed length of restraint straps which could somewhat inhibit or restrict the turning of the head and the relatively high rear collar on the device which might catch on the cockpit overhang (design at that time) during extraction had some drivers reluctant to adopt their use.

During the 2000's other models in addition to the HANS were developed and the introduction of the sliding retention strap was introduced. The sliding strap was also incorporated into the HANS and the ability to turn the head was improved without compromising the retention capabilities. The overall height of the rear collar became lower and this change resulted in gaining the attention of boat racing drivers because it seemed that extraction from the cockpit would be easier.

Standards for the restraints were also developed, notably the SFI 38.1 and the FIA 8858.

Purpose

The purpose of the evaluation was to determine if the extrication concerns expressed years earlier were still valid or had been mitigated by the design developments incorporated in the currently available devices.

Process

During the OPC Committee meeting at the 2015 UIM General Assembly in Monaco, an extrication test using head and neck restraints and the dunk training tester was proposed to be accomplished in Abu Dhabi at the Grand Prix of Abu Dhabi on November 4-11, 2015. The testing, led by Gianfranco Venturelli was accomplished on November 4^{th,} as planned, and the full report can be seen in the UIM Digital Logbook - Event – Commissioner report, Folder: Report, for the Abu Dhabi Class 1/V1 event.

A short synopsis of the above referenced test (Nov. 4, 2015) report follows: The testing was accomplished using the HANS devices, the UAE NA dunk training cockpit, and test personnel from the Bergamo Scuba Angels, two Class 1 drivers and two V1 drivers. Escapes and extrications were accomplished from both the standard cockpit hatch and the escape tunnel hatch, the smaller of the two exit routes.

A summary of the conclusions relating to the head and neck restraints follows and is quoted from the test report.

"It is suggested to consider the following points:

1. Neck containment device with a minimum size on vertical dimension

2. Strap connection with easier helmet release, and protected to avoid being a trap with any Cockpit equipment including seatbelts.

3. Wear the neck device over the life jacket, providing that the same area of contact with the device is not a floating or buoyancy material.

4. The use of the floating overall UIM Homologated and Drivers accepted, can avoid wearing the life jacket. That is a facility by the escape point of view, because it reduces the possibilities to remain locked inside the cockpit. Moreover, that would reduce also the difficulty for the pilot, to lock the seatbelt in a more effective way."

After discussion between Cominsafe, WPPA and XCAT regarding the results of the first test and considering the desire of WPPA to require the head and neck restraint in the 2016 season, further testing was planned. This additional testing was to determine the ability of some of the latest design devices to eliminate the difficulties found during the November 4, 2015 testing and noted above.

This test was accomplished on November 20th, 2015

Test Description

A test plan was developed for further testing, circulated for review, and is included in the Appendix.

Test Equipment

1 Medium size Simpson HANS III

1 Large size Simpson HANS III

1 Medium size Simpson Hybrid Sport

1 Large size Simpson Hybrid Spor

1 Simpson Hybrid Pro Lite

1 Simpson prototype (low profile)

The shoulder pads on the underside of the devices had been removed because this support will be taken up by the driving/flotation suit and/or lifejacket material.

- Other head and neck restraints provided by test personnel as their own equipment. This consisted of two earlier design HANS systems similar to what was used in the November 4th testing.
- Helmets equipped with anchors located per SFI 38.1 and / or FIA 8858 . This consisted of SPARCO helmets with standard restraint attchment locations and hardware.
- Personal air systems, were provided as part of the dunk training tester (regulator, tanks and hoses).
- UAE National Authority dunk training aparatus and equipment.
- Still photographic equipment.

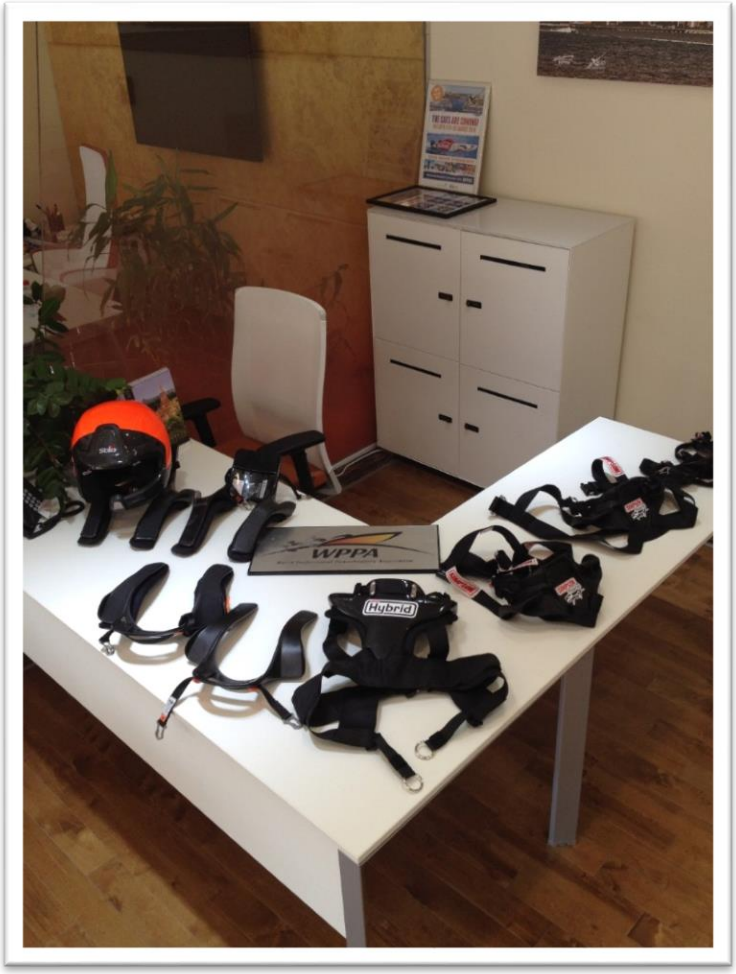
Test Personnel

The two divers that performed the previous, November 4th, test, Fabrizio Boffi and Dani Moujaes, were available to perfom these tests. Other members of the Bergamo Scuba Angels assisted. Bob Wartinger (Cominsafe), and other WPPA personnel were present and recorded the observations of the divers after each test.

Test Procedure - November 20th, 2015

The head and neck restraint devices were displayed, examined, and compared to each other prior to the testing in order to determine which devices might be the most optimum for testing.

The new HANS III devices have a lower profile than the original HANS which is advantageous for extraction, but the Hybrid versions offered the lowest profile of all and were chosen for the testing. The Hybrid also had an advantage over the HANS III as it did not bear on the chest area where certain types of flotation are often placed in lifejackets or flotation suits.



Devices examined and available for dunk testing evaluation.

After examination of the devices, the group decided to test the Hybrid Sport version due to it's low profile. The two divers who were going to test had also tested the larger HANS models during the previous test and the concensus was that by using the same divers we would obtain the most information. The Hybrid Sport version had the smallest external dimensions of the devices available and should pass through the escape tunnel the easiest.

The group moved to the dunk training cockpit for the test. The training cockpit is a replica of a Class 1 cockpit, which means it is slightly larger than the XCAT cockpit. It is also the cockpit that was used in the previous test.

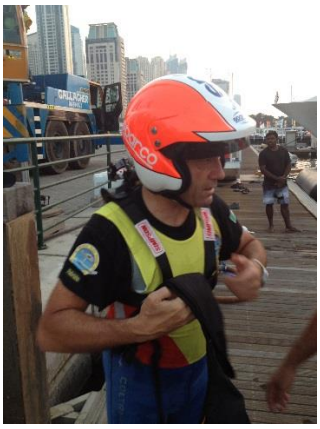
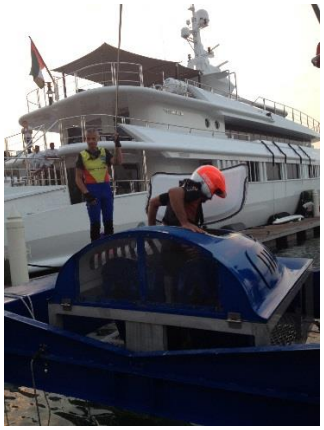
The smallest opening is the escape tunnel and it is 55mm x 55mm. This is the same size as the escape hatch opening in the XCAT cockpit.

Escape hatch in tunnel of XCAT hull.

Overhead hatch opening.

Dunk test cockpit and frame.

Cockpit rotates within the frame.



The divers adjusted their head and neck restraints and entered the cockpit. The divers were strapped in and then rotated to the inverted position. One of the divers is seen checking his ability to open the larger hatch and his range of motion with the head and neck restraint in place. The belts were released, the escape hatch removed from inside the cockpit, and the divers exited.

The cockpit was not immersed during the three trials to enable full exploration and this did not impact the results of the trials.

Test Results

The divers discussed their exit experience after each trial and for all three trials, the Hybrid devices proved much more comfortable and cleared the opening significantly easier than the HANS devices used in the previous test. On the third trial, the second diver to exit became held up by the restraint belt entangling itself in the head and neck restraint straps. He was unable to exit until the first diver returned to help release the impediment. It was difficult to imagine how the interference occurred looking at the equipment outside of the cockpit. It was believed that one of the shoulder restraints had somehow been incorrectly inserted between the helmet and the head and neck restraint straps when the diver strapped in during the test. Normal driver procedures for strapping in are such that this would not happen.

The restraint straps attached to the helmet in the test configuration did not have the quick release fittings and the divers commented that the quick release fittings might help should the device need easier removal during extraction. (It should be noted that the quick release fittings are a standard item that is available).

Another comment was that a width reduction on the shoulder belts from 7.5 cm to 5 cm would also retain the device as well as the 7.5 cm belts.

Another, and very significant, point made by the divers was that the ability to turn their heads was considerably easier and that they had a much larger range of motion than with the earlier HANS devices used in the Nov. 4th test. One of the divers had the restraint straps shortened as far as possible and still remarked about the ease of head turning and the great amount of rotation of the head/ helmet that was possible.

A few days after the test, a meeting was convened by Sid Bensalah that included Gianfranco Venturelli, Bob Wartinger, Fabrizio Boffi, Sergio Abrami, Eric Stark, Shaun Torrente, Sebastiano Pellecchia and Jodi Zylstra. The meeting was called to have a discussion reviewing the test and to discuss other possible changes that might be made to lower the risk of injury in a crash of an XCAT. Both Stark and Torrente are using Hybrid head and neck restraints in their F-1 class boats and stated that they would not race without them. Both have used the restraints for a number of seasons and Torrente has had to exit his F-1 cockpit a number of times and has had no issues. Stark stated that the safety equipment and the head and neck restraint probably saved his life during a severe crash in his F-1 boat in September, 2015. Boffi stated that from a rescuers point of view, he would be able to extract an unconscious driver by gripping the corners of the driving suit and/or the capsule lifejacket and lifting/pulling. The head and neck restraint would not get in the way and if there was any impediment, he would release it by using the quick release strap retainer ends. Pellechia suggested consideration of homologation of a type of head and neck restraint, i.e. make and model. This was considered a concern due to possible liability, but the information describing the successful results of the test and the comparison of the different types of head and neck restraints could be made available to the

drivers on the UIM web site and issued through WPPA communication channels in order to educate the drivers.

The inflatable lifejackets were judged to not be suitable for wearing in conjunction with the head and neck devices. They do not provide adequate support for the device and there is a question about what might happen if the lifejacket inadvertently inflated under the head and neck restraint. The capsule type jacket or the flotation suit would be the choice for flotation with a head and neck restraint device.

Venturelli expressed concern that arose during the test on Nov.4 regarding the diminished visibility related to the restraint straps on the HANS devices inhibiting movement. Two points were made to address his concern. One, the devices tested on November 20th were a vast improvement over the earlier design head and neck restraints permitting normal rotation through the neck, and two, a point was made by the drivers in attendance that the driver will adopt a different style of driving, will use the mirrors more (which requires improvement in some of the mirrors in use), and be able to drive as well with added protection.

Conclusions from the test

1) The concerns (listed above) that were raised from the November 4th test were satisfactorily resolved by the up to date Hybrid devices used in the November 20th tests.
2) The mandatory use of the low profile head and neck restraint with quick release anchors should be required for the 2016 season.
3) The inflatable life preservers should not be allowed to be used by the pilot or throttle man in XCAT racing. The capsule suit lifejacket or floating coverall should be used.
4) The efficiency of the head and neck restraint device depends on the proper use of the restraint belts, their mounting angles, and tightness.
5) There may be some time required for familiarization by the drivers as they learn to use the restraints. May require some practice time at first events if the team has not tested very much.

References

SFI Foundation Inc. Specification 38.1, Head and Neck Restraint Systems, March 16, 2015
http://www.sfifoundation.com/wp-content/pdfs/specs/Spec_38.1_031615.pdf

FAI 8858, HANS System
http://argent.fia.com/web/fia-public.nsf/0DE933700BF33F8EC125744300356035/$FILE/11_FIA_Stand_8858_2002_Hans.pdf

OPC Dunk test with Hans Device in Abu Dhabi,

November 4, 2015, Gianfranco Venturelli,

UIM Digital Logbook - Event – Commissioner report,

Folder: Report, for the Abu Dhabi Class 1/V1 event.

Simpson Performance Products

simpsonraceproducts.com/shop-by-product/head-neck-restraints/hybrid/

1.800.654.7223

Bergamo Scuba Angels

http://www.bergamoscuba.com

World Professional Powerboating Association (WPPA)
http://xcatracing.com/about-wppa
Contact: Sid Bensalah, Sid.b@thewppa.com

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Appendix

Head and Neck Restraint Evaluation

Test Procedure

Purpose of the evaluation:

Evaluate the extrication of the driver from the cockpit while wearing a head an neck restraint during competition. Examine both the drivers self extrication capability and the extrication capability when the driver is extracted by or aided by diver(s). Extrication capability is the term used to describe the relative ease or difficulty encountered during the extrication from an Offshore cockpit. Also determine the relative comfort of the various head and neck restraints tested and the lifejacket to device interface or driving suit to device interface as to it's ability to carry the device and the shoulder restraining belts effectively.

Evaluation equipment:

Medium size Simpson HANS III

Large size Simpson HANS III

Medium size Simpson Hybrid Pro

Large size Simpson Hybrid Pro

Simpson Hybrid Pro Lite

Simpson prototype (low profile)

The Simpson devices listed above are to be used in evaluation only and are not all certified for racing. They match the certified product in form and fit. The shoulder pads on the underside of the devices have been removed because this support will be taken up by the driving/flotation suit and/or lifejacket material.

Other head and neck restraints provided by test personell as their own equipment.

Helmets equipped with anchors located per SFI 38.1 and / or FIA 8858 .

Personnel air systems.

Dunk test aparatus and equipment.

Video equipment, if possible.

Personnel

2 test personnel

Minimum 2 rescue divers

Observers, recorder,

Video personnel (if possible).

Procedure

- Ensure that the test person is properly fit with helmet and head and neck restraint device. The tethers are properly adjusted for use.
  Note: The difference between the medium and large size devices is primarily the width between the shoulder supports and should fit comfortably to the shoulders.

- In a dry environment, the test subject(s) will go through the process of extrication exiting through both openings, if possible, and note any issues and also what works well.
- In a submerged environment, the test subject (s), will exit through each opening and note any issues and also what works well
- In a submerged environment, the divers will perform extraction according to their procedures and note any issues and also what works well.

The head and neck devices supplied by Simpson may be modified to be able to facilitate the extrication process and this information will be conveyed to the manufacturer.

Data Collection

Between each demonstration, the test clients and divers verbal reactions about the extrication process will be noted.

Video information, which may have been collected, may also be edited and used for the report.

Report

A report will be prepared describing the process activities, results, and conclusions.