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Transport Canada Study Finds Immersion Suit Performance Worse than Predicted in Realistic Sea Conditions

Sometimes bad news is good news. Take, for example, a recent study commissioned by Transport Canada, Marine Safety which found, on average, immersion (survival) suits challenged by realistic sea conditions leaked more than twice the amount predicted by the current federal standard designed to test and approve their performance. This recent report is bad news because it confirms most immersion suits do not have the thermal effectiveness expected when they were initially tested then approved by Transport Canada. On the other hand, this report is also good news because it provides Transport Canada the necessary information and motivation to improve the performance of immersion suits, and arguably, creates a legal obligation for it to do so.

The report is clear in many respects and warrants quoting: "*The method used in Canada to evaluate the thermal protection offered by approved immersion suits currently involves measuring the amount of water that enters the suit system on 11 subjects after a minimum 4.5 m jump into a calm pool followed by a 60 minute swim. The ability of this test method to estimate realistic water ingress was questioned after a fatal marine accident in 2004 where excessive water ingress was indicated as a contributor to the fatalities.*"

That accident was the sinking of the Victoria-based trawler *Hope Bay,* which drew attention to whether testing immersion suits in a "calm pool" was an accurate reflection of how the suits would perform in realistic conditions. Several more accidents followed that highlighted concerns that immersion suits were not providing the thermal protection at sea they had demonstrated in pre-approval testing. Once such case involved the towboat *Checkmate III*, which sank off Trinity Bay, Newfoundland in February of 2008. The Department of National Defence, whose coordination of the rescue effort came under scrutiny, conducted an internal review of the rescue operation.

That internal DND report of the *Checkmate III* rescue, obtained through an Access to Information Request, noted "*perhaps the most troubling aspect of this case relates to the survival suits. The two men in this case were wearing survival suits that should have allowed them to survive long enough to be saved. The fact that the suits contained so much water clearly did not allow them to maintain their thermal integrity. Why they contained so much water is not known but requires review by the responsible authority*". "*Had the immersion suits not been full of seawater and thus unable to provide sufficient amount of thermal protection, the suits should have sustained them until long after the SAR units arrived on scene*". The modeling software used by the SAR team (Cold Exposure Survival Model 3.0.5) provided an estimated survival time of 36 hours based on the assumption the immersion suits remained dry. The report noted "*the fact the casualties were wearing immersion suits led to the perception by the entire SAR team when they arrived that the casualties would be recovered hypothermic, but alive*". The bodies of the two crew were recovered two hours after the sinking, their survival suits flooded by the two-metre waves.

As a result of accidents such as this, Transport Canada funded two studies to measure whether the current standard for testing (and approving the performance of) immersion suits was providing an accurate measure of the amount of water ingress that would occur during an actual abandonment in storm conditions. The first study was carried out at-sea and found that the current standard for testing immersion suits did not underestimate ingress. This study was criticized, however, because the weather conditions on the day scheduled for testing were calm and did not challenge the seals of the immersion suits.

A second phase of the study was scheduled using a wind and wave pool in Nova Scotia. 11 volunteers wearing three varieties of immersion suits were exposed to simulated storm conditions for three hours. Following the study the report concluded that "*although the CAN/CGSB-65.16-2005 immersion suit standard has the highest requirements for immersion suit insulation in the world, this Phase 2 research has shown that the potential for water ingress in immersion suits in emergency use could be much higher than the current CAN/CGSB-65.16-2005 water ingress test method estimates*".

The study tested two common designs of immersion suits that zip up the chest to the chin, with a seal around the face. This design has come under some criticism for several reasons, including: the effectiveness of the seal relies on it fitting tightly around the face, which is difficult for a universal size suit to do on many different face shapes; the seal is openly exposed to the force of waves and spray; and water that finds its way past the face seals leaks directly into the body of the suit. The study found that the two face sealing immersion suits allowed an average of 2.5 and 2.6 kilograms of water into the suit, which was more than twice than was expected based on the current method of testing. As a result of this ingress, neither of the two face seal suits met the minimum required thermal capacity required by the federal standard.

Interestingly, the report also tested a third, less common design of immersion that incorporated a horizontal zipper across the chest and latex neck and arm seals. The suit design used a neoprene hood that covered the neck seal and a clear spray shield that covered the face. The study found the neck seal suit had an average of .177 kilograms of water ingress. The study noted that "*the two suits with unprotected face seals were found to permit significantly more water ingress (approximately 15 times) than the neck seal suit (where the neck seal was also protected by a hood and sprayshield).* The study found that although keeping water out of the suit was critical to its ability to keep the mariner warm, some suit designs were more susceptible to heat loss given the same amount of water ingress.

The report concluded by recommending "*a new water ingress test method be developed... that will reflect the water ingress challenge presented by environmental factors*". This recommendation reflected the concern that marine safety critics, the DND, as well as the Transportation Safety Board had previously expressed. It remains to be seen what Transport Canada will do with the findings of their study. Significant questions arise from the report's conclusions. If the report's findings are applied against all immersion suits currently on the market and on vessels, what portion of them fail to meet Transport Canada's own requirement for thermal effectiveness? Should Transport Canada warn mariners ingress in realistic conditions is worse than expected? I cannot answer these questions, but I am certain that Transport Canada cannot sit idle with the information it currently has.

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