

# DIVING SAFETY ALERT

## May 2007

### Diver Injury using Cavitation Blaster

A new type of HP Water Blasting system has been introduced to GoM divers.

A new underwater HP Water Blasting unit using a 4500 psi jet stream instead of 10,000 psi has been used to clean marine growth from structures and vessels, the principal is an engineered system that uses cavitation (explosive bubbles) to remove marine growth.

The system at the time of the incident was being used to clean marine growth from an offshore facility and has only recently been introduced by a couple of operators in the Gulf of Mexico. The agreement to use the tool was only considered after witnessing the unit in tank tests with the contractors and operators in attendance.

As with any HP system the divers' were briefed on the potential dangers of the unit, although it was shown by the inventor that the nozzle jet stream, due to the cavitation principal gun, would not harm a diver's body if it past over it 8 to 10 inches away. This was demonstrated time and again during the trials.

Like all HP blasting systems the gun assembly was designed that a portion of the jet stream is directed to the rear in an attempt to balance the thrust of the unit and if not balanced as in traditional HP Blasting to at least reduce the push back from the front nozzle.

What was not understood until this incident is that the retro-jet had the potential of injuring the diver.

Thus it was felt by the divers', diving contractors' and the operators' that hopefully we had at last found a diver friendly water blasting system.

It's important to emphasize that everyone involved in the familiarization, training trials and offshore utilization felt this was a better system and it may still be developed into one.

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**Brief account of Incident:** During cleaning operations the diver released the trigger on the cavitation gun (deactivating the jet stream) to reposition his body. When the diver reapplied pressure to the trigger on the gun, the cavitation gun kicked back toward the diver, causing the retro end of the gun to come into close proximity of his wrist and forearm. Subsequently the retro-jet caused a high pressure (approx. 1000psi) seawater injection injury to the diver's forearm.

**Actual Severity:** Diver was recovered to the surface and immediately seen by the medic onboard the DSV. A high pressure injection injury was apparent and it was agreed that they would Medivac the injured diver to a hospital for observation. The arrangements were made by the OIM and a night flight was set-up.

On arrival at the hospital the injured person was treated by the emergency room doctor, given oral antibiotics and then released, pending a follow-up visit to a specialist. When the specialist examined the patient it was determined the wound was shallow and the small amount of seawater injected would drain without any surgery being required. Follow-up visits to observe the patient for any sign of infection were scheduled and the patient was released for active duty.

The incident could have caused permanent injury but only resulted in a first aid case.

**What went wrong in this case:** The inventor was on site earlier in the project and had reviewed all of the hazards associated with the unit but didn't think that the retro-jet posed a threat underwater, but did recognize it while surface testing the gun. There were written procedures with several warnings in red relating to keeping out of the path of the front jet within 2" to 3" of the nozzle, but no similar warning about the retro-jet. There were demonstrations and familiarization with all of the diving crew and project management on-site; there was also recognized safe operational experience by another operator without incident.

Original engineering of the retro-jet did not prevent diver injury, due to the end of the rear baffle being less than two inches from the retro-jet. During the HAZID and following Risk Assessment of the gun and system, the retro-jet was not identified as having a high pressure injection risk as was the front jet.

One thing that was discovered is that the diver was wearing protection that covered that area of his body but was not the 11" butyl rubber gloves recommended in the diving contractor procedures. As can be seen in photo 5 the retro-jet punched a hole through the neoprene glove, which may not have happened wearing butyl rubber gloves. But this is not a tested theory.

**Immediate actions taken:** A Safety Stand Down was immediately called and all work stopped on the DSV. The injured party was dispatched to the beach and an investigation was commenced. The manufacturer was notified and informed the cavitation gun was taken out of service and it was stated that the Cavitation System would not be used until redesign of the gun was undertaken and the operator's Engineering Authority has reviewed the modification and extensive testing be completed before the system can be re-considered for use.

**Subsequent Actions:** Manufacturer has modified the retro-jet by moving the nozzle further back inside the rear baffle. The incident report has been circulated within the company and this public notice is developed for distribution to the general public.

**Pending issues:** Operator Engineering Authority hasn't examined the modifications and won't be able to make recommendations until that is done. From the diver's perspective it is hoped that the retro-jet nozzle and the baffle of the gun be redesigned, so that it is physically impossible for the diver to ever be injured in the future.



Photo 1 – Cavitation gun



**Photo 2 – End view of retro-jet**



**Photo 3 – Side view of retro-jet showing proximity of retro-jet nozzle to end of baffle. (approx 3 cm)**



**Photo 4 – High pressure injection injury to the diver's forearm**



**Photo 5 – Diver's glove showing hole at location of injection**