REPORT

By the Lanchester Gun Company into the possibility of shell damage to the vessel Western

THE LANCHESTER GUN COMPANY

Tel: 01763 248708 Fax: 01763 243271

REPORT OF LANCHESTER GUN COMPANY: TECHNICAL EVALUATION OF HOLES IN FORECASTLE DECK OF FISHING VESSEL 'WESTERN', FOUNDERED ON FEBRUARY 6TH 1981

My instructions come from a Commission formed by the Justice Ministry of the Norwegian Government to investigate the sinking of the Western, and I am instructed to determine whether the holes in the forecastle deck have been created by (1) hits from high-speed missiles, (2) hits from objects with intermediate speed, (3) impacts from objects with low speed, (4) static penetration by objects being pushed into the side, (5) fabrication (eg.drain holes etc). Depending on the answer to the first question, I am asked if it is possible to estimate with some degree of certainty the direction, the speed, the mass and the shape of the penetrating object, as well as the force and energy required to create the hole.

I am further instructed that the material concerned was aluminium sheeting of 7mm thickness.

The phrase "high-speed missiles" in this context is taken as meaning artillery shells.

An immediate difficulty in my researches was that there is no database available on shell penetration of 7mm thick aluminium, since this is far too thin to be used for tank armour (or, indeed, any kind of armour). It was apparent that in order to determine the effects of shell penetration in aluminium of this thickness, the holes would have to be re-created using the appropriate cannon shells and an appropriate sheet of aluminium, in order to have something to compare with the holes as revealed by the videos.

I obtained a sheet of 6mm aluminium (aluminium alloys have improved considerably since 1986, and a slightly thinner sheet was judged to be more accurately comparable). I started by firing high-velocity and low-velocity 7.62 x 51mm rifle cartridges (the standard NATO calibre) through the sheet. Two shots were fired into the sheet at right-angles at 300 metres per second and two further shots at 800 metres per second. Photograph 1 shows the entry hole, and photograph 2 shows the exit hole, of the shot fired at 800 metres per second. Photograph 3 shows the entry, and Photograph 4 the exit, of the shot fired at 300 metres per second. The second firing at each velocity level gave results identical to the first, so these are not shown.

Next, it was necessary to investigate the effect of firing a full velocity cannon shell at the plate, and I selected a 30mm Rarden anti-tank shell, travelling at 1,070 metres per second. Photograph 5 shows the two entry holes, Photograph 6 the two exit holes, and Photograph 7 the two exit holes shown at right-angles. These photographs all show surprisingly similar results, in that a small ring of metal, almost like a crown, is forced out sideways from the entry hole, and the exit hole is surrounded by a cone of metal with ragged edges, again looking like a slightly taller crown. In all the above cases it is noticeable that the velocity of entry makes little difference; that is to say,

Bassingbourn Mill, Mill Lane, Bassingbourn, Cambridgeshire, SG8 5PP

the 300 metres per second rifle round produces virtually identical results, both on entry and exit, to the 800 metres per second round, and to the Rarden projectile. It was therefore necessary to see if a blunter and slower projectile would produce results more akin to the hole shown in Photograph 8. This hole is the one from the starboard side, and is of approximately 80mm in diameter. However, in attempting to duplicate this hole, it was necessary to take notice of the fact that the angle of entry appears to be approximately 35° to the plane of the aluminium sheet itself. This can be determined by the degree of ovality of the hole, and also by the degree to which the torn flaps of metal on the inside of the hole are bent away from right-angles (as shown on Photograph 9).

I therefore selected for this purpose a 2-bore (approximately 27mm) sporting rifle of my own manufacture, which I deliberately underloaded in order to give very low muzzle velocity (approximately 250 metres per second) and which had blunt-nosed projectiles. I then fired this at the sheet, both at right-angles and at a 35° angle, in order to attempt to replicate the starboard side hole. The first shot, fired at right-angles, is shown on the entry side on Photograph 10, and it will be seen that the results are similar to both the rifle shot and to the 30mm anti-tank round in Photographs 1 and 5. Photograph 11 shows the exit, which is again similar. Photograph 12 shows this exit hole at right-angles.

It was therefore determined that it would be necessary to fire a low velocity round (250 metres per second) at a similar entry angle to see if I could get closer to duplicating the hole on the starboard side. In this I was only partially successful. Photograph 13 shows the entry, showing a similar degree of ovality to the hole in the starboard side and Photograph 14 shows the exit hole (Photograph 15 shows the exit hole at right-angles). From this it will be seen that there are a few similarities with the entry hole on the starboard side:-

1. There is a degree of depression around the hole which is not clean punched: there is a gentle curve in the metal down to the edges of the hole.

2. The exit hole shows more tearing and a less perfect crown formation of the edges of the metal, and Photograph 15 demonstrates this again at right-angles.

However, in my opinion, the characteristics of the entry and exit holes are much more similar to the cannon round and the rifle round than they are to the hole in the ship for several reasons:- although the starboard side hole has an approximately similar entry characteristic to the 27mm rifle round, when viewed from the inside as in Photograph 9, it will be evident that there is no sign of the perfectly round entry that would be produced by a shell travelling at even low velocity. The hole is ragged, the edges are jagged, and in my opinion could not have been produced by a circular projectile, and the tearing of the metal and bending of it back would not occur at any velocity over about 50 metres per second. That is to say, instead of being folded back, the metal would be removed.

It is notable that the lower the speed of entry the more the aluminium sheet curves down towards the hole, right up to the edges of the hole. There is a good technical reason for this: the inertia of the metal is such that at very high speeds the part struck by the shell would be instantly removed, but the metal surrounding it would not have time to start to bend out of the way. That is to say, the projectile will have exited the metal before the surrounding metal can have time to start to be bent backwards. It will be noted that the 35° entry hole shown in Photograph 13 has a very large degree of annular depression, which is not duplicated in the other calibres, and it is evident that this degree of depression increases as the velocity of entry becomes lower.

Part of my researches were conducted at the Tank Museum in Dorset in England, because they have an unrivalled collection of aluminium sheets punctured by various shells and bullets: by way of interest only, I show in Photograph 16 the results of entry of a high-explosive shell in aluminium – there is always a large degree of explosion splash around the entry hole as evidenced in the upper picture, and this is noticeably absent on the ship. The point of this is that, even if the hole was caused by a shell, it is possible to eliminate a high-explosive shell.

So far in this Report I have used mainly the larger, starboard side hole because the pictures of it seem to be extremely clear, but it is necessary to comment on the relationship between the starboard and port side holes. For four reasons I do not believe that these holes are directly connected (i.e. caused by the same object travelling right through the ship). These reasons are as follows:-

1. The starboard side hole is at 35° to the plane of the aluminium sheet and appears to be inclined towards the front of the vessel at approximately 15° from the vertical in a forward direction, as well as the 35° laterally from the plane of the metal. I am not aware of the angle at which the aluminium sheet was originally placed upon the vessel, but from the photographs it appears to be at about 10° to the vertical, leaning inwards. If the entry hole is at 35° from this plane, it therefore follows that this hole would be at 25° from true vertical. Had this been a shell penetration, this obviously would have resulted in a hole at the bottom of the boat, and I am not instructed that any such hole was discovered.

2. A projectile travelling at only 25° from vertical could not therefore have continued on to make a comparable hole on the other side of the ship, since it would have to be travelling horizontally in order to do so.

3. The hole in the starboard side is forward of the forecastle aft transverse bulkhead and the hole in the port side is aft of this same bulkhead. This would mean that a shell travelling and making both holes would have to penetrate the bulkhead, and I am not instructed that there is any appropriate hole travelling at the necessary angle through the bulkhead. Since I do not know the exact height of the bulkhead, I have presumed that it covers the level at which the holes appear (ie, a shell making both holes would have to go through the bulkhead). If this is not the case, please disregard the previous sentence.

4. Had this been a shell penetrating the ship laterally, and making a hole in both sides during its travel, these holes being opposite each other, no military shell would have expanded from 40mm to twice that diameter in only a few feet of travel.

I therefore conclude that it is necessary to dissociate the two holes, i.e. to remove any possibility that they were caused by the same impact.

Photographs 17 and 18 are of the small hole in the port side and the large hole in the starboard side respectively. It must be pointed out that it would be very difficult, even if these two holes had been cannon shell holes, for comparatively small holes 2 metres above the water line to have had any effect on the vessel, to the extent of causing it to sink.

On the video I was given, there was only a very short duration of the 2006 submersible operation which shows the smaller hole in the port side, and I think I am right in saying that there is no interior shot of this hole: this is regrettable, since much more is learnt about the nature of the object penetrating from the inside of the hole than from the outside.

CONCLUSIONS

I therefore conclude that:-

1. Hits from high-speed missiles, impacts from objects with intermediate speed, and impacts from objects with low speed, can be effectively ruled out, unless the speed is so low as to amount to the fourth possibility suggested by the Commission – that of static penetration by objects being pushed into the side. Since the character of the holes cannot be matched by any ballistic effect known to me, from any known weapon, I have to conclude that this is the only possibility. Similarly, fabrication (e.g. drain holes) can be ruled out.

2. It is possible to estimate the direction, probable speed, and approximate shape of the object that created the hole on the starboard side. I estimate that it was 10° from the vertical on the fore and aft axis, and 25° from the vertical on the lateral axis. The speed I estimate to be well below 50 metres per second, but the mass of the object will be difficult to estimate. Kinetic energy varies according to the mass of the object moving, but it varies as the square of its velocity, so it will be appreciated that a small object travelling at high speed will have approximately the same amount of kinetic energy as a heavy object travelling at low velocity. However, since ballistic penetration has been ruled out, it seems evident that an object of comparatively large mass moving at low speed had created the hole. It further appears that the object has been moved while actually in the hole, because the appearance of the hole is so ragged on the inner edge as to presume that an object has been moved to and fro while penetrating, enough to tear the metal in an irregular way. However, my expertise is solely in ballistics, and on this occasion I am only able to say what did not cause the hole: I am not a position to say what did. With regard to the degree of certainty of my answers, I can be happy that I am 99% likely to be correct as regards direction and speed, but mass and shape can only be guesswork.

I must acknowledge my gratitude for the assistance given to me by the Tank Museum in England: during my visit, they enabled me to inspect several hundred examples of shell penetration holes in various metals, including aluminium, and their experts,

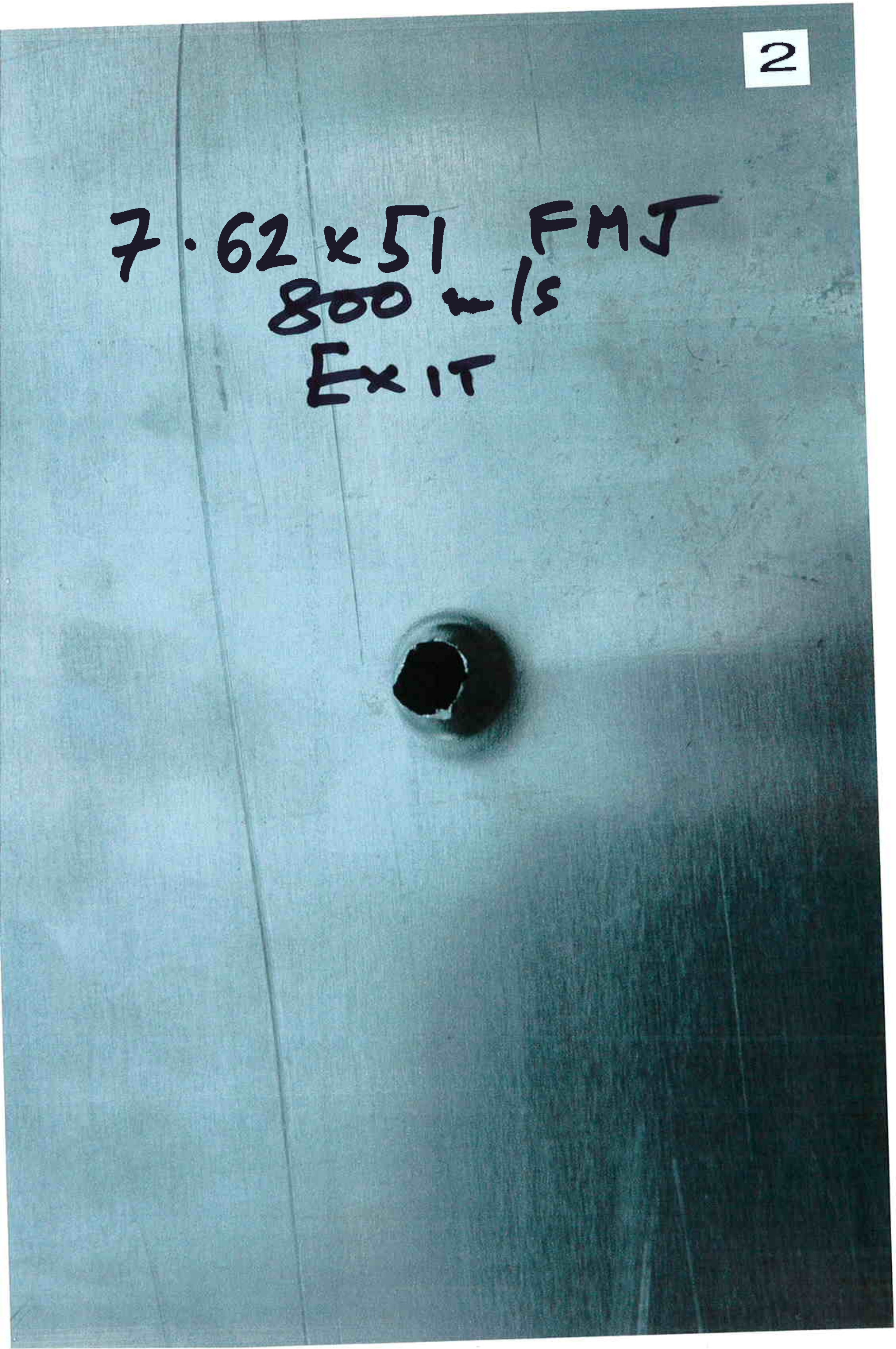
including the Curator, were unanimous in their opinion that the holes in the vessel could not have been caused by a shell. Similarly, I am grateful to the staff at Ordnance Test Solutions Ltd, a company who carry out most of the cannon firing trials for the British Army. They lent me the Rarden anti-tank cannon, and supplied the cartridges for my testing, and again, as experts in the art of penetrating armour with missiles, they were unanimous that the holes were not caused by any form of military missile.

Please come back to me if you have any questions or need any further explanations. If required, I should be pleased to attend the Commission in Norway, and to bring with me the aluminium sheet on which all the comparative puncture tests have been carried out.

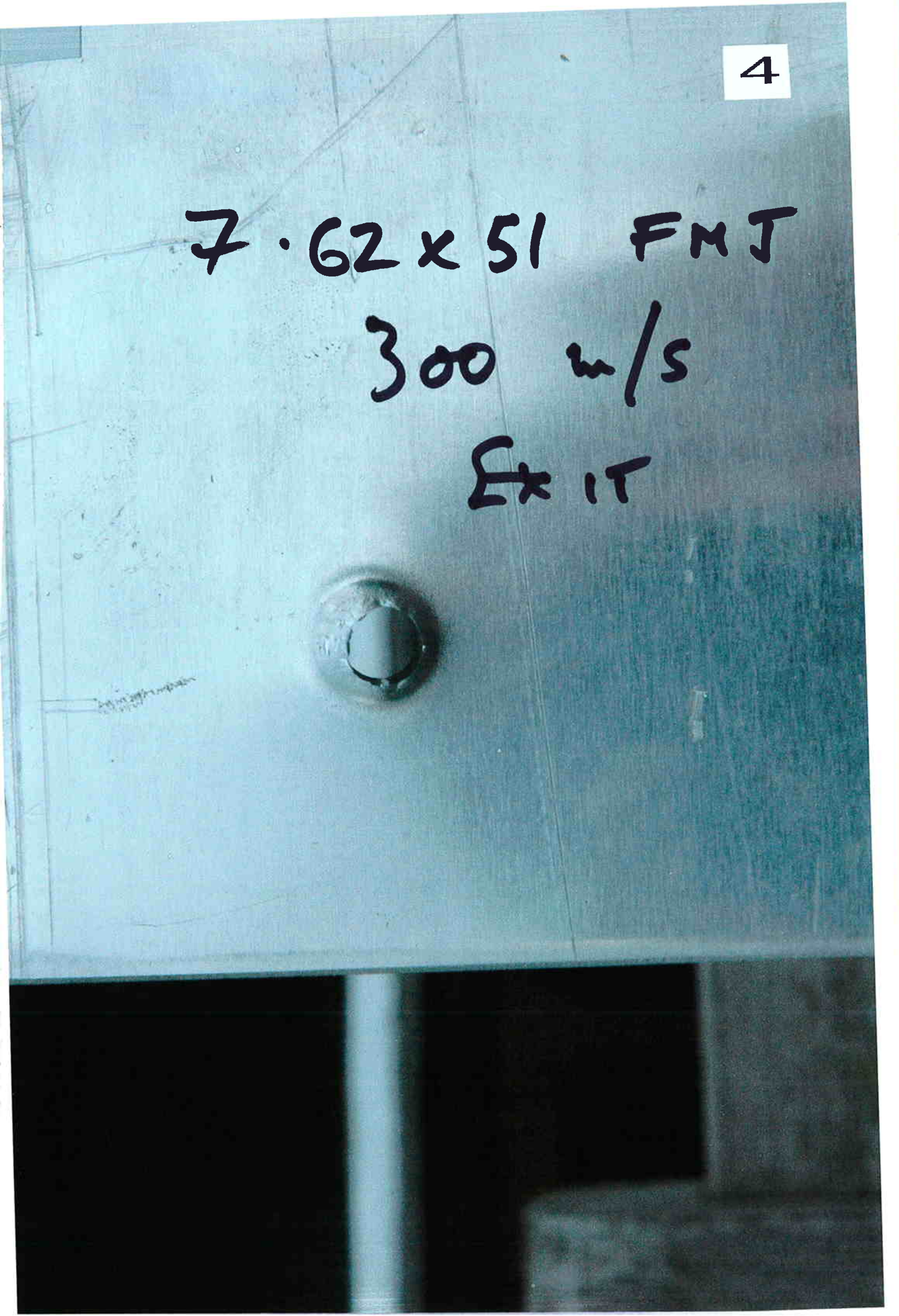
Giles Whittome. 24.V.07

GILES WHITTOME
pp the Lanchester Gun Co

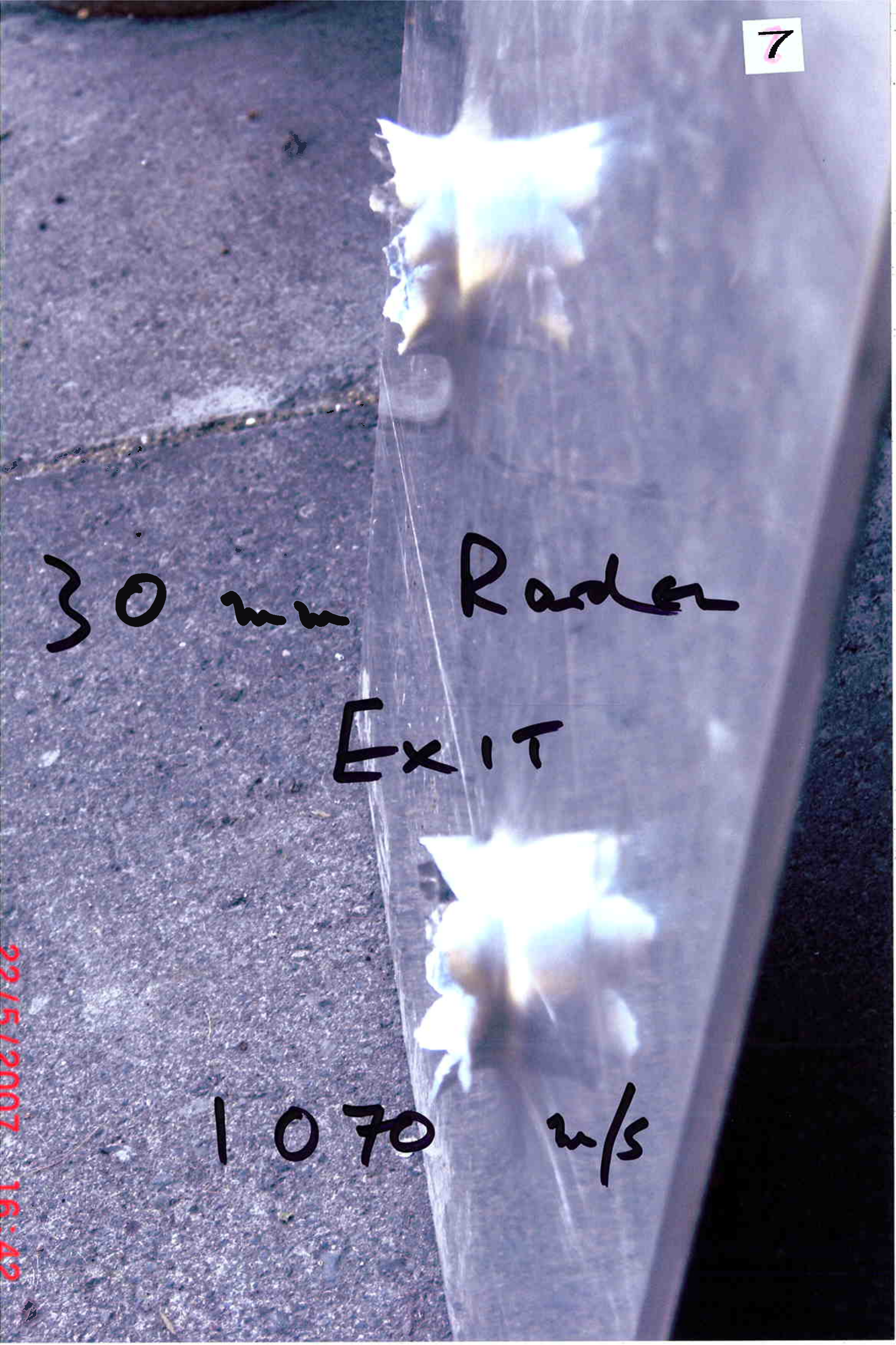

1
7.62x51FMJ 800m/s
ENTRY


2
7·62 x 51 FMJ
800 m/s
EXIT


7.62x51FMJ 300m/s
ENTRY
3

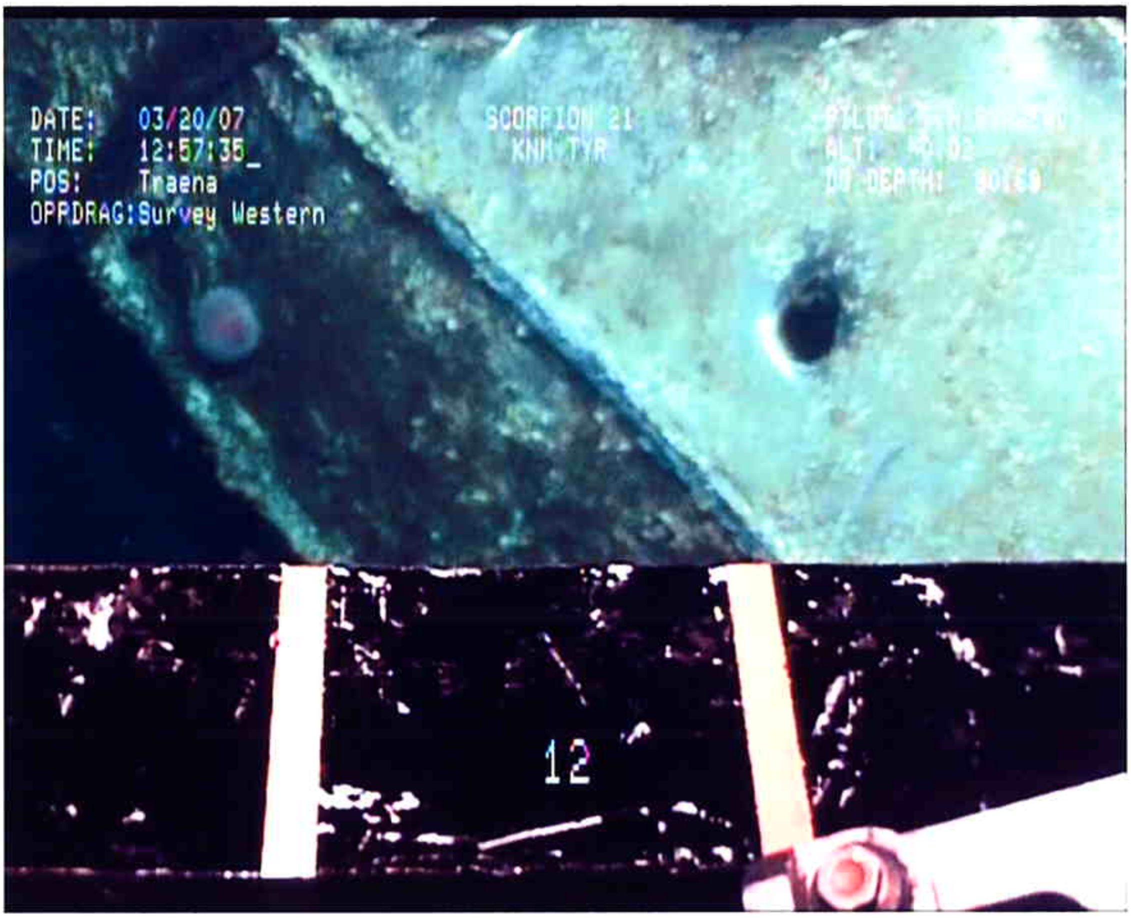

4
7.62 x 51 FMJ
300 m/s
Exit

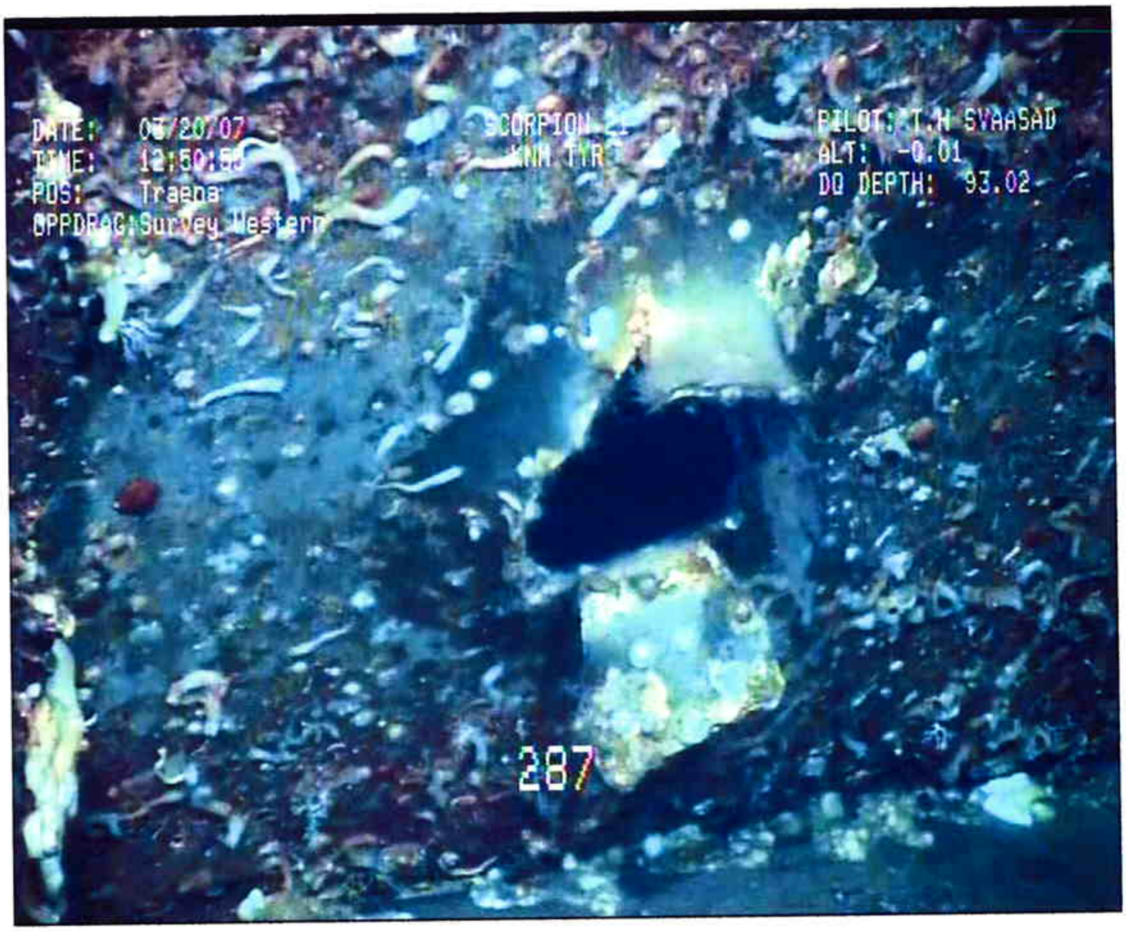

6
30 mm Rarden
Exit
1070 m/s

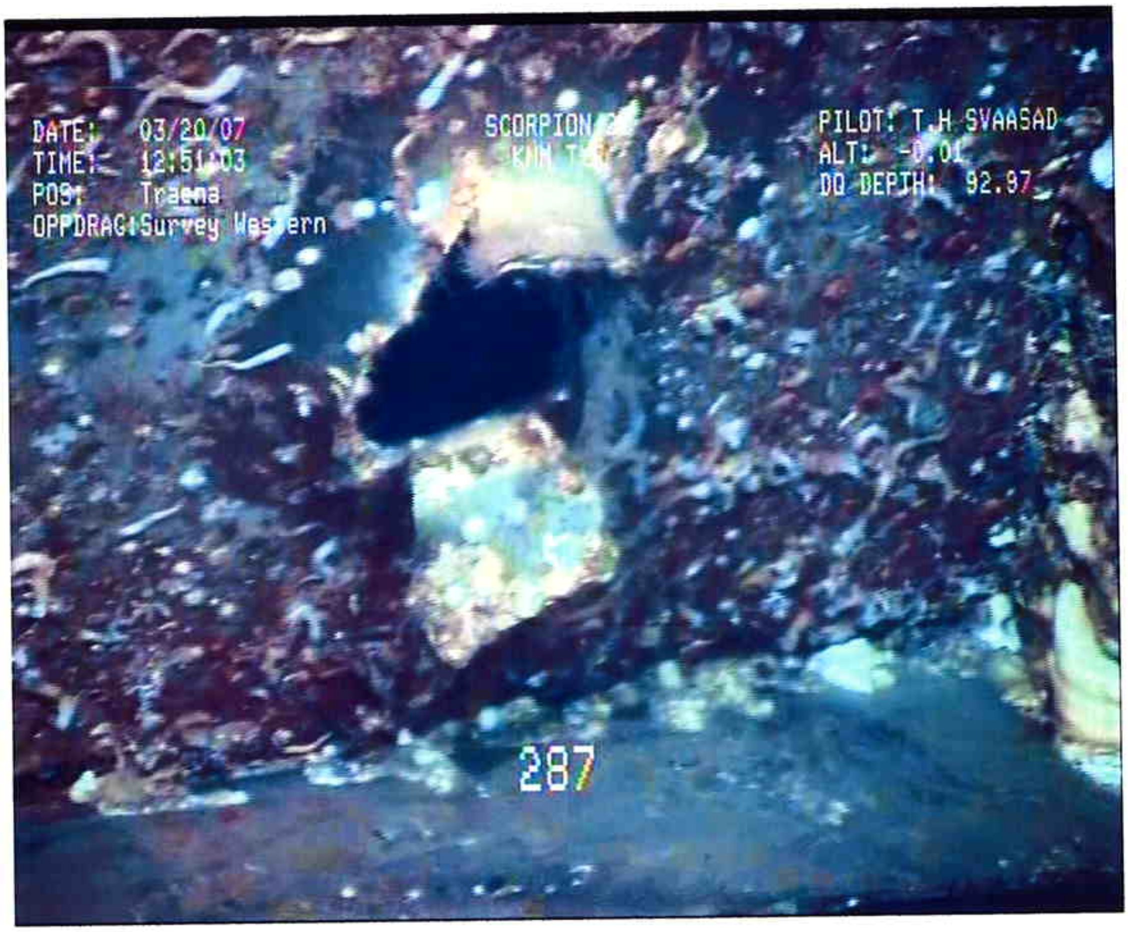


7
30 mm Rarden
EXIT
1070 m/s
22/5/2007 16:42

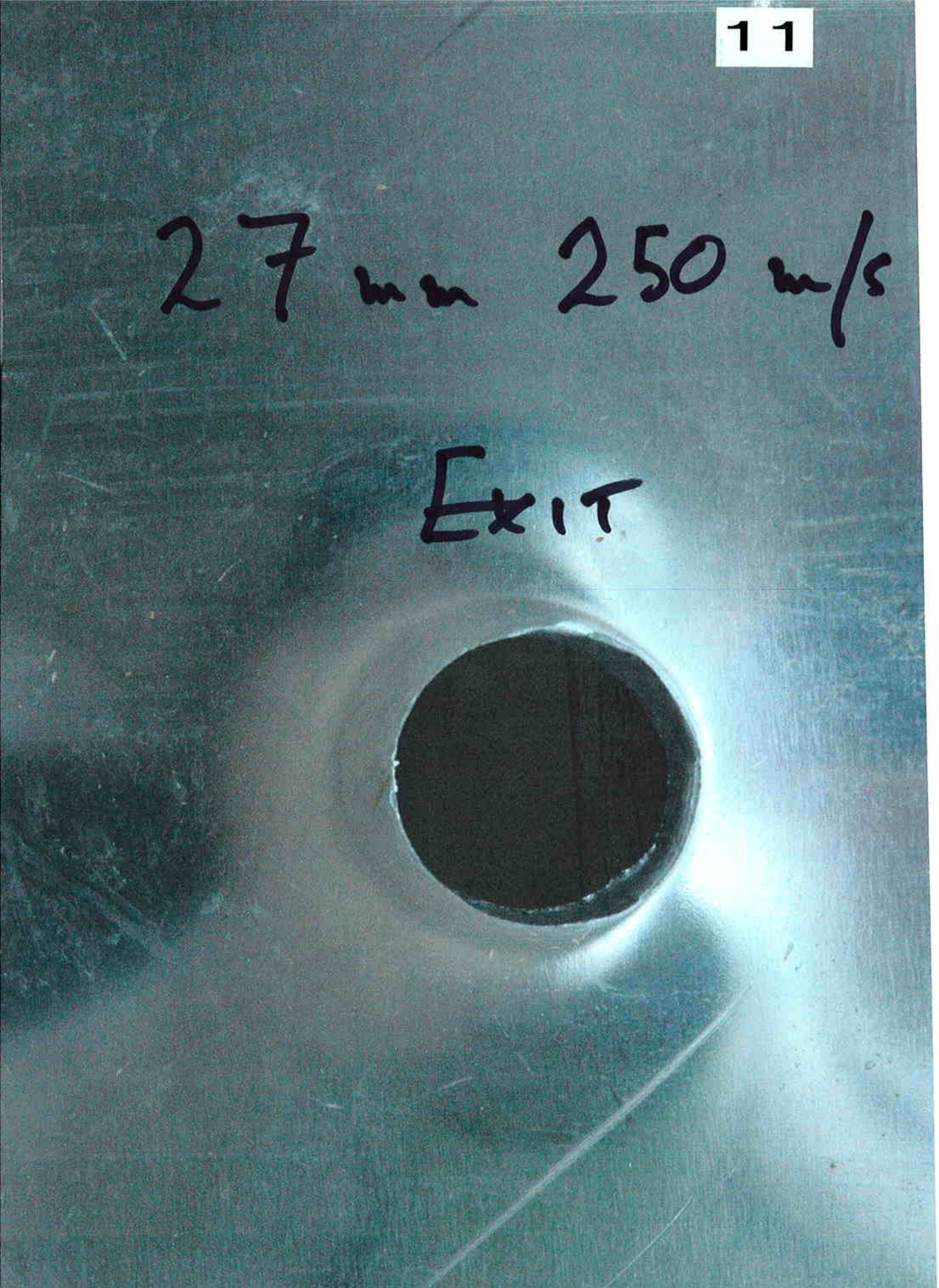

DATE: 03/20/07
TIME: 12:38:56
POS: Traena
OPPDRAG:Survey Western
T.H SVAASAD
92.41
55

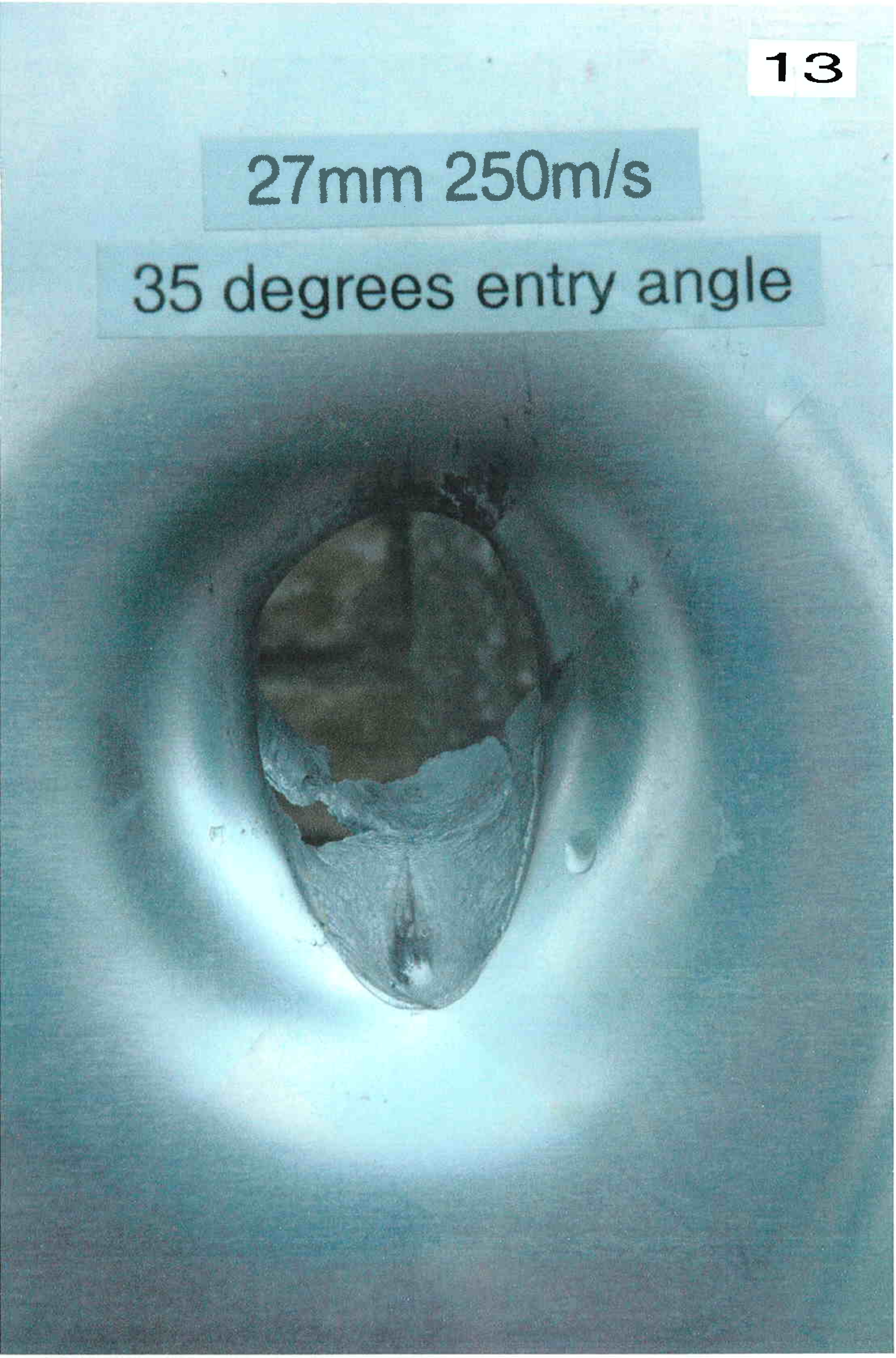

DATE: 03/20/07
TIME: 12:57:35_
POS: Traena
OPPDRAG:Survey Western
SCORPION 21
KNM TYR
12

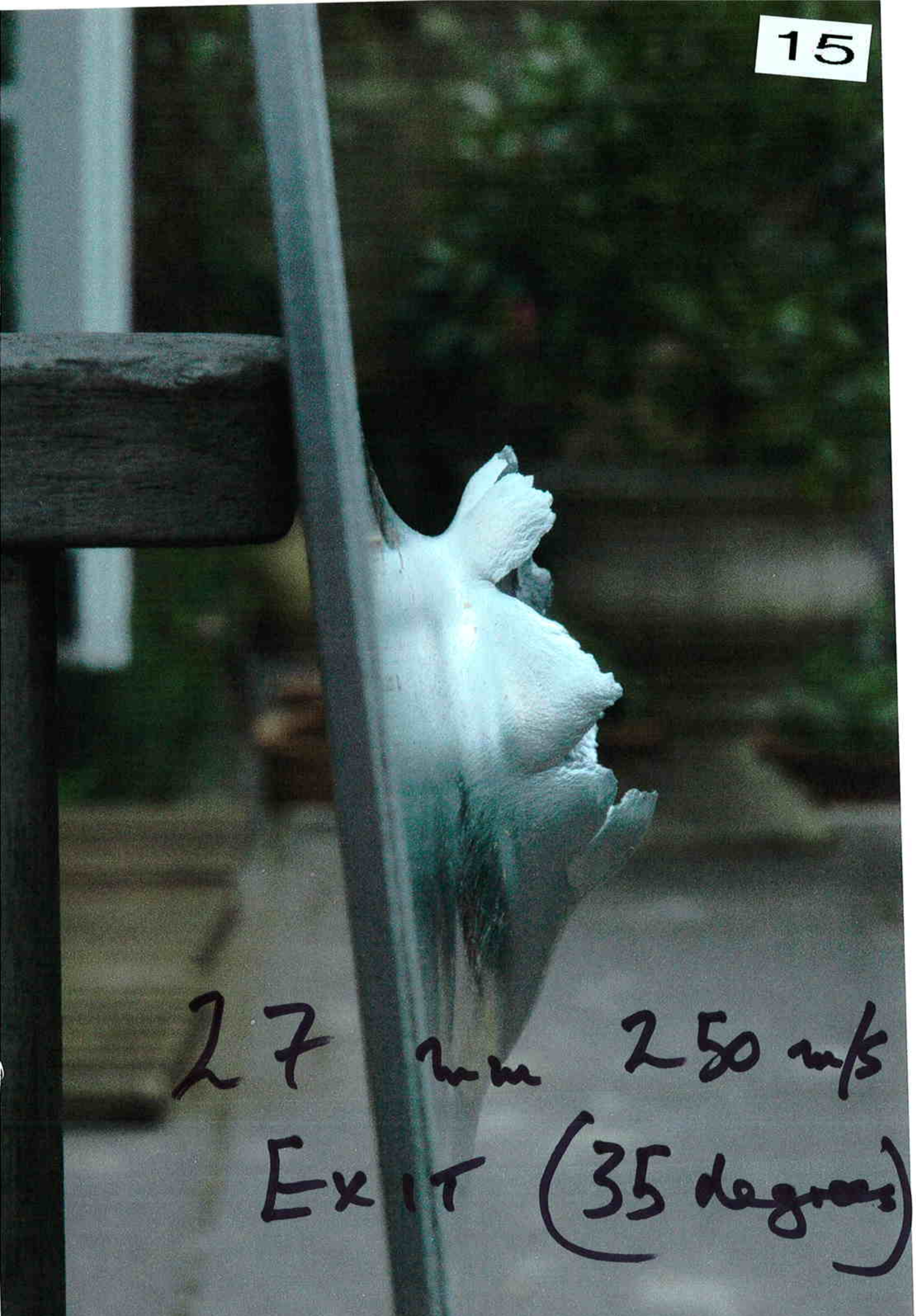

DATE: 03/20/07
TIME: 12:50:58
POS: Traena
OPPDRAG:Survey Western
SCORPION 21
KNM TYR
PILOT: T.H SVAASAD
ALT: -0.01
DQ DEPTH: 93.02
287


DATE: 03/20/07
TIME: 12:51:03
POS: Traena
OPPDRAG:Survey Western
SCORPION
PILOT: T.H SVAASAD
ALT: -0.01
DQ DEPTH: 92.97
287


27mm 250m/s
ENTRY
10


11
27 mm 250 m/s
EXIT
11


13
27mm 250m/s
35 degrees entry angle


15
27 mm 250 m/s
EXIT (35 degrees)

HIGH EXPLOSIVE
ENTRY HOLE

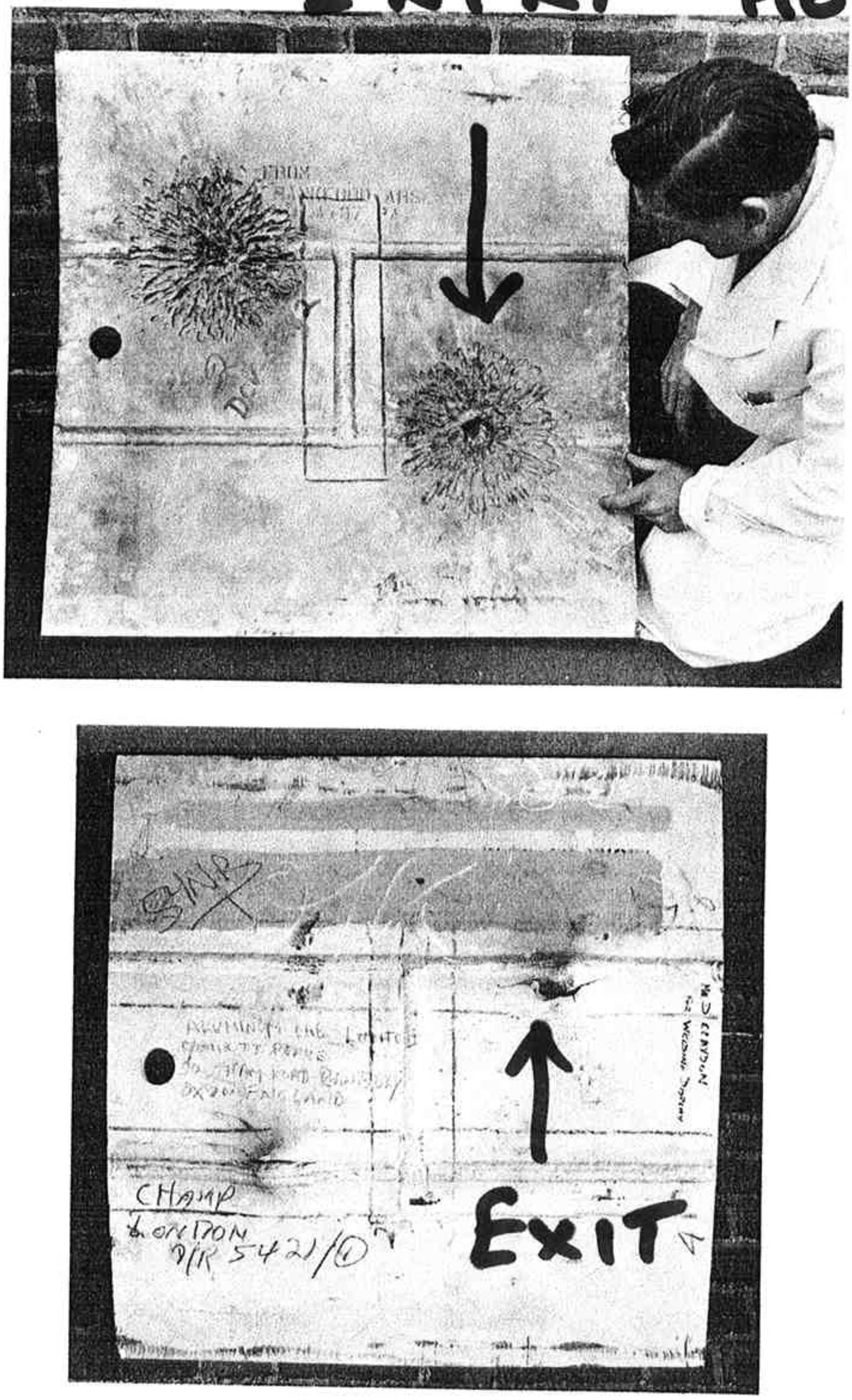
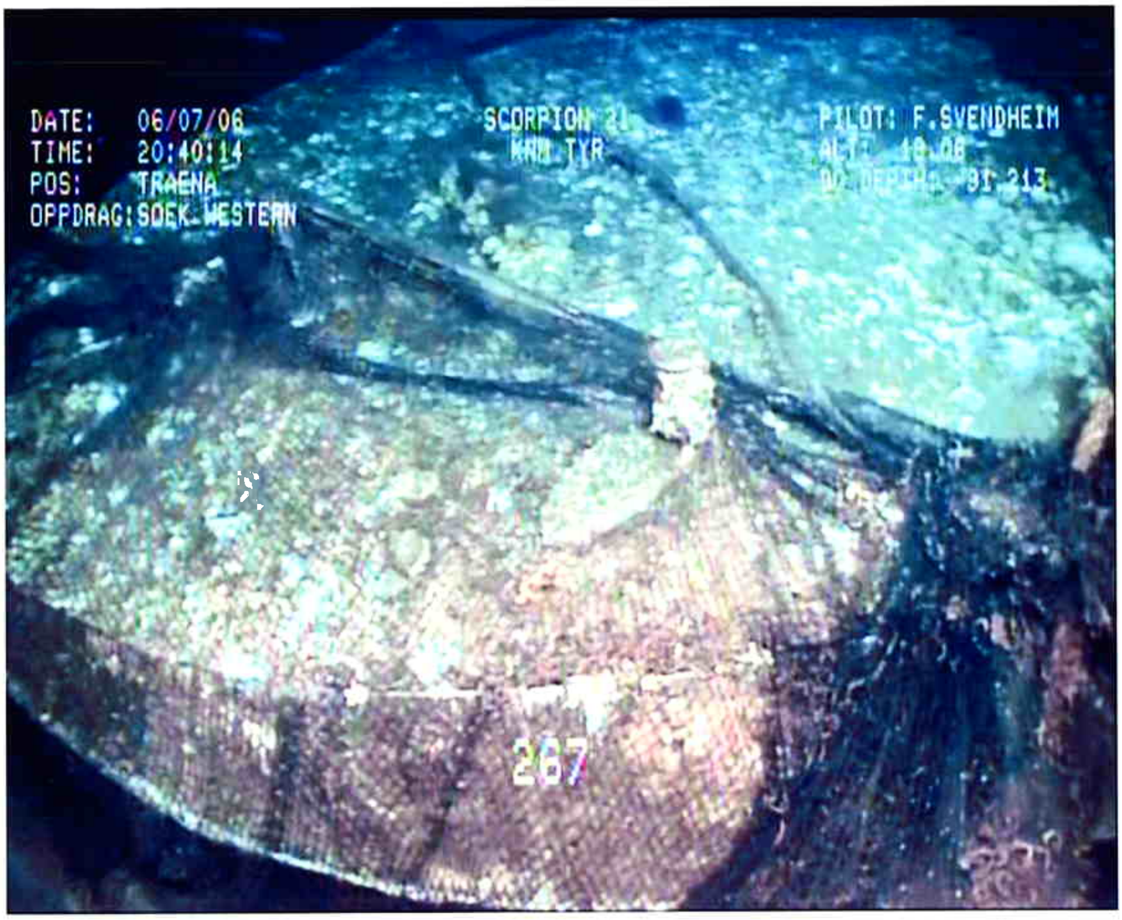


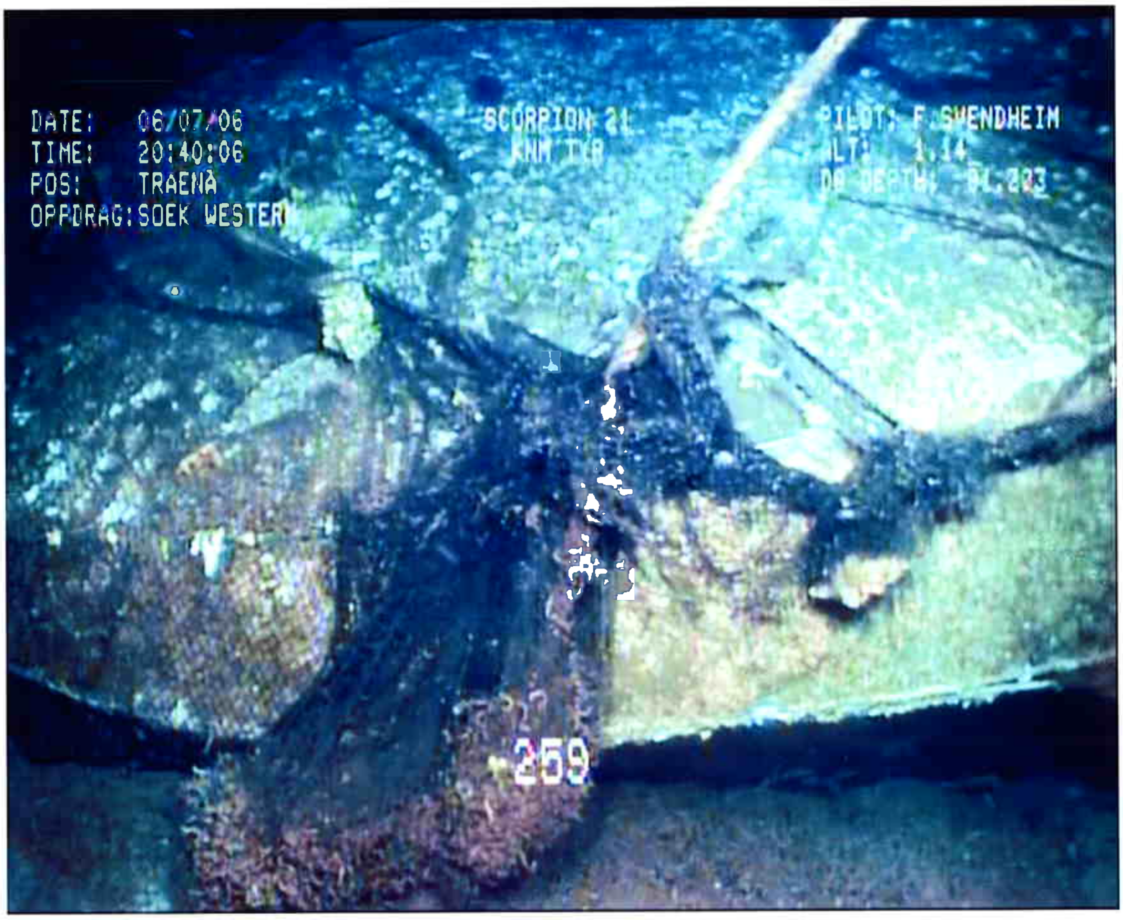
Fig. 38 Front (top) and Back (bottom) of H-Plate (weld test) after attack by 37 mm H.E. at Frankford Arsenal.

(Small) Hole in port side (aft of forecastle aft transverse bulkhead) approximate position indicated by black arrow

(Large) Hole in starboard side (forward of forecastle aft transverse bulkhead) approximate position indicated by black arrow

Principal dimensions of Western: Length overall 21.98 m, Breadth 5.67 m


DATE: 06/07/06
TIME: 20:40:14
POS: TRAENA
OPPDRAG:SOEK WESTERN
SCORPION 21
KNM TYR
PILOT: F.SVENDHEIM
267


DATE: 06/07/06
TIME: 20:40:06
POS: TRAENA
OPPDRAG:SOEK WESTER
SCORPION 21
KNM TYR
PILOT: F.SVENDHEIM
ALT: 1.14
259