Headfor P/L ABN 84073495557 T/As

McLennans **Diving Service**

- Marine Contractors

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AS/NZ 4801 Work Health and Safety
Accredited

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To Martin Dawson
Department of Crown Lands

From Alan McLennan
Project Manager 28th June, 2019

LTMMP Inspection of ex-HMAS Adelaide wreck - June 12 to 13th, 2019
Thank you for asking us to inspect the ex-HMAS Adelaide in order to carry out the requirements of the Long Term Monitoring and Management Plan (LTMMP) for structural condition monitoring. This report also includes inspection of the barred off areas in the upper superstructure and Ultrasonic Thickness (UT) testing of the six Monitoring Locations. Our last inspection was on 12th July 2018.

The Dive Team was supervised by myself and David Allchin with the five other divers being Louis Dupressoir, Daniel Fell, Andrea Pedone, Tony Whittem and Jarod Eriksson. All the divers hold ADAS Part 2 or 3 qualifications and are experienced ship inspectors. The diving equipment used was SCUBA and the breathing gas was Nitrox 32%. We dived from the 2C surveyed boat "Sandy Bottom", in three separate buddy pair teams.

The depth of the diving was limited to 30 metres in order to maximize our dive time and comply with AS2299.1.2007 Section 6. This depth allowed the divers to descend to just below the main deck level and observe the hull down to the seabed. The sea state was exceptionally calm with no swell. There was no current and visibility was about 6 metres. A strong East Coast Low (ECL) had passed through the area in the previous week with the swell rising to over 5 metres. So this was an ideal time to inspect the wreck.

On the first day we made two full sweeps of the vessel and observed the major Monitoring Points listed in LTMMP Section 2.1.2. In addition, we fastened buoys to the bow and stern and pulled the lines tight so that their exact positions could be recorded on the surface by a swimmer with a GPS. The divers also recorded the water depths of the bow and stern and the seabed levels.

Survey Results

Structural Integrity (ref LTMMP 2.2.2)

The wreck can be divided into two halves. The upper section above the main deck is the aluminum superstructure, which holds the mast and bridge area. The lower section from the main deck to the keel, is the steel hull, which contains the machinery and living spaces.

Steel Hull

There were no changes observed in the steel hull since our last inspection. It appears to be lasting well. There were no signs of any cracking or deformations. The main deck is level and even with no signs of warping. The hull has a uniform coverage of marine life with no signs of corrosion outbreaks. Five areas on the main deck were selected for thickness testing using an ultrasonic gauge. The thickness measurement results were very close to the original nominal thicknesses. When the marine growth was removed for the testing, the paint coating underneath was found to be still intact.

The steel hull was fully supported by the sand. There was no scouring observed despite the strong ECL the previous week. The sonar dome was not visible and the duck tail was partly exposed on the stern. The sand level was very close to the ship's waterline. This is very similar to the situation last year.

Aluminum Superstructure - The aluminum superstructure has suffered steady deterioration in the last twelve months and it appears that this will continue at an ever-increasing rate in the future.

We found the following areas of deterioration have occurred since our last inspection:

1. The Port Side Helicopter Hangar Wall – The entire hangar wall has now broken out and is laying on the seabed. Fortunately, it has broken out very cleanly and no loose or jagged metal has been left behind. Both the port and starboard walls of the hangar are now completely missing however the heavy steel frame of the hangar remains intact and it seems to be in good condition. See Figure 16.
2. A section of the starboard wall amidships which was flexing in the swell last year has now broken out. Their location is amidships about frame 215 on Deck 1. The missing section is about 4 metres long and two metres high. One panel remains "hung up in the middle of the breakout but it will soon break out. See Figure 19.
3. The exterior panels of the bridge, in particular around the bathroom, have corroded through in many spots. In addition, many large holes were observed in frame members and panels due to corrosion. See Figure 1.
4. The weld seams of most of the exterior panels of the aluminum superstructure are highly corroded. The corrosion appears to have attacked the Heat Affected Zones of the welds. Much of the weld metal is now missing leaving a gap between the panel and the frame. It would be expected that the loss of these panels will be a regular occurrence in large swell events. See Figure 3
5. There are more loose and swinging aluminum panels inside the superstructure than last year. This reflects the increasing deterioration of the upper superstructure, especially as the large holes have opened up allowing more water force inside. However, we did not observe any panels which had blocked exits or created any heightened risk for the recreational diver. See Figure 18
6. The white chalky corrosion breakouts in the aluminum superstructure observed last year have become widespread. Also observed this year was a type of "delaminating" of the aluminum. It is peeling in sheets at many locations on the floor of the 02 deck. See Figure 7

I conclude that the aluminum superstructure has continued to deteriorate and that the rate deterioration will increase as corrosion and water movement weaken the structure. I expect that many more section of aluminum superstructure will break away over the next year depending on the frequency of heavy swells.

LTMMP Monitoring Locations –Thickness Testing.

In addition to visual monitoring, six locations were also chosen for thickness testing close to the LTMP monitoring points.

The method used was as follows at each area to be measured:

1. An area was selected for testing and its position was recorded.
2. An area 100mm in diameter was scraped clean
3. An Olympus 26MG ultrasonic thickness gauge with a 60 metre long probe cable was used to measure the metal thickness (calibration certificate is attached). The probe was placed on the cleaned area and the diver notified the surface team.
4. When a stable reading was achieved the Diving Supervisor recorded the thickness and signaled the diver to move to the next location.
5. The thickness test results were recorded in the table below. The locations are shown in the drawing in the Appendix.

Table of Thickness Tests

Location – Main Deck except for Location 6	Frame Number	Nominal Thickness (mm)	Recorded thickness (mm)	Difference (mm)
1 – Hangar Deck – 300mm aft of the centre pillar –	335	6.35	9.59	+0.06
2 – 300mm off the change in shape at waist on the port side -	180	7.95	7.73	-0.2.2
3) 300mm off the change in shape at waist on the starboard side -	180	7.95	7.65	-0.35
4) 300mm off the base of the weather shield – port side	100	6.35	9.93	+3.58
4) 300mm off the base of the weather shield – port side	100	6.35	9.72	+3.37
5) 300mm off the missile launcher opening	85	9.52	10.68	+1.16
6) Base of main mast 02 deck	The aluminum deck is extremely pitted due to severe corrosion that no meaningful thickness test is possible.			

Notes on the thickness tests –

- All the tests were close to or greater than the predicted thickness.
- The paint coatings were not ground off. The paint thickness is included in readings above. This may explain some of the thicknesses being greater than the nominal steel size.
- We did not try and discriminate the paint coating thickness. The underside paint thickness may also have been captured if it is well bonded
- The locations were marked so they can be retested in future surveys.
- There were no visual signs of loss of section in the steel structure.

LTMMP Monitoring Locations –Visual Monitoring.

The Divers made note of the monitoring items listed in the LTMMP Locations 1 to 6.

- Location 1 – the hull plating on the forecastle just aft of the GMLA launcher. There has been no deterioration in this area.

- Location 2 – amidships at the base of the forward screen (where the superstructure and hull are bonded together) – There is no visible deterioration in this area. There is no sign of any separation between the forward screen and the hull.

- Location 3 - at the vertical midpoint of the main masts –The entire main mast was examined. The mast is heavily encrusted with marine life restricting a detailed examination. However, no sign of cracking or deformation was observed. All parts of the mast remain straight and true. The base of the mast was also closely examined and no sign of cracking or deformation were observed.

- Location 4 – the connections of the masts to the 02 deck. There is no sign of any deterioration in the legs. No cracking or deformation was observed. However, the aluminum plating that the legs pass through has severely corroded.

- Location 5 – the hull plating on the transom – The transom area has changed very little since the sinking. It was noted that a number of the handrails have broken away in the last year

- Location 6 – where the helicopter hangars are attached to the hull. In May 2015 the starboard hangar wall suddenly broke way and fell to the seabed and this year the port side wall also broke away. However, the main framework of the hanger is steel and this is still securely attached to the main deck. This frame shows no sign of failing.

- Internal Debris As noted previously there are numerous collapsed internal panels littering the passageways in 01 deck. These have presumably been dislodged by surge coming through the new openings in starboard sidewalls near Frame 160. They don't pose any heightened risk to divers in low to moderate seas. In large swells these objects would fly around the interior of the hull and may be dangerous.

2.1.3 Vessel Stability – The vessel's list was checked in three ways:

1. By measuring the water depth on opposite gunwales amidships. We found that there is an 800 to 900 mm difference between the two sides of the vessel which is equivalent to a slightly less than a 4 degree list to port (3.68º assuming the deck is 14 metres wide).
2. By measuring with spirit level. We found that the spirit level was out of level by 70mm over a level length of 1220mm. This indicates a 3.28º list to port)
3. In addition, this year a two metre string line with a plumb bob was hung from the top of the hangar. The gap from the plumb bob to the corner of the hangar was measured using a level tape measure. The angle between the plumb bob and the corner of the hangar was calculated to be approximately 4 degrees. This agrees with the first two methods.
4. This list is unchanged from previous years.

2.1.4 Vessel Position and Vessel Settlement –

The vessel's position is unchanged since our last inspection.

- The trim is unchanged based on our measurement of the water depth at the bow and stern and observation of the sand levels.
- A float was attached to the bow and stern and pulled tight to allow us to record the vessel's exact position with a GPS.
- The depth of water to the deck when compared to previous surveys indicates that the vessel has not settled any further into the seabed. The hull appears to be very stable in its current position.
- The water depth to the seabed (in LAT) behind the stern was 33.1 metres and to the top of the transom was 29.8 metres.
- The water depth at the seabed under the bow was 35.6 metres and at the tip of the bow it was 29.3 metres (on top of the gunwale).
- The location of the tip of the bow was 33º 27.887' S, 151º 27.486 E
- The location of the centre of the transom was 33º 27.864 S, 151º 27.401 E

Corrosion

There is a stark contrast between the level of corrosion on steel lower hull and the upper aluminum superstructure.

There were no signs of corrosion observed in the steel hull. The main deck was scraped clean at five locations and at each location the paint coating was still intact and no corrosion or pitting was visible.

The aluminum superstructure displays wide spread signs of severe corrosion. The welded joints of the panels to the sub frame have corroded away in many areas leaving the panels poorly secured. The 02 deck horizontal surfaces have numerous breakouts of an unusual delamination of the aluminum panels, and thick white deposits of corrosion products are visible over all exterior aluminum surfaces. Also, the aluminum frames have severe corrosion and a numerous holes through the frame members were observed.

The rate of deterioration of the aluminum superstructure is appears to have greatly accelerated compared to previous years.

Barred off and Restricted Areas

The wreck was originally fitted with eighty-nine "barred off" areas that were designed to prevent divers entering spaces that were considered unsafe for SCUBA diving. The contributing factors that made barring off necessary were; extremely narrow passageways, no other exits and a danger of a zero visibility "silt outs" in the confined space.

During this survey all the barred off areas on the main deck and higher were examined. These locations were all secured with a welded bar across the opening and not just steel mesh. In total 19 locations were found and at all of these the barring was still in position. The only barring missing was in the Captains Bathroom Frame 109 ceiling which has corroded away.

Marine Life

The marine life on the vessel is spectacular at every level and it is possibly becoming denser as the vessel breaks up. A cloud of baitfish such as yellowtail fish envelops top of the wreck

and predators such as kingfish are a common sight. The masts in particular are festooned in dense colorful plant life. Despite the fact that fishing is banned on the site, noted a large number of snagged lures and lines all over the vessel.

Conclusion

- The vessel shows no signs of deterioration in the steel hull. Thickness testing and visual observation indicate no loss of steel section and all coatings appear to be intact.
- The aluminum superstructure is suffering from severe corrosion and two large new breakouts of the wall panels have occurred. These are the loss of the port side hangar wall and the starboard wall on 01 deck at frame 165.
- The aluminum superstructure is likely to continue to break down rapidly with every storm event.
- The position, trim and list of the vessel are unchanged since our last inspection in July 2018
- The barred off areas which have steel bars welded across them are still intact.
- The marine life has increased in diversity and density.

Attached: following are photographs which illustrate each part of this inspection.

Thank you for asking us to undertake this inspection, regards,

Alan McLennan
Phone 0433111528

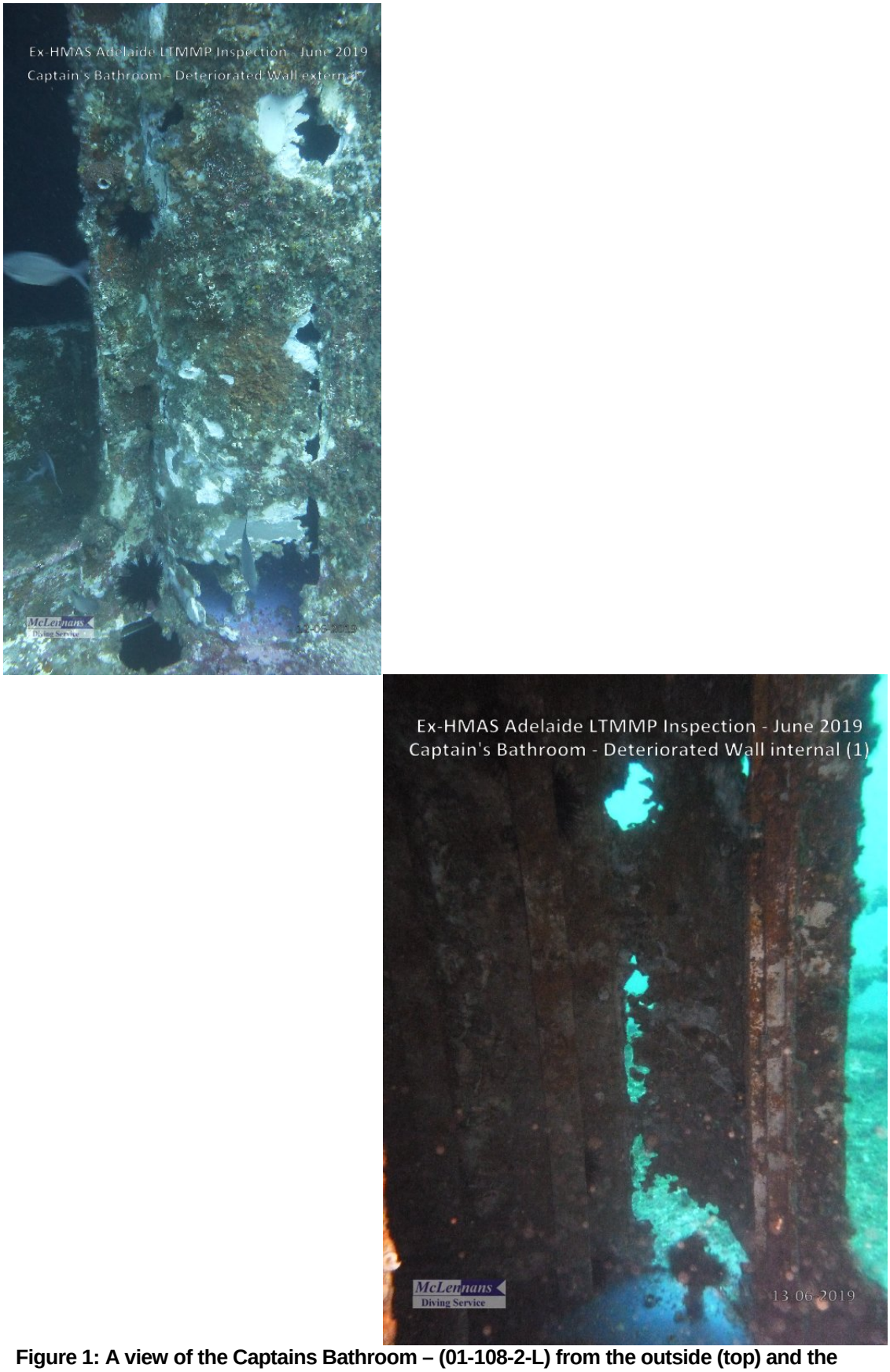


Figure 1: A view of the Captains Bathroom – (01-108-2-L) from the outside (top) and the inside (bottom). The extreme state of the corrosion in the aluminum paneling is obvious

Figure 2: The Captain's Chair which is a popular site in the bridge has lost it coverings and the footring has snapped.

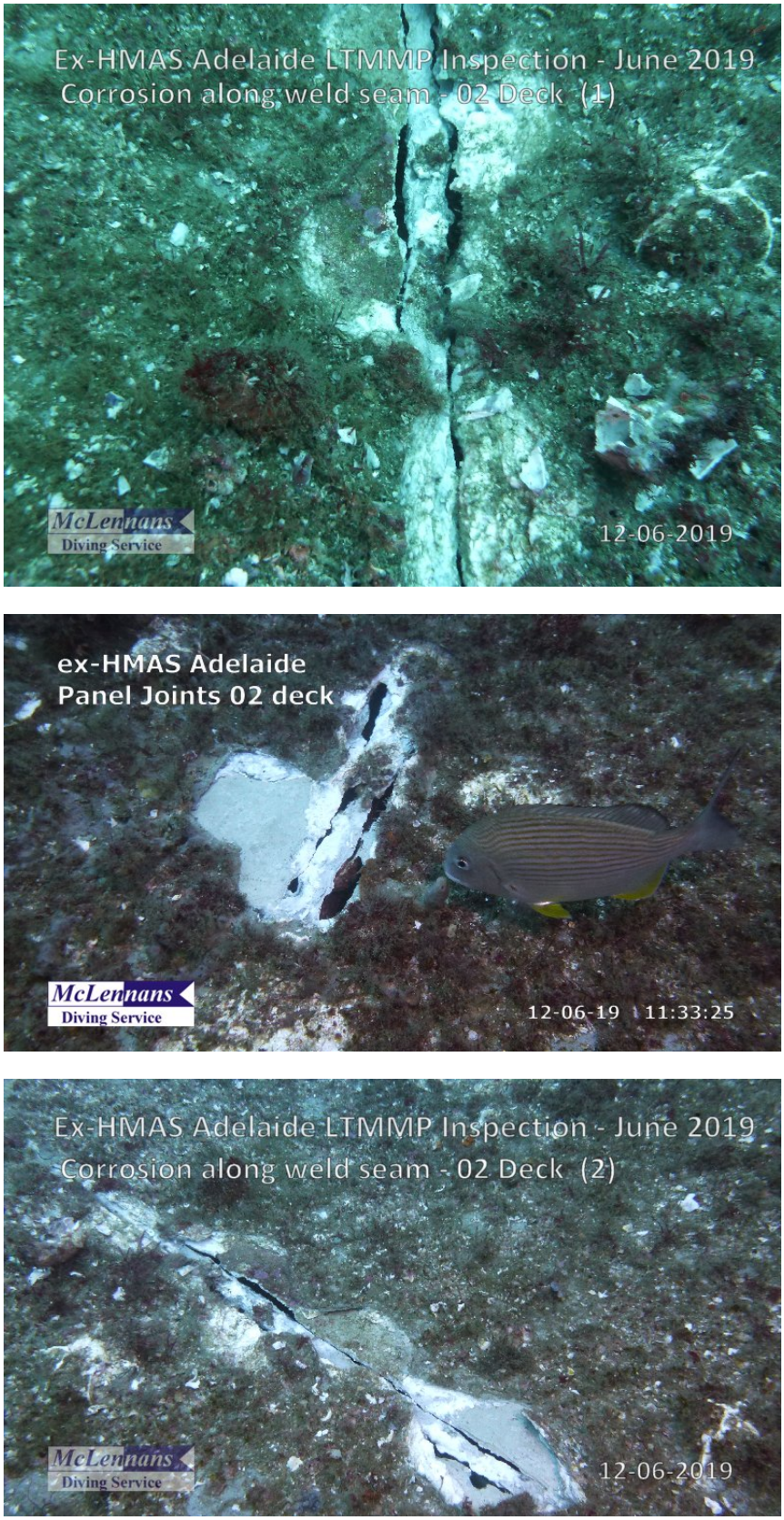


Figure 3: These photos show the typical condition of the panel joints on the aluminum superstructure. The weld seam has corroded away leaving the panels unsupported.

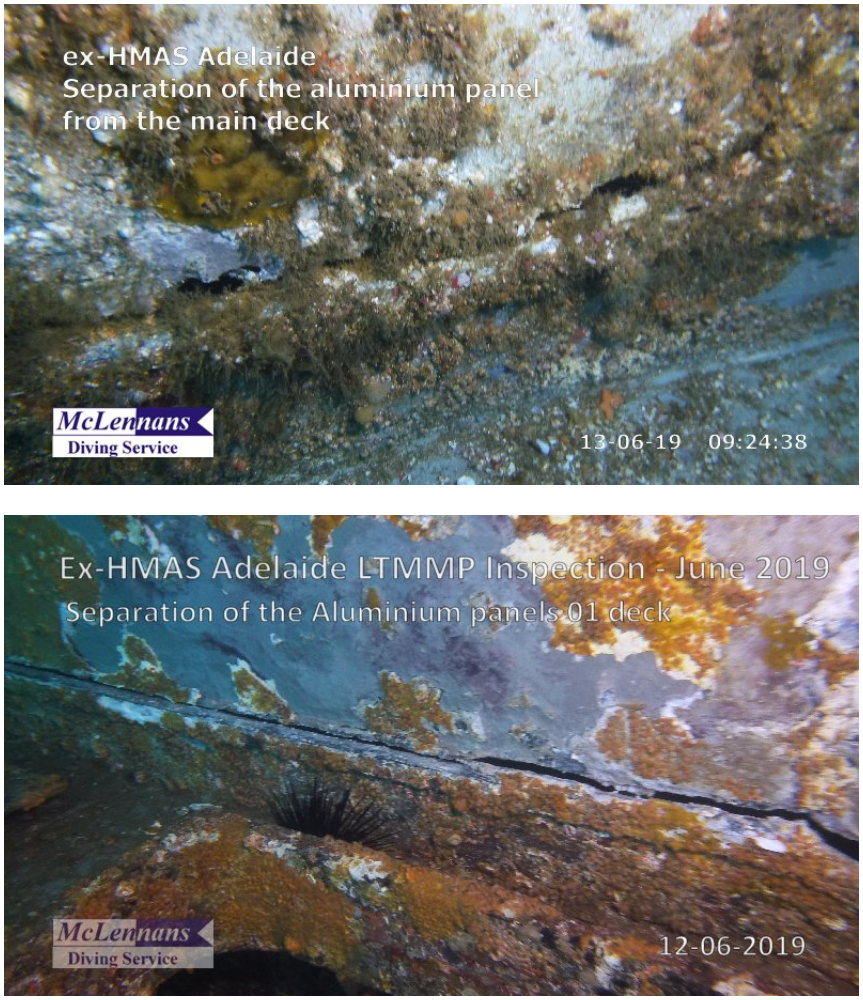


Figure 4: Typical connection of the aluminum wall panel to the main deck. The panel is corroded away along the joint in many areas. The top photo is from outside. The bottom photo is from inside. Deck 1 Frame 215 Stbd

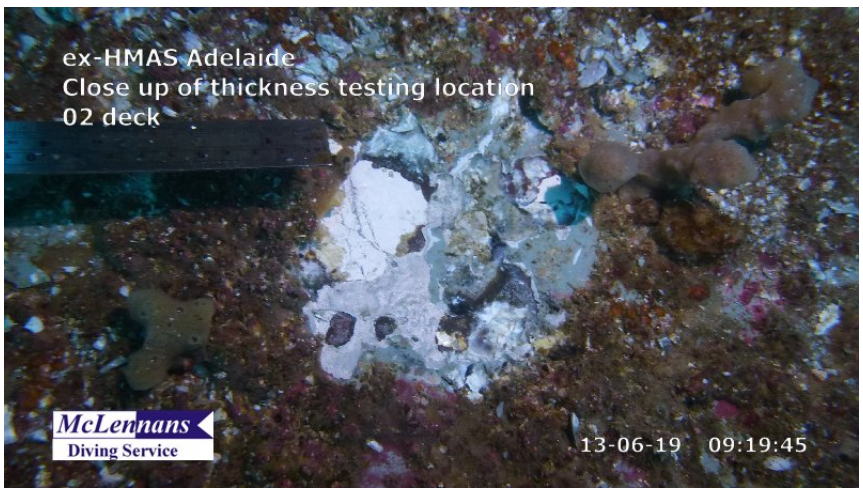
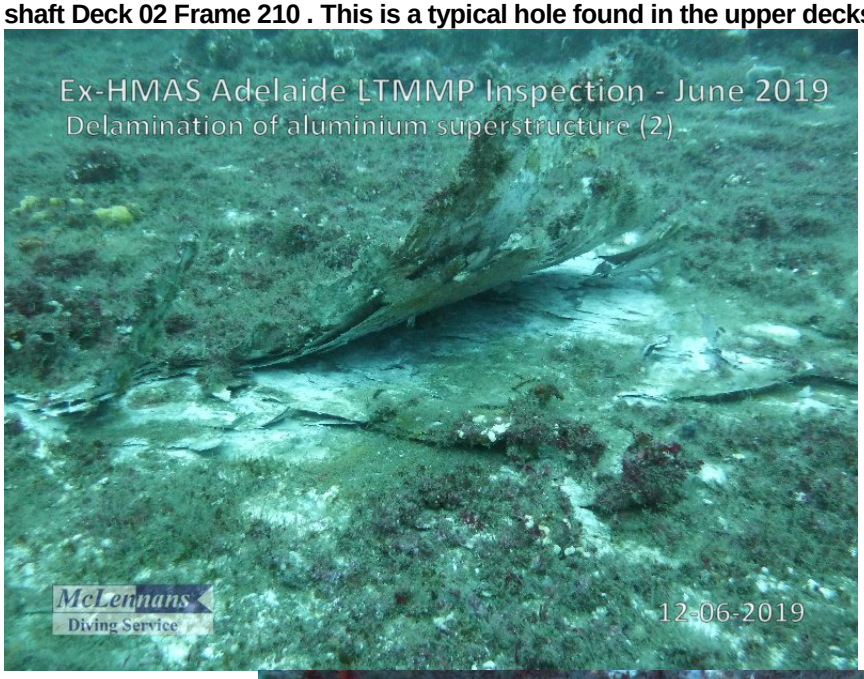


Figure 5. The aluminum deck at the base of the main mast. The surface is highly corroded with deep pitting. There is no value in attempting thickness testing on this deck. Deck 02 Frame 180

Figure 6: This photo shows the aluminium frame and panelling at the top of the elevator shaft Deck 02 Frame 210 . This is a typical hole found in the upper decks



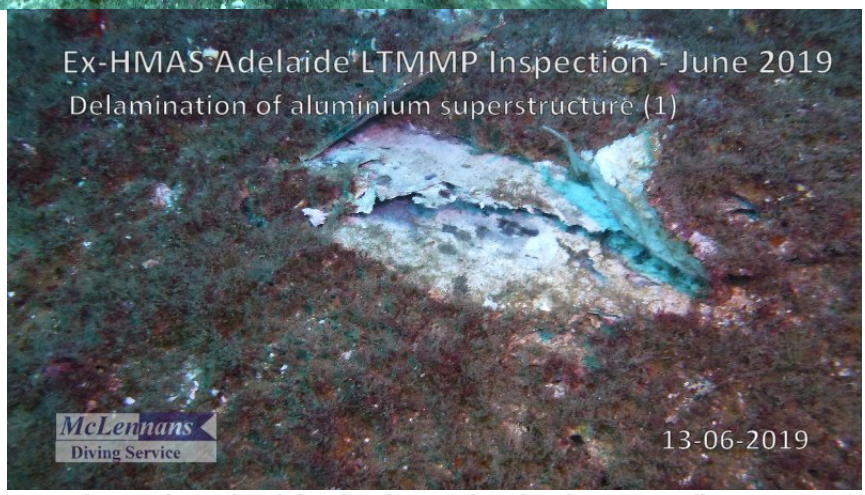


Figure 7: The two photos above show the delamination of the aluminum paneling on top of 02 deck.

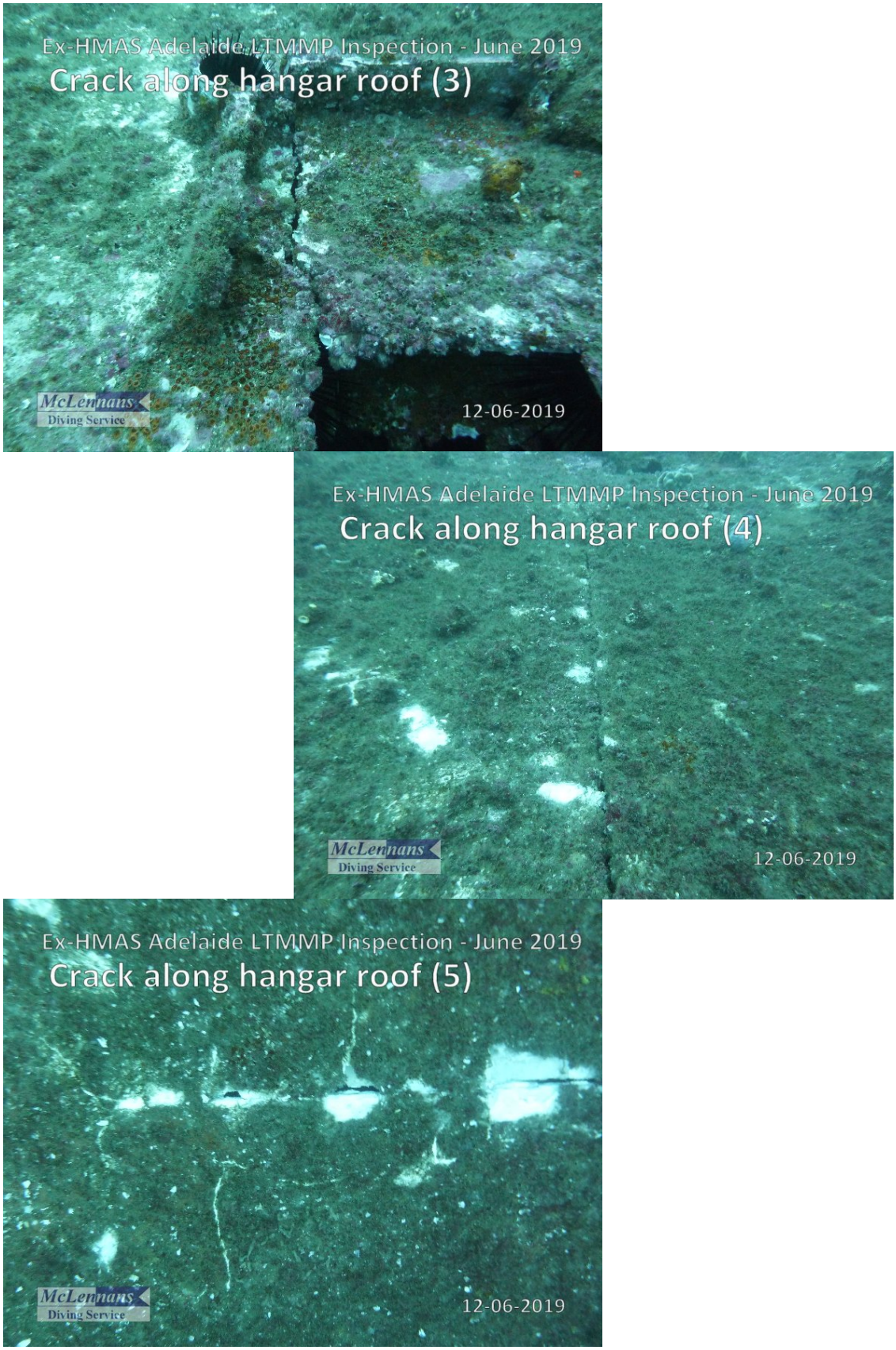


Figure 8: These pictures show the crack which runs through superstructure amidships. The crack appeared soon after the sinking, but has not become any worse since then. Deck 02 Frame 210.

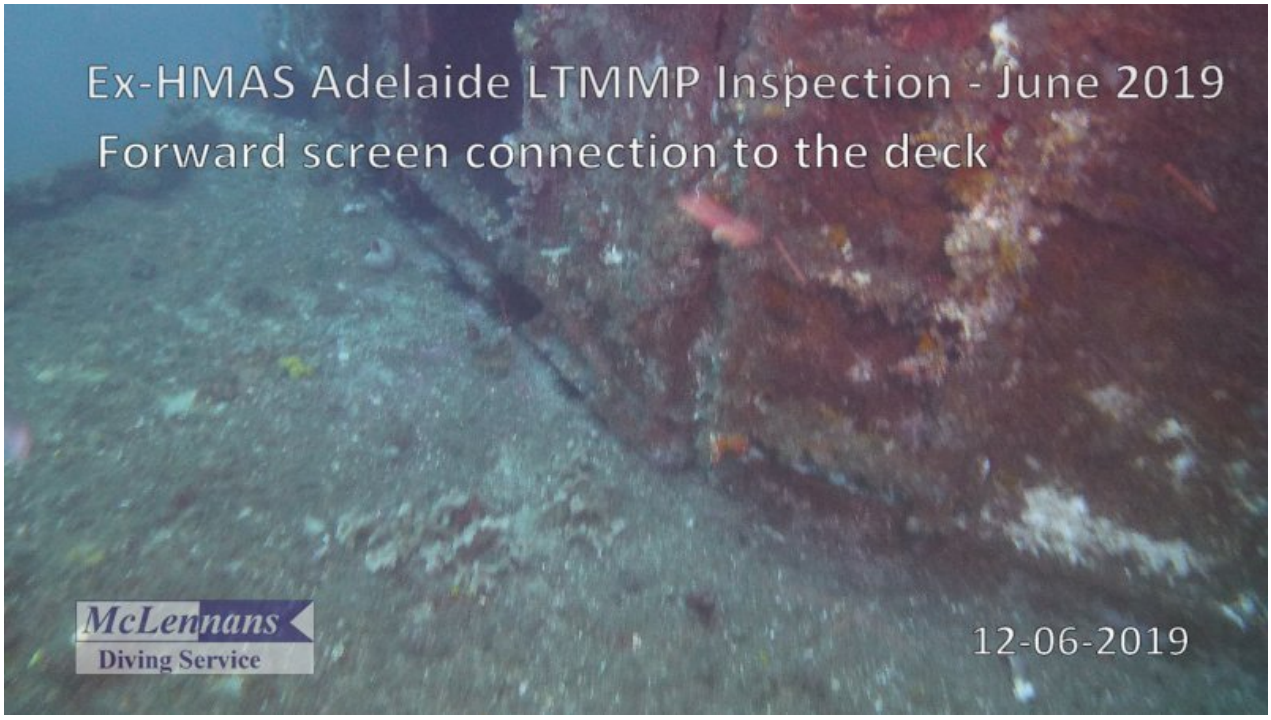


Figure 9: The base of the weather shield where it attaches to the main deck. There is no sign of any deterioration in this area. Thickness test and visual inspection reveal that there has been no loss of metal in the steel work of the main deck. All coatings are intact.

Figure 10: The centre frame of the helicopter hangar, attachment point to the main deck. There is no sign of deterioration in any part of the steel frame of the hangar.

Figure 11: Two views looking forward to the end of the hangar at Frame 330. All the steel surface are free of corrosion.

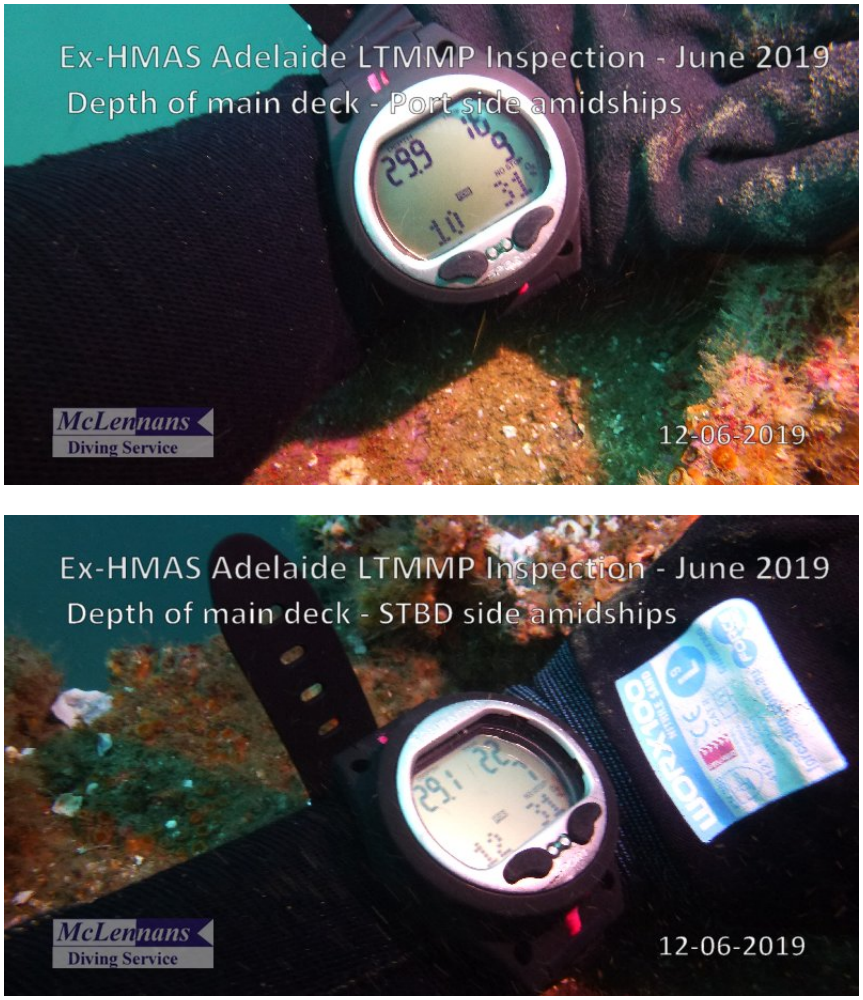


Figure 12: The depths on the opposite gunwales amidships. These indicate the vesssel has a list of approximately 4 degrees. The vessel has been stable in this position since quite soon after the sinking.

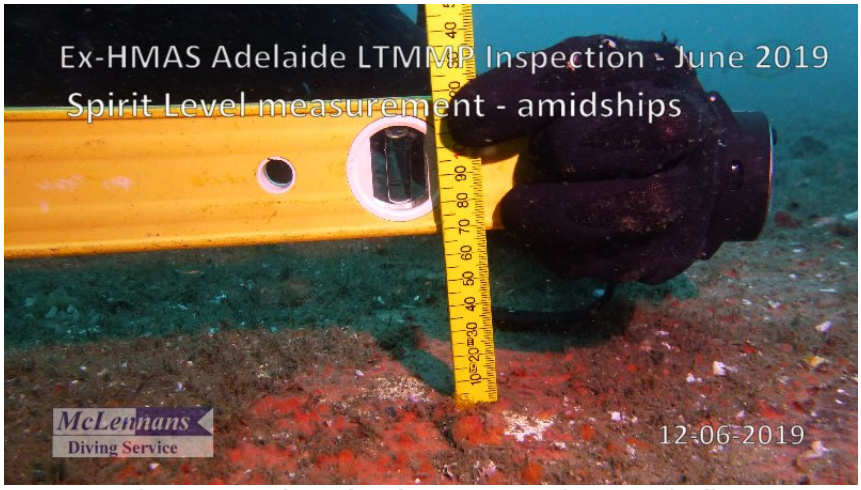
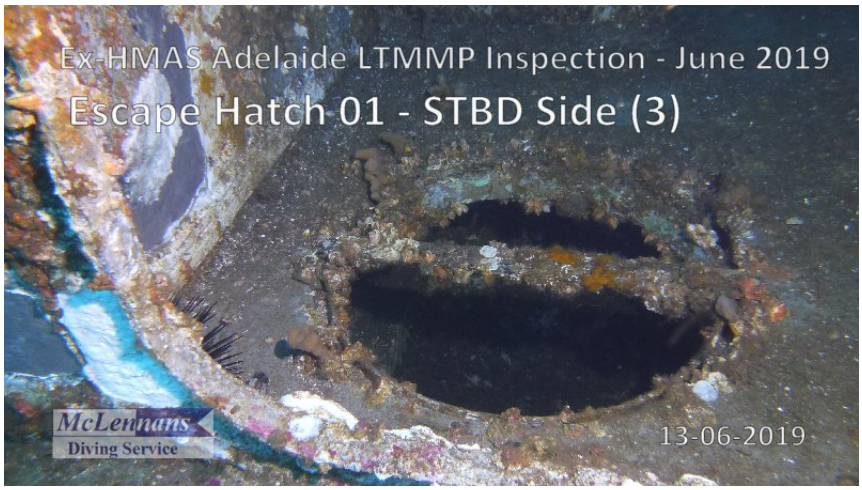
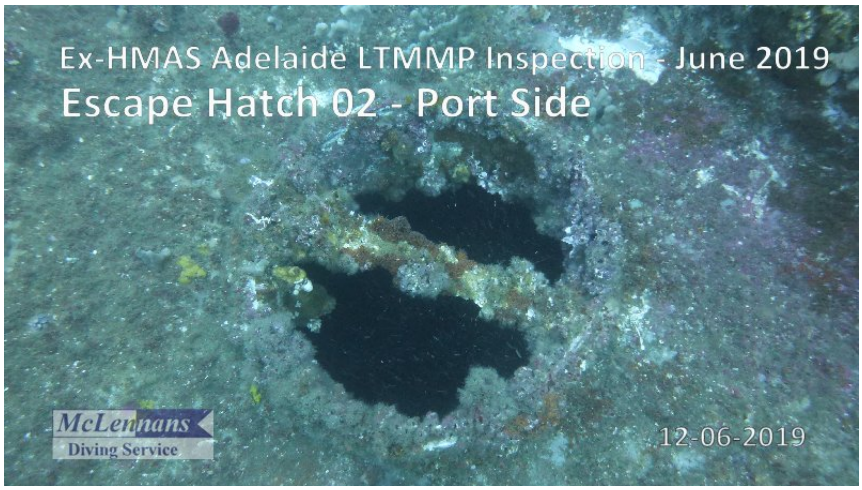


Figure 13: Using a level to measure the vessel's list

Figure 14: The main mast shows no sign of deterioration and supports an abundance of marine life. Note the white corrosion deposits on the aluminum deck.


Ex-HMAS Adelaide LTMMP Inspection - June 2019
Escape Hatch 01 - Port Side (2)
McLennans
Diving Service
13-06-2019


Ex-HMAS Adelaide LTMMP Inspection - June 2019
Escape Hatch 01 - STBD Side (3)
McLennans
Diving Service
13-06-2019


Ex-HMAS Adelaide LTMMP Inspection - June 2019
Escape Hatch 02 - Port Side
McLennans
Diving Service
12-06-2019

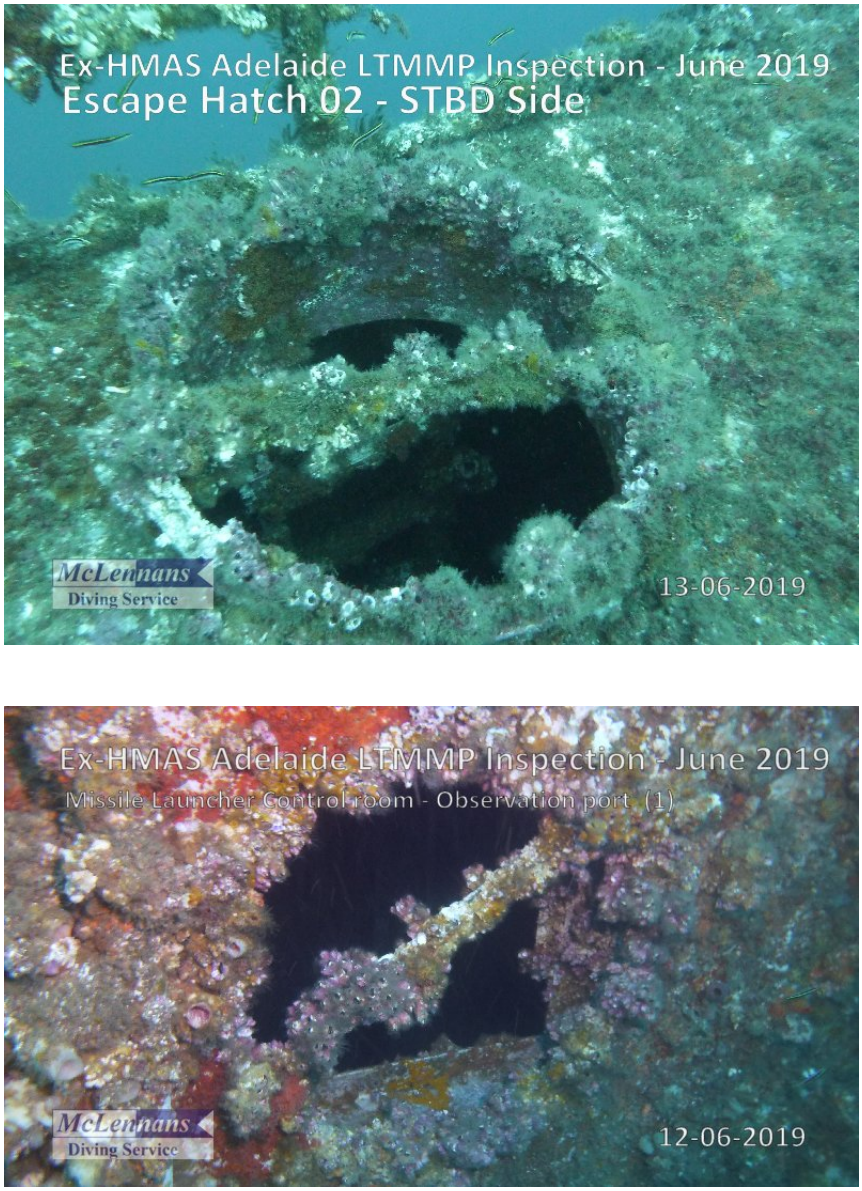


Figure 15: The above photos showed barred off areas.

Figure 16: The port side of the helicopter hangar. The top photo shows the panel laying on the seabed and the lower one shows the clean break on the superstructure. Deck 1 Frame 280

Figure 17: The stern with the sandy seabed visible. The seabed is approximately 3 metres below the top of the transom. The duck tail is just visible at the seabed.

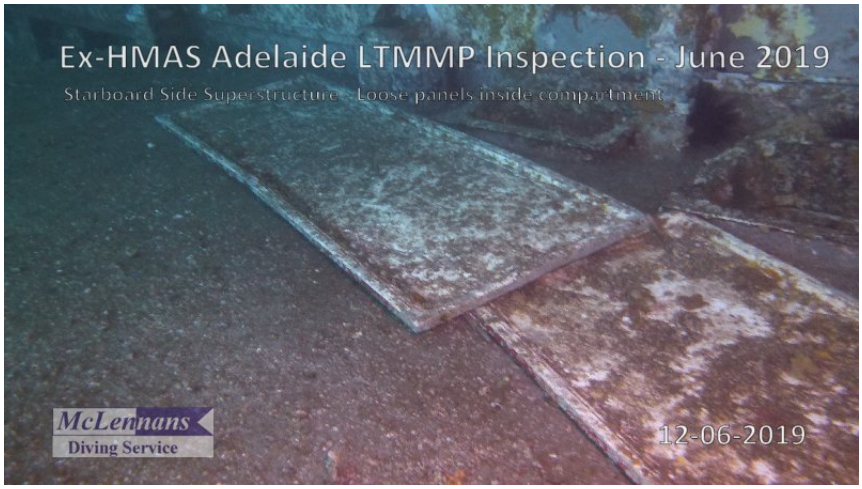


Figure 18: These panels are laying on the floor of 01 deck inside the superstructure. There are a large number of these type of panels laying inside the vessel.

Figure 19: The photos above show the "blown out" wall on the starboard side of 01 deck at Frame 215. The panel of the internal wall is hanging by just a couple of screws so it will soon detach.

Figure 20: The location of one thickness testing spots on the main deck aft of the hangar

Figure 21: The main deck aft of the Hangar after scraping away the biofouling. Note that the steel is well covered in grey paint with no corrosion. The diver is holding the thickness testing probe.

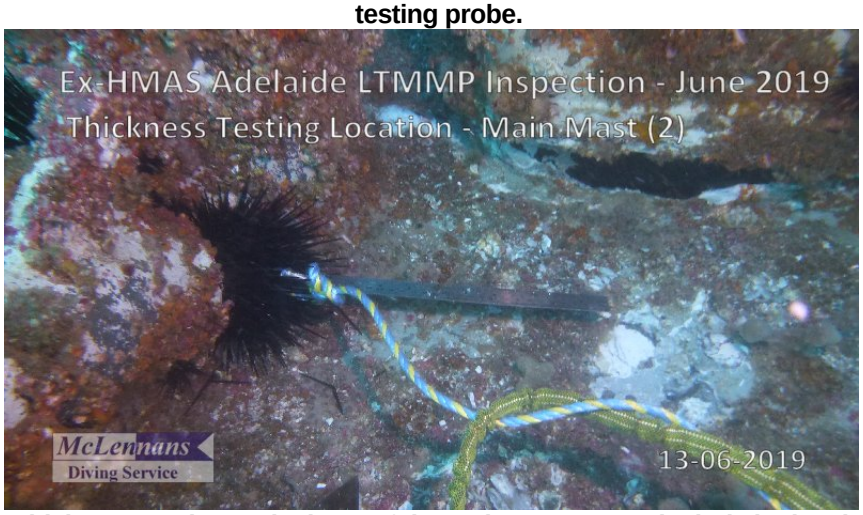


Figure 22: Thickness testing at the base of the main mast. Note the hole in the aluminum deck and the rough highly corroded aluminum where it has been scraped near the end of the ruler.

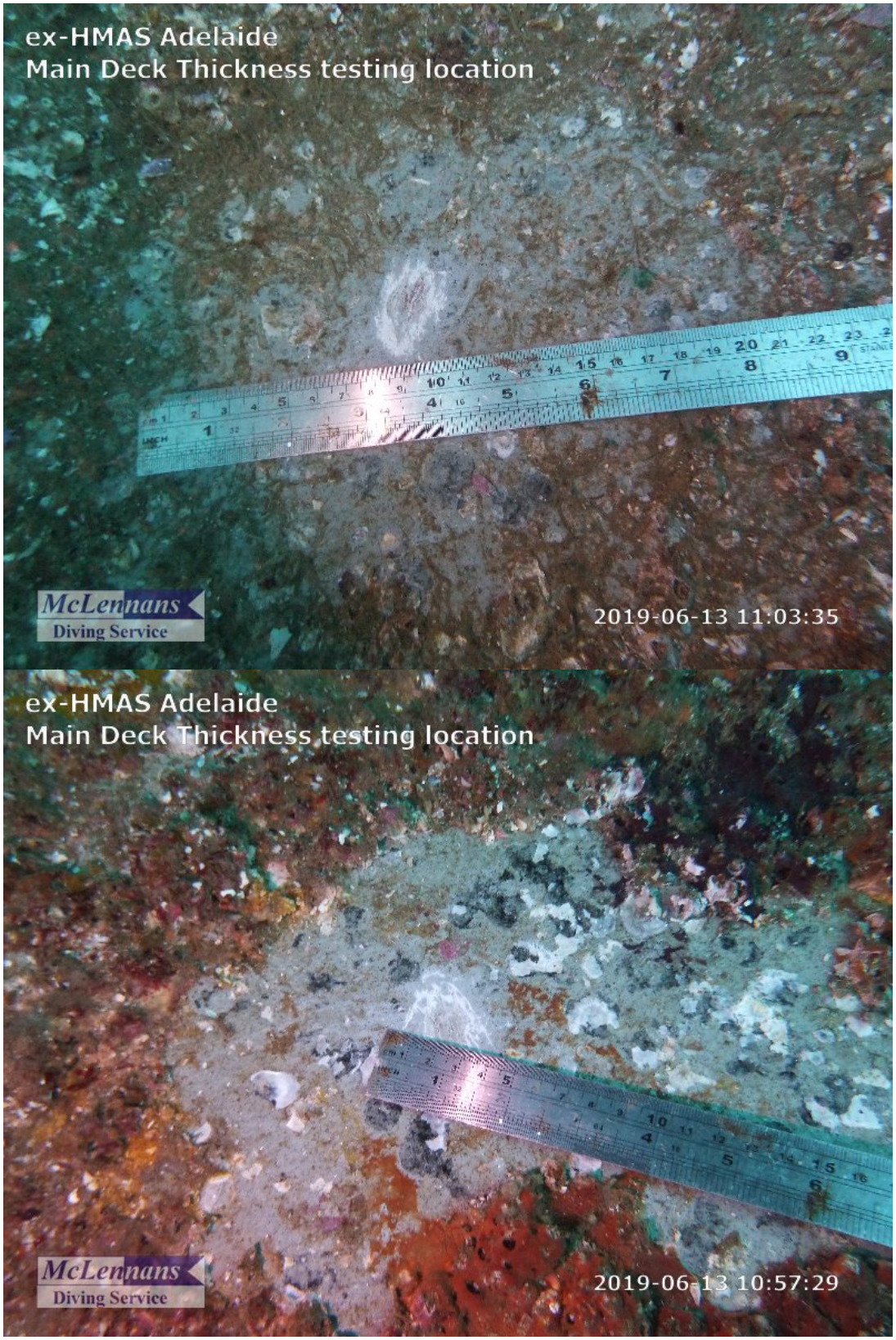
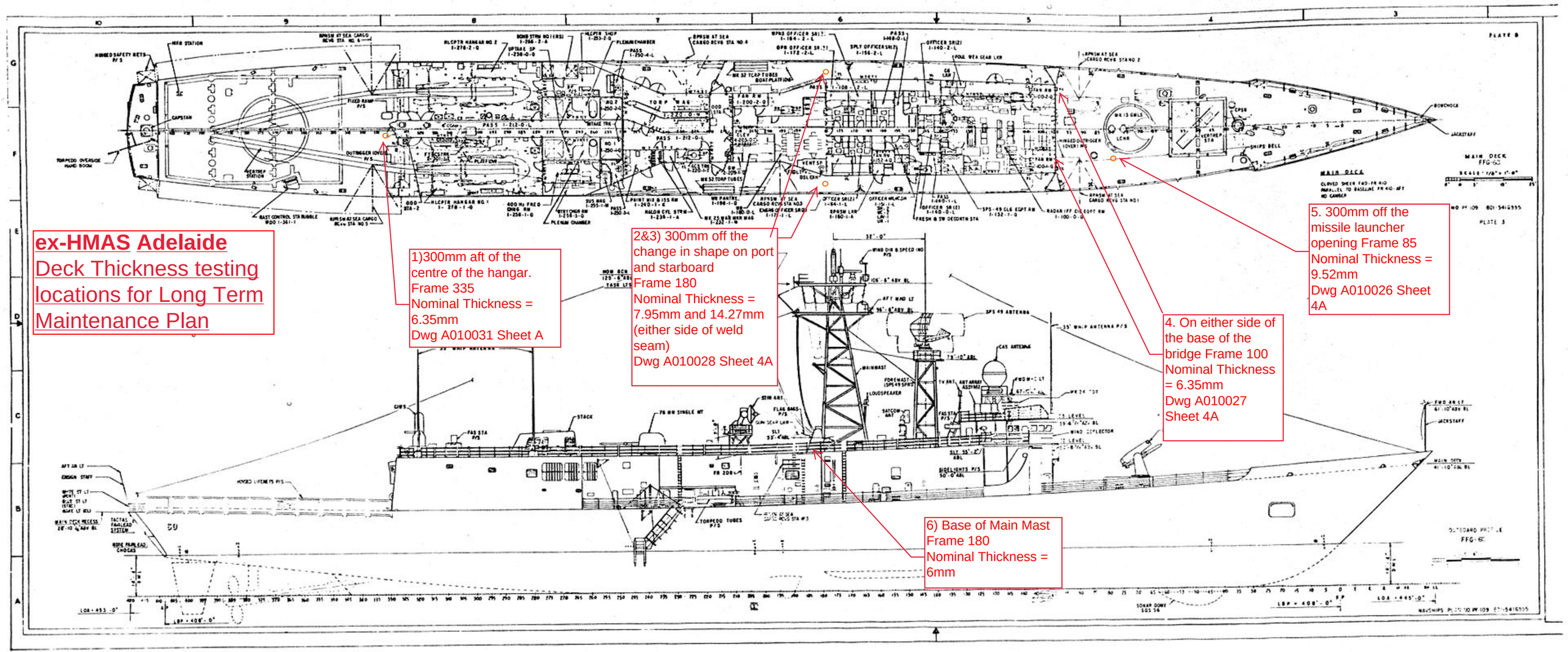


Figure 23: Two locations prepared for Thickness testing on the main deck. Note the paint coating is intact and no sign of corrosion


ex-HMAS Adelaide
Deck Thickness testing locations for Long Term Maintenance Plan
1)300mm aft of the centre of the hangar.
Frame 335
Nominal Thickness = 6.35mm
Dwg A010031 Sheet A
2&3) 300mm off the change in shape on port and starboard
Frame 180
Nominal Thickness = 7.95mm and 14.27mm (either side of weld seam)
Dwg A010028 Sheet 4A
4. On either side of the base of the bridge Frame 100
Nominal Thickness = 6.35mm
Dwg A010027 Sheet 4A
5. 300mm off the missile launcher opening Frame 85
Nominal Thickness = 9.52mm
Dwg A010026 Sheet 4A
6) Base of Main Mast
Frame 180
Nominal Thickness = 6mm

Olympus Scientific Solutions America

ISO 9001 CERTIFIED

OLYMPUS

Certificate Number 2100207

ENTERED

Certificate of Calibration

Form NDT Version 2.0.5 - 259K

Certificate Number 2100207

Customer:	McLennans Diving Service		
NDT Sales Order/RA:	300094809		
Gage Model:	MG2-XT	**S/N:**	121019106
Gage Status:	Calibration Only	**Transducer Status:**	As Received
Operational Software:	1.04/1.01x		
Transducer Model:	D7906-RM	**S/N:**	853021
Temperature:	22	**Humidity:**	49

This certifies that calibration of the above ultrasonic thickness gaging system has been verified within the tolerance and measurement range indicated below, using calibration standards with measured thickness traceable to the National Institute of Standards and Technology (N.I.S.T.). The calibration standard material is TB1064 CARBON STEEL. The test procedure used conforms to the requirements of ISO-9001 section 7.6.

All units below are: mm

System Calibration Data					
Test-block S/N	Certified Length inches/mm	Measured Length inches/mm	Deviation inches/mm	Tolerance +/-inches/mm	Within Tolerance?
A22381	.9990	N/A	N/A	N/A	N/A
A22382	1.9980	2.00	.0020	.102	YES
A22383	5.0110	4.98	-.0310	.102	YES

OLYMPUS AUSTRALIA LIMITED

PO Box 985 Mount Waverley Victoria 3149 Australia

Australia-wide Customer Service: 1300 132 992

ABN 90 078 493 295

Certified System Quality ISO 9001 SAI GLOBAL

A22384	9.9820	10.01	.0280	.102	YES
A22385	19.9750	20.01	.0350	.102	YES
A22386	49.9309	49.97	.0391	.102	YES
A22387	100.0100	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A

Gage Setup: N/A

Gage Velocity after Calibration: 5.740 mm/µs

Gage Zero after Calibration: 6450

Note: The measurement accuracy of any ultrasonic gaging system is dependent on the performance and proper usage of both the gage and transducer. This certificate of calibration identifies the part number and serial number of the transducer used to make the recorded measurements. System performance with other transducers may differ, especially with transducers that have been subjected to excessive wear or overheating. The user assumes responsibility for verifying system accuracy if the gage is used with transducers other than the one identified on this certificate. It is the responsibility of the user to periodically verify system calibration as outlined in the instrument operating manual.

Comments: Next Cal.On :06-03-2020

With the exception of cosmetic tests on repaired gages, does the above gage pass all test requirements of Olympus SSA procedure #715-102? <<YES>>

Special Setup Approval: N/A

Technician: Jack Zhu / Specialist Technician

Date: 6 March 2019

Signature: Jack Zhu

OLYMPUS AUSTRALIA LIMITED

PO Box 985 Mount Waverley Victoria 3149 Australia

Australia-wide Customer Service: 1300 132 992

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