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CHAPTER 35

INSPECTIONS, TESTS AND TRIALS

3501. General

- a. The implementation of good CBRN and Damage Control practice depends largely upon the efficiency of watertight structure, doors, hatches and fittings and CBRN and Damage Control equipment. To ensure this efficiency, numerous inspections, trials and tests and conscientious maintenance must be carried out. For most items, the necessary procedures and their periodicity are clearly set out in the appropriate maintenance schedule to which reference must always be made.
- b. During the construction of a warship, watertight compartments are detailed in the 'tabular statement of watertight compartments', a document which forms part of the ships drawings. The compartments listed are water-pressure tested before the ship is launched and measures taken, if necessary, to provide additional stiffening and to make good any leaks discovered. Once a ship is in service, watertight compartments are given periodic visual inspections that will indicate obvious threats to watertight integrity. Reference must be made to BR 2000(60) - Naval Marine Engineering Practices (Hull), should it be necessary to water-pressure test any compartment of a ship in commission. The only compartments likely to require such testing are those that normally contain fuel and which have been subjected to repairs affecting their integrity.

3502. Ministry of Defence Inspections

- a. Inspections of CBRN and Damage Control material arrangements are carried out in all new construction ships. The inspections are made by the platform Project Team (PT). Associated with the inspections are representatives of the Resident Project Officer (RPO) and the appropriate ships officers. These inspections are included in the programme of inspections and trials prior to completion of the ship.
- b. In MM/PP and larger ships two such inspections are held:
- (1) **Preliminary.** Carried out when work on the CBRN and Damage Control arrangements is approximately 60% complete. This inspection is mainly to provide guidance on the application of all the relevant drawings and specifications before the work is too far advanced.
 - (2) **Final.** Carried out when work on the arrangement is at least 90% complete, with all the equipment in place in the ship and fully operational (otherwise it is impracticable for the inspecting officers to carry out a proper check).
- c. The principal arrangements to be covered by the inspection(s) are:
- (1) The layout and equipment of HQ1 and HQ2, if applicable.
 - (2) The layout and equipment of Section Bases in large ships or of Fire and Repair Party Posts in small ships.

- (3) CBRN and Damage Control equipment, materials and stores.
- (4) Firefighting arrangements generally.
- (5) CBRN storerooms, cleansing stations and arrangements for decontamination.
- (6) CBRN and Damage Control markings.
- (7) Citadel arrangements.
- (8) Ventilation arrangements.

3503. Citadel Tests

- a. To exclude contamination, it is necessary for the citadel pressure to exceed the static pressure exerted by the relative wind at leaking positions in the citadel boundary. An in-service citadel pressure of 50 mm water gauge (WG) minimum is the acceptable standard. This is equal to the static pressure exerted by a 56 kt relative wind. If the citadel pressure was reduced to 25 mm WG this would be sufficient only in a 40 kt relative wind. Test procedures aim at achieving a minimum standard of 6.875 mbar (70 mm WG) at the HAT (citadel) with a corresponding pressure of 5 mbar (50 mm WG) at the SAT (citadel), and are operationally essential in new construction ships.
- b. Test requirements for air filtration units (AFU) are specified in BR 6590(003), for Filter Unit CBRN No 3 and in BR 6590(002) for Filter Unit CBRN No 6 and 7.

3504. Types of Citadel Test

The citadel concept cannot be effective unless rigorous air tests are enforced to ensure the boundaries are initially tight and subsequently do not decline during service. The two tests are:

- a. **Vacuum Test.** Carried out for leak detection, for subsequent repair.
- b. **Pressure Test.** Carried out to determine the degree of air tightness of the citadel boundaries.

3505. Vacuum Test

- a. Close all known openings in the citadel boundary, ie doors, hatches and ventilation openings (except [sub para d](#) below).
- b. Shut off all ventilation in the citadel.
- c. Stop as much machinery as possible to achieve a quiet ship.
- d. Run an exhaust fan of adequate size to draw an initial vacuum large enough for leaks to become evident by hissing, and arrange to measure the fan output as in [Para 3507](#). A 250 mm or 310 mm centrifugal fan such as fitted in the galley is normally sufficient for the whole citadel in a small ship or up to a 2830 m³ section in a large ship.

- e. Plug leaks with temporary sealant, noting the location of each leak.
- f. Once the large leaks have been sealed, the vacuum will increase and the smaller leaks will become more apparent. As these are progressively stopped the corresponding degree of tightness will be indicated by the higher readings on the U-tube. The test is not complete until all measurable leaks have been stopped. The fan output is then measured and the maximum U-tube reading taken when steady. For a successful test, the leakage worked out from the formula given must be within the capacity of the number of AFUs fitted.
- g. If the test is not successful, the search for leaks must be continued. An important conclusion to the test is to make good the temporary sealing by permanent repair and to re-test the whole citadel.
- h. Classes of ships are provided with check-off lists detailing all citadel openings. Ships are responsible for up dating these lists as A&As are completed. Ships without check off lists are to make full use of 'as fitted' drawings including the CBRN arrangement drawing.

3506. Pressure Test

- a. Close all ALFA openings and open Romeo openings.
- b. Restrict access to and from the citadel to the minimum essential numbers, using only the recognised airlocks.
- c. Run the ventilation system in its normal closed-down recirculation condition and start the AFU fans. Run machinery space fans. Care must be taken to ensure that the re-circulating fans do not contribute to the citadel pressure by drawing air from the outside atmosphere through leaking flap closures.
- d. Record the internal pressure shown by the manometer(s).

3507. Instrumentation for Testing

- a. **Pressure and Vacuum.** A 150 mm U-tube or an electronic manometer can be used for sensing citadel pressure or vacuum. See BRd 2170(2) for details of both instruments.
- b. **Exhaust Fan Output.** For vacuum tests, a velometer is used. This measurement will give the fan output against the vacuum achieved. To calculate the leakage area either of the following formulae may be used:

$$(1) \quad A = \frac{10^6 Q}{12\sqrt{P}} \text{ mm}^2$$

Where A is the area of leakage in mm², Q is the fan output in m³ per second and P is the pressure on the U-tube water gauge in millibars.

$$(2) \quad A = \frac{0.036Q}{\sqrt{P}} \text{ in}^2$$

Where A is the area of leakage in in², Q is the fan output in cu ft per minute and P is the inches of water gauge pressure measured on the U-tube.



Note. 1 inch water gauge is equivalent to 2.5 millibars.

3508. Harbour Acceptance Trial (Citadel)

Ships being built or undergoing upkeep periods are to be given a HAT (Citadel) before entering service. For ships building, the HAT (Citadel) is to be undertaken by the shipbuilder and completed to the satisfaction of the RPO. In other instances the trial will be the responsibility of the Upkeep Authority and carried out by them with the assistance, if necessary, of the ships staff. The trial is to be included in the completion programme and is not to be undertaken until all fitting-out or repair work affecting the citadel is complete. The HAT (Citadel) is to be conducted in two parts as follows:

- a. **Pre-HAT (Citadel).** A vacuum test is to be carried out using temporary sealing as necessary to determine leaks. A pressure test is to be conducted to check the running of the AFUs and the citadel pressure. If the pressure fails to reach the minimum standard set by MOD(N) a further search is to be made for leaks. All leaks found are to be made good and at least one week is to be allowed between pre-HAT and HAT for this purpose.
- b. **HAT (Citadel).** This need only be a pressure test, providing a pressure of at least the minimum standard set by MOD(N) is achieved without the use of temporary sealing. If this pressure is not achieved, leaks are to be found, repaired permanently and the test repeated until the minimum standard is achieved.

3509. Sea Acceptance Trial (Citadel)

To prove the operational material state of the citadel, a pressure test is to be conducted at sea during post-upkeep trials, or Part IV programme for new construction ships. If a pressure of at least the minimum standard set by MOD(N) is not achieved, leaks are to be located (if necessary by vacuum test) and rectified by DEFREP procedure. The trial is to be repeated on completion.

3510. Firefighting Equipment Inspections

- a. In new construction ships, a series of inspections of firefighting equipment is carried out. The inspections aim to ensure that all fixed and portable firefighting equipment is available; in the correct place and that the relevant Test Forms have been completed and signed. These activities should be complete by Contract Acceptance Date (CAD), which is also the date at which the vessel is accepted into Naval service.
- b. Inspections are the responsibility of the platform Project Team (PT), who may call upon MCTA to provide specialist support and advice for the following serials:
 - (1) **Preliminary Inspection.** Normally conducted by the RPO staff, with the Shipbuilder and Ships staff, this is a check, against the firefighting general arrangement drawings, to ensure that the basics are in place.

(2) **Pre-Contractors Sea Trial (CST) Inspection.** This is conducted by the PT, with the RPO, Shipbuilder and Ships staff. This inspection is part of the requirement to obtain Fire Safety Certification, which the ship must have prior to proceeding to sea for the first time (on CSTs). It should be noted that for CSTs the portable firefighting equipment embarked is normally non-MOD pattern, supplied by the shipbuilder. The inspection will ensure that the portable equipment is in sound working order and is stowed in the correct place (normally as per RN fit). An audit of the relevant Test Forms will also be undertaken to ensure that the fixed systems (ie engine room gas drench and the HPSW system) required for CSTs are complete in all respects. The inspection will also ensure that the ships staff (who normally form the SSEP during CSTs) have had adequate time to conduct firefighting training onboard and are familiar with the equipment.

(3) **Final Inspection.** This is conducted prior to Acceptance of Contract (AoC)/ Programme Acceptance Date (PAD) by the PT with RPO staff, the Shipbuilder and Ships staff in attendance. The aim is to ensure that the full RN fit of equipment is in place and in sound working order. The general arrangement drawings will again be used and the HAT (CBRNDC) document completed as far as possible. A final audit of the relevant Test Forms will also be undertaken.

c. At each of the above inspections, any defects or deficiencies are recorded in the Defect and Deficiencies Data Base (D3B), which forms part of the acceptance documentation.

d. Practical discharge tests of fixed foam systems are conducted as part of the relevant Test Forms, and in First of Class Ships, a full discharge trial of any gas drench system will normally be undertaken to ensure that concentration levels are in line with calculations.

3511. Damage Control Equipment Inspections

a. Damage control is covered in the same way as firefighting, with a pre-CST inspection, to ensure that the agreed minimum of equipment is in place for sea trials, and a final inspection that covers the full outfit. As with firefighting, the opportunity is taken, during the final inspection, to complete as much of the HAT (CBRNDC) document as possible, although in both cases it is the material aspects that are looked at in detail. Ships staff are responsible for ensuring that procedures are in place, in accordance with current Safety and Readiness Check (SARC) documentation.

b. The operation of portable pumps and other portable equipment is either conducted as part of a Test Form activity or as individual trial; Ships staff will always be involved.

3512. Fire Safety Certification

- a. All Royal Navy ships, submarines and RFAs are to be issued with a Design and Material State Fire Safety Certificate by the relevant PT Team Leader. This certificate, which is part of the overall ship safety assessment, verifies that the residual fire safety risks have been reduced to a level that is as low as is reasonably practicable (ALARP). The fire safety of the ship is also dependant on the competence and training of the ships staff and the ongoing routine maintenance of firefighting systems; these are the responsibility of Fleet Commander/DCNS and are not covered by the certificate.
- b. The certificate validity will initially be from CSTs to first refit. The certificate will then be re-validated near the end of the refit before the vessel proceeds to Sea Acceptance Trials. The Platform PT will suspend the certificate during major upkeep periods between refits if the volume or nature of work significantly degrades the ships firefighting capability or adversely affects the vessels fire safety. The certificate will be re-instated on completion of a satisfactory material state assessment.
- c. The issue of a Fire Safety Certificate by the MOD does not preclude the requirement to obtain Maritime and Coastguard Agency (MCA) fire safety certification for vessels that are certified by maritime regulating authorities, such as Lloyds Register of Shipping. In these instances the MCA and MOD certificates will be complementary, with the latter covering any aspects such as military equipment not covered by the MCA.

3513. Harbour Acceptance Trial (CBRNDC)

- a. A HAT (CBRNDC) is to be carried out by Ships staff, towards the end of an upkeep period, using Check Lists copied from [Annex 35A](#), [Annex 35B](#) and [Annex 35C](#). The administrative procedures are detailed in BRd 3001 - Fleet Engineering Orders, including the auditing of completed Check Lists by the Fleet Base Port Waterfront Organisation (FWO). The three stages of a HAT (CBRNDC) are:
 - (1) **HAT (CBRNDC) Part 1.** Pre-SSMOB Checks, as part of SARC 1.
 - (2) HAT (CBRNDC) Surface Ship Material State Verification Inspection (MSVI) Check Form for Issue of Certificate of Safety (Fire)(CS(F)), as part of SARC 2.
 - (3) **HAT (CBRNDC) Part 2B.** Pre-Ready for Sea Date (RFSD) Checks to be completed prior to Fleet Date Inspection (FDI) - Part III, as part of SARC 3.
- b. A ships officer is to be appointed HAT (CBRNDC) Coordinator and is to be responsible for:
 - (1) Overall coordination of the HAT (CBRNDC) inspections, ensuring full compliance with the HAT documentation.
 - (2) Devising and implementing personnel and whole ship CBRN and Damage Control training serials in accordance with SARC requirements. These are to be achieved prior to:

- (a) SSMOB. SARC 1.
 - (b) RFSD. SARC 2.
 - (c) FDI. SARC 3.
 - (3) Compilation of a HAT(CBRNDC) report for each Part (ie Part 1, 2A or 2B), detailing items outstanding, emphasising any 'starred' items outstanding that affect achievement of a successful HAT(CBRNDC).
 - (4) Presentation of the completed HAT (CBRNDC) documentation to the Commanding Officer (CO) via XO/CBRNDCO for approval.
 - (5) Drafting the achievement signal for each Part of the HAT(CBRNDC) for the CO, in accordance with the SARC DIN and BRd 9274 - Maintenance of Operational Capability (Surface Ships).
 - (6) Arranging for the Base Part FWO, Local FWO or FOST to audit the completed HAT(CBRNDC) Check List for each Part.
 - (7) Presentation of completed HAT(CBRNDC) documentation to the FDI inspecting authority.
- c. The Whole Ship CBRNDC Qualified (WSQ), as directed by the HAT(CBRNDC) Coordinating Officer, is responsible for the conduct of the HAT(CBRNDC) inspection and for:
- (1) Ensuring that personnel undertaking the HAT(CBRNDC) inspections are in possession of the correct documentation and are made aware of their duties.
 - (2) Correlating the results of Parts 1, Surface Ship Material State Verification Inspection and 2B of the HAT(CBRNDC) inspections and presenting the results to the HAT(CBRNDC) Coordinating Officer.
 - (3) Ensuring that any discrepancies or deficiencies are dealt with in a timely manner, paying particular attention to 'starred' items which must be completed to achieve the HAT(CBRNDC) Parts 1, Surface Ship Material State Verification Inspection and 2B standards.
- d. Ships staff are to note the following when preparing for a HAT(CBRNDC).
- (1) The date chosen for the inspections must be discussed and agreed by all parties involved with the ships upkeep period. Careful coordination is required to ensure that equipment/lockers/sign writing/communications facilities are in place prior to the Ships staff inspections for each HAT (CBRNDC) Part. Possible constraints/limitations which may affect the conduct of, or the ability to achieve, a satisfactory HAT (CBRNDC) standard are to be discussed with the appropriate FWO (or Squadron for MM/PP) staff and PCM.
 - (2) Certificates of compliance (clean air certificate) must be current and available for inspection by FWO/Squadron staff during the audit.

3514. Prewetting - Sea Acceptance Trial

During Part 4 acceptance trials and post upkeep period sea acceptance trials, ships are to carry out a trial of their prewetting system(s). Stabilised ships can apply an enforced roll through a moderate angle to improve the sluicing effect. The trial is to ensure that all nozzles are clear, that no leaks exist and that no work undertaken during the build or upkeep period has adversely affected the desired coverage. Defects discovered during the trial are to be treated as DEFREP's and instances of poor coverage or inadequate drainage are to be reported, giving the following information:

- a. The area not wetted.
- b. Direction and speed of relative wind.
- c. Ship motion during trial, ie steady, rolling, pitching, stabilised, etc.
- d. Number of pumps in use and pressure in system.
- e. Other pertinent factors.