

Tele: 022 2275 1158

Naval Trials and Acceptance Authority
C/o Fleet Mail Office
Mumbai 400 001

NATAA/318/H

21 Dec 21

The Officer-in-Charge
Hull Inspection and Trials Unit
C/o Fleet Mail Office
Kochi - 682004

The Officer-in-Charge
Hull Inspection and Trials Unit
C/o Fleet Mail Office
Visakhapatnam - 520014

The Officer-in-Charge
Hull Inspection and Trials Unit
C/o Fleet Mail Office
Port Blair - 744102

MACHINERY COMPARTMENTS VENTILATION SYSTEM TRIALS

1. Refer to the following:-

(a) NO 07/18

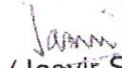
(b) HITU (Mbi) letter HITU/300/39-1 dated 16 Nov 21, not addressed to all, copy enclosed.

2. HITUs are mandated to undertake Heating Ventilation & Air Conditioning (HVAC) System trials of all compartments as part of Pre and Post refit trials of ships and submarines. The ventilation system of machinery compartments has been a neglected area which has led to cascading effect on equipment and systems. It is pertinent to mention that sub-optimal machinery ventilation system severely hampers the operating conditions of the main engine and other auxiliary machinery with inappropriate ambient conditions like temperature, relative humidity, air flow, etc. Further, an improper machinery ventilation also adversely affects watch-keepers. It is important that the ventilation in these compartments are balanced and ventilation / exhaust / supply blowers are exploited as per the design and in the correct configuration. The blowers in the machinery compartments are generally of higher capacity and by exploiting them haphazardly may lead to either a vacuum / higher pressure inside the compartment. This leads to either loss of cool air from the adjacent lobbies to machinery compartments, or travel of high

temperature air to the adjacent lobbies from machinery compartments causing undesirable heat load inside the ship.

3. HITU(Mbi) has undertaken comprehensive ventilation trials of *three* machinery compartments (FER, AER and AMR) onboard INS Delhi as part of Post Refit Trials. Further, trials of the other machinery spaces are being undertaken. The detailed trials include design parameters vis-à-vis NES 102 along with impetus on system integrity checks and airflow measurement incorporating neglected areas like instrumentation, inspection windows, lagging, bellows, supporting clamps, etc. The trials report rendered by HITU(Mbi) also has brought out important observations and has recommended way ahead/ corrective actions for improvement of machinery ventilation of the ship. A copy of the report is enclosed for reference.

4. In view of the above, it is requested that Machinery Compartment Ventilation trials report prepared by HITU(Mbi) be studied and a detailed machinery compartment ventilation trials of ships and submarines under respective jurisdictions be undertaken as part of Pre and Post Refit trials of ships / submarines under NR / MR.


(Jasvir Singh)
Captain
Director
for Director General

Enclosure :- As above

Copy to :-

The Flag Officer Commanding-in-Chief
(for CCONO / CEO)
Headquarters, Western Naval Command
C/o Fleet Mail Office, Mumbai – 400001

The Flag Officer Commanding-in-Chief
(for CCONO / CEO)
Headquarters, Southern Naval Command
Kochi – 682004

The Flag Officer Commanding-in-Chief
(for CCONO / CEO)
Headquarters, Eastern Naval Command
Visakhapatnam – 530014

The Commander-in-Chief
(for CTO (Marine))
Headquarters, Andaman Nicobar Command
Port Blair- 744102

The Officer-in-Charge
Diesel Testing & Tuning Team
Naval Dockyard
C/o Fleet Mail Office
Visakhapatnam 530014

The Officer-in-Charge
Gas Turbine Testing & Tuning Team
Naval Dockyard
C/o Fleet Mail Office
Visakhapatnam 530014

RESTRICTED

The Officer-in-Charge
Diesel Testing & Tuning Team
C/o Fleet Mail Office
Mumbai 400001

The Officer-in-Charge
Machinery Trials Unit
Naval Dockyard
C/o Fleet Mail Office
Visakhapatnam 530014

The Officer-in-Charge
Machinery Trials Unit
C/o Navy Office, Hastings
Kolkata 700022

The Officer-in-Charge
Machinery Trials Unit
Naval Base
C/o Fleet Mail Office
Kochi 682004

The Officer-in-Charge
Gas Turbine Testing & Tuning Team
C/o Fleet Mail Office
Mumbai 400001

The Officer-in-Charge
Machinery Trials Unit
C/o Fleet Mail Office
Mumbai 400001

The Officer-in-Charge
Machinery Trials Unit
C/o Headquarters Goa-Naval-Area
Vasco-da-Gama, Goa 403802

The Officer-in-Charge
Hull Inspection and Trials Unit
C/o Fleet Mail Office
Mumbai 400001

RESTRICTED

Telephone: 2275 1345

Hull Inspection and Trials Unit
c/o Fleet Mail Office
Mumbai - 400 001

HITU/300/39-01

16 Nov 21

The Commanding Officer
(for Executive Officer)
INS Delhi
c/o Fleet Mail Office
Mumbai - 400 001**VENTILATION TRIALS OF MACHINERY COMPARTMENTS-**
INS DELHI (MR-MLU)

1. Refer to NATAA signal DTG 151935/ Nov.
2. Ventilation trials of major machinery compartments viz. AMR, FER and AER were undertaken by HITU (Mbi) on 15 Nov 21.
3. **Guideline for trials.** Def Stan 02-102 and NES 102.
4. **Design Parameters.** The following have been considered as design parameters based on NES 102:-

- (a) Ship's exploitation under following environment conditions (Hot Climates as per NES 102):-

Dry bulb Temperature	Wet Bulb Temperature
35 °C	30 °C

- (b) **Temperature.** Main and large auxiliary machinery spaces, in 'Open Ship' condition, temperature rise above external ambient restricted to 15 °C {as per para 4.1 (d) of section 4 of NES 102}.

- (c) **Airflow.** The exhaust should be between 107-115% of the total supply so as to account for temperature rise and dissipation of smoke, if any from the compartment {as per para 8.1.1 (c) of section 8 of NES 102}.

5. **External Environment Conditions during Trials.** The external environment parameters measured during the trials were as follows:-

Dry Bulb Temp (°C)	Wet Bulb Temp (°C)	Effective Temp(°C)	RH (%)
29	25	26.4	71

6. **Ventilation Arrangement.** The ventilation arrangement onboard in the above mentioned compartments is as follows:-

(a) **FER & AER.** These compartments are provided with two supply and one exhaust blowers each to be used in 'Open Ship' condition. One supply blower is fitted with a HE which is supplied with chilled water from the AC plants in a closed loop circuit for maintaining the temperature inside the compartment. The other supply blower is not fitted with any HE or sea water cooler. Moreover, one natural supply is provided to the compartment to be used in 'Open Ship' condition. This supply is provided with a sea water cooler known as the Bilge cooler.

(a) **AMR.** The compartment is provided with two supply and two exhaust blowers to be used in 'Open Ship' condition. No supply blower is fitted with any HE or sea water cooler.

7. **Trials.** Measurements wrt air flow of supply and exhaust blowers and temperature were recorded for each compartment. Air flow for natural supply could not be recorded for any compartment. Detailed report on the trials is placed at enclosure.

8. **Observations.** Salient observations of the trials are as following:-

(a) **FER.**

(i) All the blowers were operational and data was recorded wrt airflow and temperature. The effective temperature and relative humidity (RH) were calculated to be 31 °C and 38%.

(ii) Total supply and exhaust were recorded to be 4595.40 m³/hr and 13824 m³/hr which was found to be SAT as per the criteria indicated at para 4(c) above.

(iii) 11 inspection windows were missing at various locations on the ventilation trunking.

(iv) Lagging of HE was incomplete.

(b) **AER.**

(i) All the blowers were operational and data was recorded wrt airflow and temperature. The effective temperature and relative humidity (RH) were calculated to be 27 °C and 65%.

(ii) Total supply and exhaust were recorded to be 18638.64 m³/hr and 16727.04 m³/hr which was found to be UNSAT as per the criteria indicated at para 4(c) above.

(iii) Seven inspection windows were missing at various locations on the ventilation trunking.

(iv) Lagging of HE was incomplete.

(c) AMR.

- (i) All the blowers except one exhaust blower were operational and data was recorded wrt airflow and temperature. The effective temperature and relative humidity (RH) were calculated to be 25.5 °C and 70%.
- (ii) Total supply and exhaust were recorded to be 13458.24 m³/hr and 2592 m³/hr which was found to be UNSAT as per the criteria indicated at para 4(c) above.
- (iii) Exhaust blower (S) was found to be non-ops.
- (iv) Six inspection windows were missing at various locations on the ventilation trunking.
- (v) Bellows of both supply blowers and one exhaust blower were missing.
- (vi) Supporting clamps of exhaust blower trunking (S) were damaged.
- (vii) Two wire mesh of supply blower (S) were found to be missing.

9. Inferences. The following can be inferred from the trials:-

(a) Airflow.

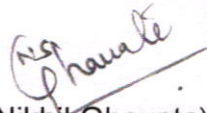
- (i) The airflow data recorded during the trials can be considered SAT for FER and UNSAT for AER and AMR view not complying with the design consideration as per NES 102 as indicated at para 4(c) above.
- (ii) The trial data however cannot be compared with the design/ commissioning data view unavailability of the same.

(b) Temperature. Although the temperature recorded can be considered **SAT** in all the compartments inspected, it is pertinent to mention that the heat load of the compartments were significantly lesser than what it is expected to be while the ship is out at sea view major machinery viz. Main engines, GTGs and other auxiliary machinery not running during the trials and therefore no conclusive inference can be made from the recorded trial data.

10. Recommendations. In view of the above, following is recommended:-

- (a) SS to project the above mentioned observations to ND(Mbi) for early liquidation.
- (b) SS liaise with ND (Mbi) for early liquidation of above mentioned defects.
- (c) Conduct of Ventilation trials of machinery compartments to be undertaken in conjunction with the Phase II HVAC trials at sea with full heat load disposition

so as to make meaningful assessment of ventilation system in machinery compartments.


(Nikhil Ghavate)
Lieutenant Commander
Trials Officer
for Officer-in-Charge

Encl:- As above

Copy to:-

The Flag Officer Commanding-in-Chief
(for SCONO)
Headquarters, Western Naval Command
Ballard Pier, Near Tiger Gate
Naval Dockyard
Mumbai - 400 023

The Flag Officer Commanding
(for FNAO)
Headquarters, Western Fleet
c/o Fleet Mail Office
Mumbai- 400 001

The Director General
{for Capt (E)}
Naval Trials and Acceptance Authority
c/o Fleet Mail Office
Mumbai- 400 001

VENTILATION TRIALS OF MACHINERY COMPARTMENTS- INS DELHI

Ser	Compt	Blower	Ducts	Measured Values					Design Flow Rates(m3/ hr) (Commisioning Trial Document)		Temperatures & RH			
				Air Flow (m/s)	Duct Area (m ²)	Flow Rate (m3/ hr)	Total Compt. Flow Rate (m3/ hr)	Total Flow Rate (m3/ hr)	Compt	Total	DB Temp °C	WB Temp °C	Effective Temp °c	RH (%)
1	FER	Supply Blower - Axial	15	1.00	0.0090	32.40	2,676.24	4,595.40	NA	NA	39	27	31	38
				1.90	0.0090	61.56								
				2.40	0.0900	777.60								
				1.60	0.0090	51.84								
				0.30	0.0090	9.72								
				0.70	0.0900	226.80								
				1.80	0.0090	58.32								
				1.50	0.0090	48.60								
				1.80	0.0900	583.20								
				1.40	0.0900	453.60								
				0.80	0.0090	25.92								
				1.20	0.0090	38.88								
				0.80	0.0900	259.20								
				0.80	0.0090	25.92								
				0.70	0.0090	22.68								
		Supply Blower-Centrifugal	3	18.80	0.0090	609.12	1,919.16							
				3.80	0.0780	1,067.04								
				2.50	0.0270	243.00								
		Exhaust Blower	1	5.00	0.7680	13,824.0	13,824.0	13,824.0						

Ser	Compt	Blower	Ducts	Measured Values					Design Flow Rates(m3/ hr) (Commisioning Trial Document)		Temperatures & RH			
				Air Flow (m/s)	Duct Area (m ²)	Flow Rate (m3/ hr)	Total Compt. Flow Rate (m3/ hr)	Total Flow Rate (m3/ hr)	Compt	Total	DB Temp °C	WB Temp °C	Effective Temp °c	RH (%)
2	AER	Supply Blower - Axial	14	9.00	0.0400	1,296.00	1,425.60	18,638.64	NA	NA	30	25	27.0	65
				8.00	0.0400	1,152.00								
				5.50	0.0750	1,485.00								
				3.40	0.0500	612.00								
				3.00	0.0080	86.40								
				3.70	0.0080	106.56								
				4.80	0.0080	138.24								
				5.50	0.0080	158.40								
				2.50	0.0080	72.00								
				4.50	0.0080	129.60								
				7.50	0.0900	2,430.00								
				4.60	0.0900	1,490.40								
				0.30	0.0080	8.64								
				0.40	0.0900	129.60								
		Supply Blower-Centrifugal	4	1.50	0.0900	486.00	17,213.04							
				2.10	0.0300	226.80								
				7.70	0.0300	831.60								
1.20	0.0300			129.60										
Exhaust Blower	1	6.60	0.7040	16,727.04	16,727.04									
3	AMR	Supply Blower(P)	5	1.60	0.1200	691.20	5,843.16	13,458.24	NA	NA	28	24	25.5	70
				6.50	0.0170	397.80								
				4.50	0.1200	1,944.00								
				7.80	0.0170	477.36								
				5.40	0.1200	2,332.80								
		Supply Blower (S)	7	7.10	0.1200	3,067.20	7,615.08							
				7.20	0.0170	440.64								
				13.00	0.0170	795.60								
				6.50	0.0450	1,053.00								
				17.00	0.0170	1,040.40								
				6.60	0.0240	570.24								
1.50	0.1200			648.00										

Ser	Compt	Blower	Ducts	Measured Values					Design Flow Rates(m3/ hr) (Commisioning Trial Document)		Temperatures & RH			
				Air Flow (m/s)	Duct Area (m ²)	Flow Rate (m3/ hr)	Total Compt. Flow Rate (m3/ hr)	Total Flow Rate (m3/ hr)	Compt	Total	DB Temp °C	WB Temp °C	Effective Temp °c	RH (%)
3	AMR	Exhaust Blower (P&S)	1	6.00	0.1200	2,592.00	2,592.00	2,592.00	NA	NA	28	24	25.5	70