

***REPORT ON VENTILATION IN H.M.T. D.—**

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BY

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THE following report on air temperatures and conditions of ventilation in H.M.T. D.— during a voyage from temperate to tropical zones has been drawn up in accordance with instructions and requirements laid down in War Office letters 24/Gen/2417/Q(M)/1a, dated April 2, 1943, and September 14, 1943.

SCOPE OF INVESTIGATION

- (1) Preliminary enquiries and inspection of system of ventilation.
- (2) Observations of air temperature, cooling power, and air velocity.
- (3) Appendix "A." Special report on certain quarters found to be defective.

(1) INSPECTION OF VENTILATION SYSTEMS

In the first instance, the S.M.O. and Troops Officer were contacted and information obtained from them as to the quarters in which the adequacy of ventilation was doubtful, and details obtained of the system of ventilation in various parts of the ship. A diagram was made of the quarters and a preliminary inspection carried out to determine (a) the general condition and use being made of the ventilating mechanisms, and (b) sites in quarters at which routine observations of air temperature, etc., should be made.

A detailed inspection of the system of ventilation was carried out, the following points being noted :

- (i) *The system of ventilation* comprised several different types of equipment, according to the date of installation and local requirements :
 - (a) Cowl ventilation supplying fresh air.
 - (b) Large power fans on Port and Starboard sides, supplying fresh air along trunking to quarters and corridors.

*Apart from minor corrections and the omission of diagrams of the ship's quarters, this paper is a reproduction of a report rendered to the O.C. Troops, H.M.T.D.—, by the ventilation officers appointed for the voyage. The report was prepared under extremely difficult conditions and the authors tender their apologies to readers for the literary style and many defects which would have been remedied had time permitted.

(c) Local power fans supplying fresh air through recently installed trunking fitted with "punkah louvre" delivery units.

(d) Local power fans delivering fresh air through trunking fitted with louvres of various types.

(e) Fans for re-circulating air in cabins in which there is no supply of fresh air when ports are closed as required during the hours of blackout.

(ii) *Cowl Ventilation and Extraction Vents.*—Certain cowl ventilators needed directional adjustment and the gridded vents on trunking connected with supply fans were in several cases partially blocked with rubbish and deposit adhering to the wire meshes. These defects were remedied and personnel detailed for the routine inspection and cleaning of supply and extraction vents.

(iii) *Power Fans and Trunking.*—Some fans could be operated at two speeds but the majority had only one speed. They were run at the maximum speed. The trunking of the power fans exposed on the Port and Starboard sides of "B" Deck Aft were defective in several places. Holes approximately 3 in. diameter were noted and in one place large quantities of air under high pressure were emerging from a hole 1 foot square, where the trunking from the port side fan linked up with the steam heater. Attention was drawn to this defect and steps taken to remedy it.

(iv) *Inspection Plates.*—Particularly in the case of the recently installed trunking for the punkah louvre system, it was noted that the inspection plates had been removed in several quarters, and, in one case, a plate 18 in. by 6 in. had been detached. Orders were issued that these plates were to be replaced at once and not interfered with. It was explained to the troops that removal of these plates reduces the force of the air jets from the louvres and stencilled "DO NOT TOUCH" notices were painted on the trunking.

(v) *Delivery Louvres.*—In many cases it was noted that the louvres were directing the air jets against individual hammocks or clothing or tables. It was pointed out that to get the best general advantage of this type of fresh air ventilation the air stream should be directed between tiers of bunks, or rows of hammocks, viz. down alleyways, towards the extractor of the cowl ventilator which in some cases was present, or the centre stairway in others. In some cases the louvres were so adjusted as to promote a circulation of air—see Appendix, quarters "D" 2. These louvres might be marked with a line painted on the trunking to indicate the setting and enable any alterations to be easily detected. Occupants of certain quarters were advised not to leave clothing drying at night as it both hindered the air stream and added humidity to the air.

(vi) *Cabin Fans.*—In cabins and quarters unventilated by fresh air, the need for increased cooling power of the air movement created by fans was particularly marked and with the reconditioning of certain fans and the installation of others, conditions were much improved. Although this was a help—the re-circulation of air without entry of fresh air is unsatisfactory as the humidity increases rapidly in occupied quarters.

***(2) OBSERVATIONS OF AIR TEMPERATURES, COOLING POWERS, AND AIR VELOCITY.**

Some Dry and Wet Bulb Temperatures were recorded by two Mason's Hygrometers issued for the purpose, but as these instruments take some minutes to reach stability on change of location, the vast majority of readings were taken by means of an Edney Swing Hygrometer.

Measurements of Cooling Power and Air Velocity were taken by means of a Kata thermometer.

Observations relevant to constructive criticisms of the ventilation conditions of certain quarters are given in Appendix "A."

APPENDIX "A." SPECIAL REPORT ON VENTILATION IN CERTAIN QUARTERS

The ventilation in the undermentioned quarters is defective in comparison with that appertaining generally. Our opinion in this respect is based on observations of air temperatures given in the schedule below, together with simultaneous observations of outside shade temperature, and records of the number of occupants, all of which information is required by W.O. letter 25/Gen/2417/Q(M)/1a dated September 14, 1943.

In regard to inlet cowls, in one instance only, viz. that of the Separation Ward, which is discussed at a later point, were the cowl systems rendered ineffective during the voyage.

Fans were in continuous operation as soon as the need for them occurred during the voyage. Inspection plates in the trunking were found to have been removed and damaged in certain quarters but this matter was dealt with effectively before completion of the voyage by:

- i. Enforcing the replacement of the plates.
- ii. Stencilling the trunking near each plate with the words DO NOT TOUCH.
- iii. Warning troops, through S.R.O.s that interference with plates would be severely dealt with.

In regard to damaged plates and defects in the trunking system generally, the ship's staff undertook repairs as from time to time we reported them, after detection.

A diagram of the ship's quarters is given which should be consulted in conjunction with Appendix "A" tables for the following quarters:

Section 1.	"D" Deck.	"D" 2 quarters, 77 officers.
" 2.	"C" "	Various cabins.
" 3.	"B" "	Various dormitories and one troop deck.
" 4.	"C" "	Island Aft; Separation Ward.
" 5.	"L" "	Stewards' quarters.

We wish to draw attention to the following factors influencing the effectiveness of the system of ventilation installed, assuming that the fresh air provision, by means of the

*Instructions for the use of instruments and procedure recommended for the investigation of ventilation and thermal comfort conditions in ships are given in: Medical Research Council War Memorandum No. 17, "Environmental Warmth and Its Measurement," by T. Bedford, H.M.S.O. 1946.

Recent studies bearing on problems of thermal comfort in ships are referred to in the following paper: "A Survey of Physiological Studies of Mental and Physical Work in Hot and Humid Environments," by G. P. Crowden, Transactions of the Royal Society of Tropical Medicine and Hygiene, Vol. 42, No. 4, January 1949.

APPENDIX "A." SUMMARY OF OBSERVATIONS TAKEN IN DEFECTIVE SPACES. H.M.T. D.—

Date	Time	Location	°F.		%	Remarks
			D.B.	W.B.		
SECTION 1 D.2. 77 OFFICERS						
28 Jan. 44	0700	D2. Fully occupied, ports closed	74	73	95	
28 Jan. 44	2330	D2. Fully occupied, ports closed	78	68	58	
28 Jan. 44	2330	Punkah louvre air entry	70	64	71	
28 Jan. 44	2330	D2. Companion-way	75	67	65	
4 Feb. 44	0700	D2. Fully occupied, ports closed	92	88	85	Ordinary fan installed on 4/5.2.44
4 Feb. 44	0700	Outside shade temp.	86	80	76	No discomfort felt during night 4/5.2.44
4 Feb. 44	2330	D2. Fully occupied, ports closed	88	82	77	
4 Feb. 44	2330	Outside shade temp.	85	78	72	
5 Feb. 44	0700	D2. Fully occupied, ports closed	85	80	79	Note drop on Wet Bulb since previous morning of 8° F.
SECTION 2. "C" DECK						
31 Jan. 44	2000	C Deck. (Outside)	82	73	64	
31 Jan. 44	2000	Corridor near hot wall outside cabin 436	85	74	58	Occupants complaining of excessive heat due to radiation from Engine Room Bulkhead
31 Jan. 44	2000	Cabin 436. FAN ON	85	75	62	
3 Feb. 44	2000	Cabin 442 (corridor outside) ..	88	80	69	Demonstrating uselessness of opening cabin door to relieve conditions inside cabin
3 Feb. 44	2000	Cabin 442	82	76	75	Engine Room bulkhead closed at time
3 Feb. 44	2000	Cabin 408	87	78	65	Cabin 408 near hot wall demonstrating rise in temp. due to radiation
3 Feb. 44	2000	Outside deck temp.	82	74	67	
4 Feb. 44	2200	Outside deck temp.	84	78	76	
4 Feb. 44	2200	Cabin 436 (3 occupants)	90	82	70	Demonstrating need of fresh air supply
4 Feb. 44	2200	Cabin 408 (4 occupants)	90	84	77	
4 Feb. 44	2200	Corridor outside cabin 408 ..	89	81	70	Lights in corridor should be blacked out to facilitate opening of corridor roof ventilators. Note surface temp. of cool walls in corridor 90° F.
SECTION 3. "B" DECK						
4 Feb. 44	1115	Dormitory B8 (33 officers) ..	92	85	74	Observations as at time when defective spot was reported. No occupants, ports open
4 Feb. 44	1115	Outside shade temp.	86	80	76	Punkah louvre in operation but very weak
4 Feb. 44	2200	Corridor wall	125	—	—	Surface temp. outside Dorm. B8

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recently installed punkah louvre, allowed for the closure of ports during the blackout, and for conditions of maximum occupancy in tropical climates :

- i. The provision of a fresh air supply to the Separation Ward is essential and that, should a voyage in cold climates take place, heating would be necessary.
- ii. In dormitory " B " 9 occupied by 33 officers, hot water pipes just above the top tier of several 3 tier bunks* put an excessive load on the punkah louvre system and there were many complaints of discomfort.
- iii. In dormitory " B " 8 similar conditions to " B " 9 were found, considerable heat being liberated in the space by a hot floor, under which was situated a galley, and from the trunking of an extraction ventilation shaft which passes through the quarters, and which was found to be noticeably hot on some days.

In the corridor opposite these cabins, a large expanse of internal panelling had a temperature of 125° F., and in this connexion, attention is also drawn to data for cabins 436 starboard, and 408 port, two of a number of cabins in which observations were taken which show the increased temperature resulting from radiation by these hot walls. Appropriate lagging and air spaced panel insulation would eliminate this factor contributing to discomfort.

There is no provision for fresh air entry in any of the " C " Deck cabins occupied by troops in transit, and absence of fresh air supply naturally leads to rapid increase in humidity when ports are closed.

It was found that the ventilation in these cabins compared unfavourably with that of troop decks possessing the punkah louvre system.

In regard to air movement, it was found that stagnant air pockets collected in the centres of certain troop decks, viz. B6 and A5, and it is suggested that ordinary fans be installed at the foot of stairways leading to the upper deck to facilitate air movement in this direction, and, by so doing, increase the cooling power of the air as measured by the Kata thermometer.

Directional adjustment of individual louvres is necessary for the best general ventilation and it therefore suggested that some system of marking the louvres for this setting is used, for example, an arrow point on the louvre and a black dot on the socket.

We regret that time does not allow us completely to assess the observations and data which we have collected, but the report as it stands comprises the main points. As the voyage was made from temperate to tropical zones, the last few days only were the most useful for testing the efficiency of ventilation with consequent reduction in time available for assessing the data.

February 6, 1944.

*It seems to be extraordinary that bunks should be located in close proximity to hot pipes, etc., in any ship destined for tropical voyages. Similar conditions recorded in this Journal were found in 1933 in H.M.T.D.— in which case several cabins had a top berth which became unusable after reaching the Red Sea, metal bars round and above the bunks were too hot to hold and air temperatures well over the 100° F. mark.—E.D.