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**THE HABITABILITY PROGRAM FOR
SUBMARINES, AIRSHIPS AND CERTAIN OTHER
LONG DURATION MILITARY TASK UNITS:
PRINCIPLES OF ANALYSIS**

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**THE HABITABILITY PROGRAM FOR SUBMARINES,
AIRSHIPS AND CERTAIN OTHER LONG DURATION MILITARY TASK UNITS;
PRINCIPLES OF ANALYSIS**

It was ten years ago this June that the (now) Human Engineering Branch of Medical Research Laboratory began a systematic analysis of the effects which high mechanization and long duration missions would be expected to have upon human factors in military operations. The principles which were then formulated, disseminated, and put into practice on submarines, have since been applied successfully to a wide variety of military units, both static and mobile.

1. The purpose of habitability programs is, in general, to increase the efficiency of the personnel. Specifically:

(a) To increase the general physical and mental well-being of the personnel by providing physical arrangements which enable them to sleep restfully, eat with satisfaction, work with confidence and relax with ease.

(b) To promote a state of mind which causes the personnel to anticipate a return to cruise duty with agreeableness or with pleasure.

(c) To minimize, as far as consistent with operational efficiency, decided differences between the habits and customs established by fifteen to twenty years of American home life and the living conditions aboard a ship.

(d) To increase the satisfaction of each individual with his own work and stimulate pride in his particular ship.

2. The above objectives are accomplished not only by actually designing and installing improved living conditions, but by properly planning organizational relationships.

(a) Publicity. Service personnel, their friends and families, must be kept aware of the fact that there is a continuing habitability program, that staffs of men are actively planning things for their benefit, that advantage is being taken of the experiences of other Services and that the living and working conditions are superior to those provided in private industry.

(b) Participation of the crews, officers and enlisted men. Advice should be sought from the "old timers". As soon as the first personnel

are assigned to a ship they should be brought into consultation. This phase of the work may or may not actually produce worthwhile suggestions, but it will result in better "customer acceptance" of the final product. Actually, some of the best, most useful and easily accomplished ideas, will come from the crewmen. Excellent ideas can be obtained by inspecting the "jerry rigs" found on operating units.

(c) Invite manufacturers to try to produce material to meet requirements. Take advantage of their "know-how" in their special fields, of their initiative, freedom of action and willingness to make speculative investment in ideas.

(d) Avoid "freezing" specifications. The program must be elastic to permit the trial of new items, new materials and new arrangements on subsequent ships.

3.0. General Principles: - Personnel.

(a) Permit as much privacy for the individual as possible (at the toilet, while sleeping; and there are times when a man "just wants to be alone").

(b) Give each individual as much personal space as possible (own bunk or bedding, own locker, own clothes bag, own drawer for toilet articles).

(c) Offer opportunity for freedom of movement - to "stretch the legs", wander around, perform simple exercises, get fresh air, watch the sea and sky and weather.

(d) Provide variety. Monotony is the arch-foe of long-duration military tasks. Lighting changes should be periodic on a watch or diurnal cycle, with opportunity for individual modification. (This requires at least two types of lighting - such as local and overhead - for living compartments). "Place variety" is obtained by color and design differences between compartments. Provision can be made for changing furniture, curtains, pictures, etc., (called "dressing" in the theatre) to provide variety within compartments. Some variety of activity will automatically be furnished by work schedules but will be augmented by inventive leadership of the officers.

(e) Reduced interference with sensory reception. This means a low level of noise, vibration, odors, bad tastes and glaring lights.

(f) Maintain touch with the news of the world.

3.1. General Principles: - Material. The over-all objective is not the salvage of a few feet of space but the elimination of man hours and job positions, and, therefore, the reduction in number of personnel aboard. The elimination of one man from the crew does not save merely the few cubic feet his body occupies, but releases the space of his bunk, lockers, place at table, food in refrigerator and the physical equipment for servicing his other needs.

The following four principles are self-evident, but a systematic survey which employs these criteria will pay dividends:

(a) Miniaturize: - can anything be made smaller? or lighter? or simpler?

(b) Eliminate: - can we get along without it? - or, can one thing be used for two purposes so the other can be removed? Can one space be used for two purposes now served by two spaces?

(c) Compact: - can the available cubic footage be reorganized to obtain more actual working and living space? Aim for compactness. Plan form-fitting units. (Specific design to anthropological and psychophysical measures is the special problem for the Human Engineer).

(d) Choose materials: - for durability, simplicity of upkeep, comfort and appearance.

4. Lighting. Poor lighting not only increases fatigue and decreases efficiency (leading to errors and substandard performance), but becomes the whipping boy for other causes for discontent.

(a) Brightness levels for all areas for both red and white lighting should be determined by a careful survey. The nature of the visual tasks involved in each area and specific location should be studied. If the services of a lighting specialist can be obtained, the survey should be a joint undertaking between him and all hands. The lighting design should provide for both visual efficiency and comfort. The goal is to direct the illumination to where it is needed and not waste it where it is not useful,

operationally or aesthetically. This takes considerable time and work but will be worth it in visual efficiency, crew comfort and saving in power.

(b) Fluorescent fixtures should be used whenever feasible. From the variety of standard units one can be found which will best fit each situation. Plastic lamp cylinders are stocked with which white lights can be converted to standard red lighting. The initial development costs are rapidly repaid in fuel savings and in increased operational efficiency.

(c) Red lighting is sometimes essential in connection with night operations but should not be inflicted on more men nor for longer periods than is necessary. Red-lighting of compartments can sometimes be eliminated if "light trapped" or completely shielded from periscope areas. If only a few men are needed at a time for topside watch, careful observance of red-goggle routines may permit the rest of the crew to live in ordinary white lighting.

(d) Glare is of two kinds - high brightness, and reflected. High brightness contrasts can be avoided by proper placement of fixtures: (1) they should be directed toward the work and not in the eyes, and (2) "dark holes" - unlighted areas - should be supplementary lighted to at least 1/10th that of the bright areas. To avoid reflected glare it is necessary to place the fixtures so that the angle of incidence does not equal the angle of reflection to the eye, or the angle of the instrument faces may be changed. It is also imperative that "bright work" of all sorts be eliminated. It is impossible to provide a glareless environment in a compartment which is fitted with polished metals.

5. Color. Schemes should be adopted with the advice of color consultants if available. The services of different design staffs may be contracted for in order to achieve variety and provide a series of optimal schemes. However, without expert advice, the combined effort of officers, crew and "yard" personnel has frequently created new and excellent interior schemes. (Builds morale, too). The Standard Navy Colors were designed by Medical Research Laboratory to provide a nearly "foolproof" variety of background colors.

(a) Standard Navy Colors. BUSHIPS Instruction 9190.13 of 25 March 1954, Subj: Interior Finished Paints for Living Spaces; Habitability Improvement, obtainable from U. S. Navy Publications and Printing Office,

Third Naval District, 2500 Hudson Street, New York 13, New York. Additional color chips are available from the Industrial Test Laboratory, Philadelphia Naval Shipyard, to the attention of Mr. Arthur P. deMarco.

(b) Standard curtain materials, decking and upholstery is from time to time available from supervisory Bureaus. If these are not color compatible, materials should be obtained through open purchase.

6. **Sleeping.** If it is possible to avoid "hot bunking" every effort should be made to do so. If individual bunks cannot be made available to each man, thought should be given to individual bedding which is personal to each member of the crew. Pivoted reversible bunks are another solution. In this connection, provide individual clothes bags (of a light, "breathing" plastic) and individual drawers for shaving gear. If the washing gear can be stowed near the wash basins it reduces traffic confusion in narrow spaces. In general, these things help a man to maintain his sense of individual personality.

Sleep is more restful on a flat bed, and a hard-pan support for the mattress is recommended rather than suspension springs. Noise reduction should be a first consideration in sleeping quarters (substitute stanchions for chairs, treat partition and doors acoustically, use resilient flooring). Individual bunk lights for reading and writing should not inconvenience men in other bunks. Install separate ventilation controls. Screening bunks from each other will promote privacy, induce sleep and somewhat reduce transmission of catarrhal infections.

7. **Eating.** A varied diet is the principle incentive to appetite. Attempt to diminish overcrowding. Comfortable seats are preferable to benches if they can be managed. The standards of attractively-presented servings should be kept high. Plan traffic routes that avoid confusion. Separate waste and garbage disposal from the eating areas. Warm tinted lights make all foods more attractive. Investigate commercially available units of such nature as drinking fountains, ice cream freezers, garbage cans, retractable wash basins, and coffee-dispensers before making custom built requests.

8. Recreation. Recreation should be deliberately arranged for. Writing materials should be provided as well as writing conveniences. Attention should be given to making writing surfaces available (such as light, matte-plastic surfaces hinged desk-fashion to the wall). Stationery imprinted with the name and insignia of the station is sometimes the commissioning gift of the prime contractor. The same could be true of playing cards which can be ordered for use under red lighting. A place for cards and game boards should be provided. Also, if transparent panels are provided on bulkheads within which photographs, pin-ups, post cards and clippings can be placed, it tends to keep the bulkheads and machinery free from unsightly accumulation of such material. A 100-record player is recommended. Under vibration, needles will stay in the groove better with 45 RPM records than with 33 1/3 RPM. In addition to racks for magazines brought in by the crew members, a small library should be carried. Consider a 16mm projector and a wall painted with a matte white rectangle to be used for the screen. Personal, "home movies" should be shown as well as professional. Music instruments will encourage group participation. Pets, (even octopuses and monkeys) provide wonderful relaxation, a social focus, and are in thoroughly good military tradition. A survey should be made to discover other types of relaxation which have been discovered by crews in the past, including hobbies requiring small, light equipment (crimshaw, fishing flies, leather tooling); arrangements must be made for storage of such gear.

9. Housekeeping. In general, every consideration should be given to diminishing the onerousness of housekeeping. Materials should be chosen which are washable and require little or no additional treatment such as scrubbing, waxing or polishing. Also they should be chosen for comfort; a resilient decking or footrail at standing stations will reduce fatigue; cushions in which men are seated for long periods should be resilient but not so soft as to support the buttocks uniformly. Safety and a feeling of security is promoted by non-slip deck covering or tile in the wash-rooms, showers, laundry spaces and exposed decks. Garbage cans, disposal and cleaning gear are unsightly and, when left in passageways and

corridors are hazardous; special provision should be made for their incorporation in cabinets. Built in units should be considered for all power units such as ice-cream freezers, mixers, washers, etc. False ceilings and plenums which enclose ducts, cables, pipes and brackets can be used to reduce the areas in which dirt accumulates.