VIBRATION DISCOMFORT WITH RECLINED SEATING

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The health effects and the discomfort caused by vibration and shock are influenced by vibration in the three translational directions at the seat, the back, and the feet, and by the biodynamic responses of the body, which are influenced by sitting posture. Providing support for the back changes the response of the body and may either increase or decrease vibration severity, depending on the frequency and direction of the vibration and the inclination of the backrest. As a seat is reclined, more of the weight of the upper-body is supported by the backrest and the load on the lower spine is reduced. It may be hypothesised that spinal forces due to vertical shocks might also be reduced and the injury potential of some motion environments alleviated by suitable seat inclination. However, reclining a seat will increase the transmission of vibration to the upper-back and may increase discomfort. Resolving vertical vibration at the seat and back into components in the *x*- and *z*-axes of a basicentric coordinate system, BS 6841 (1987) and ISO 2631-1 (1997) predict that reclining a seat will increase discomfort and risks to health at frequencies less than 4 Hz but will decrease discomfort and health risks at frequencies greater than 4 Hz. Therefore, the motion characteristics must be considered when predicting the influence of seat inclination.

The influence of seat inclination on the discomfort of people exposed to high-speed marine craft was investigated in a laboratory study. Subjects experienced reproductions of vertical, fore-and-aft, and pitch motion recorded on a high-speed marine craft and reproduced in the Human Factors Research Unit laboratory with high fidelity (to be demonstrated at the event). Subjects attended one session with six seating conditions: (i) upright, horizontal seat pan, no backrest or headrest; (ii) 15° reclined seat, no headrest; (iii) 30° reclined seat, no headrest; (iv) 30° reclined seat with headrest; (v) 45° reclined seat with headrest; (vi) 60° reclined seat with headrest. Judgements of discomfort were obtained for each motion by the method of absolute magnitude estimation. Subjects also indicated the area of the body in which they experienced most discomfort by providing a number according to a body map.

When seated either upright or nearly upright with no headrest, subjects felt most discomfort in the buttocks near contact with the seat pan, but when reclined at 45° and 60° most discomfort was experienced in the lower-back and the upper-back. However, seat inclination was found to have little influence on overall discomfort. As the seat reclined from 0° to 60°, evaluation of x-axis and z-axis components according to BS 6841 suggests, discomfort due to vertical vibration at 1 Hz (the dominant frequency and axis) should be increased about two-fold; discomfort due to vertical vibration at frequencies greater than 4 Hz should be reduced. The absence of any large change in discomfort with a large change in seat inclination may be due to deficiencies in the standard and due to a trade-off between reduced discomfort at low frequencies and increased discomfort at high frequencies.

The small changes in discomfort found in the study suggest that reclined postures in high speed craft may be beneficial due to expected reductions in forces in the spine without major increase in vibration comfort. The influence of seat inclination may differ for other types of motion.

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