COMPARISON OF TWO METHODS FOR DETERMINING VIBROTACTILE PERCEPTION THRESHOLDS AT THE FINGERTIPS

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Introduction

ISO 13091-1 provides four alternative configurations for the orientations of the stimulator and finger to determine vibrotactile perception thresholds (VPTs).[1] In these four configurations, two of them are with the probe of the stimulator contacting the fingertip from below, while another two are with the probe facing down and contacting the fingertip from above. The two configurations with the fingertip contacted from above are considered in this paper, which are shown in Figure 1. For these, only a probe contacts the fingertip in Method A (left panel in Figure 1), whereas the probe and a surround contact the fingertip in Method B (right panel in Figure 1). In both methods the hand is fully supported by an arm rest with the palm facing upwards.

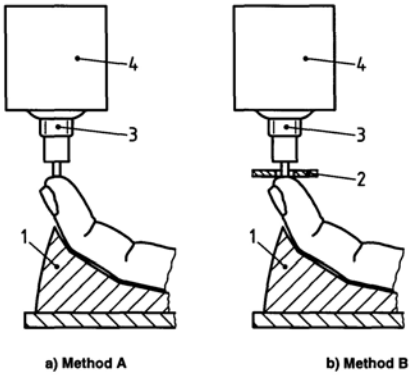

Figure 1: Reproduction of lower part of Figure 1 from ISO 13091-1[1]

Methods and Results

A summary of the measurement conditions is given in Table 1. All results in this paper provide VPTs either for young adult males, or females, aged 25-35 years. Data are given for the mean VPT of digits 3 and 5 for both hands combined. Fingertip skin temperatures were between 27 and 35°C.

The presence or absence of a surround, and sex of the subjects, do not seem to produce a consistent trend in thresholds except at 125 Hz, and perhaps at 4 Hz. It appears males tend to possess higher (i.e., less sensitive) VPTs than females at 4 Hz (t-test, $p < 0.05$) and 125 Hz (t-test, $p < 0.005$). The difference between the mean VPTs at 4 Hz for methods A and B (for males) is most probably due to the improved stimulator waveform at this frequency, which resulted in less harmonic distortion in the instrument used for method B than method A, and to lower system noise in this device[2]. The waveform and the motion at 4 Hz of the stimulator are shown in Figure 2, upper panel and lower panel, respectively. Note the short stimulus duration (~1.5 s) and the low harmonic distortion, which was about 6%. The acceleration waveform shown was filtered with a bandwidth of 2-32 Hz.

Table 1: Measurement Conditions and Mean VPTs at the Fingertips of Healthy Males and Females

Method (A or B)	Measurement Conditions (N.B. All probes & surrounds - circular cross-section)	Mean VPTs (dB re 10^{-6} m.s^{-2})				Sex (M or F) [# of Fingers]
		4 Hz	20 Hz	31.5 Hz	125 Hz	
A	3 mm probe, no surround; 0.05 N contact force (~0.9 mm indentation); U-D† [data from Ref. 3]	78.8		100.2	(110)	M [n = 99]
B	3 mm probe, 6 mm surround; 0.6 N contact force (~0.5 mm indentation); U-D†	76.0		103.9	112.1	M [n=12]
B	3 mm probe, 6 mm surround; 0.6 N contact force (~0.5 mm indentation); U-D†	76.5	93.9		111.5	M [n=36]
B	3 mm probe, 6 mm surround; 0.6 N contact force (~0.5 mm indentation); U-D†	72.8		101.6	105.6	F [n=40]
A or B	ISO 13091-2:2003[4]	77.5	92.3	100.3	107.8	M

†U-D - staircase algorithm, intermittent stimulation; ( ) value interpolated from VPTs determined at 100 and 160; n - number of digits included in calculation of mean VPT.

From these results, it appears that methods A and B can yield the same mean VPTs for males with appropriate choice of measurement conditions (see Table 1).

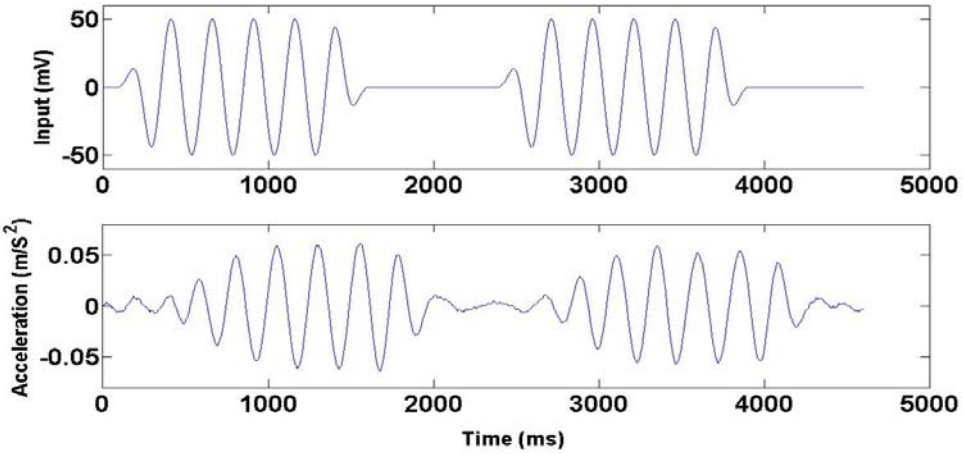

Figure 2: Stimulus waveform at 4 Hz: Input to amplifier (upper panel) and acceleration of stimulating probe with bandwidth of 2-8 Hz (lower panel).

Acknowledgements

We wish to acknowledge the contributions of Mr. Takafumi Asaki, and Mr. Simon Kudernatsch to the mechanical design and construction of the tactometer. Work supported by NIOSH grant 5R01 OH008997.

References

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Forward – Welcome Address

On behalf of my conference co-chairs, I am pleased to welcome you to Guelph, Ontario, Canada for the 5th American Conference on Human Vibration. The 5th ACHV is being co-hosted by the University of Guelph, Laurentian University, Western University and the University of Toronto. We are honored to be hosting this biennial conference on the University of Guelph campus. As the premier North American conference for human exposure to vibration, the conference provides a unique and convenient opportunity for researchers, engineers, medical professionals and industry representatives to exchange information on all aspects of vibration control and human responses to hand-transmitted vibration and whole-body vibration. The theme for this year's meeting is "Human Vibration - From Theory to Industrial and Clinical Applications".

Founded in 1827, Guelph was named after the British Monarch King George IV, who was from the House of Hanover. Selected as the headquarters of a British development firm called "The Canada Company", Guelph was designed by John Galt, who was a Scottish Novelist. The town was designed to resemble a European city center comprised of squares, wide main streets and narrow side streets. Guelph was home to Lieutenant Colonel John McCrae, the author of "In Flanders Fields". Its references to the red poppies that grew over the graves of fallen soldiers resulted in the remembrance poppy becoming one of the world's most recognized memorial symbols for fallen soldiers. Guelph was also the home of North America's first cable TV system. Fredrick T. Metcalf created MacLean Hunter Television (now part of Rogers Communications) and their first broadcast was of current monarch Queen Elizabeth II's Coronation in 1953. With a population of over 120,000, Guelph is part of a technology triangle which is comprised of the cities of Guelph, Kitchener, Cambridge and Waterloo. Guelph is consistently rated as one of Canada's best places to live because of its low crime rate, clean environment, high standard of living and low unemployment rate. Almost one quarter of Guelph employment is provided through the manufacturing sector with over 10% provided through Educational services. The City of Guelph has identified life science, agri-food and biotechnology, environmental management and technology companies as industries on which to focus future economic development activities.

Many thanks to Elyse Dubé from Conference Services at the University of Guelph for all of her hard work in helping to plan and sort through the conference logistics. We'd also like to thank Guelph Engineering students Gregor Scott and Dan Leto as well as School of Engineering technician Carly Fennell for their help in setting up the laboratory tours. We hope that your visit to the 5th ACHV and Guelph will be both educational and enjoyable.

Sincerely,

Michele Oliver, Jim Dickey, Tammy Eger and Aaron Thompson