Comment on “Tensiometer Data Acquisition System for Hydrological Studies Requiring High Temporal Resolution”

The technical note presented by Nyhan and Drennon (1990) is of use to individuals making measurements of matric potential under field conditions. Further useful insight may be gained by considering Fig. 2 of the note in light of pressure-transducer product specifications.

In Fig. 2 of Nyhan and Drennon, the diurnal variation of pressure of two water-immersed tensiometers is reported. The reported fluctuations correspond to the temperature changes in the experimental environments. Although no specific mechanism is suggested and the tensiometers are shown to have an otherwise rapid response time (Fig. 3 of Nyhan and Drennon), the authors suggest that the findings are explained by the fact that the fluid in the tensiometer cup was not in thermodynamic equilibrium with the liquid in the bucket.

An explanation for the observations may be found, however, in the Micro Switch product description of the 141PC15G device Nyhan and Drennon employed. We find that the readings of the device vary by ±1% of full range with a temperature variation of 38 °C in the normal operating temperatures between −18 °C and 65 °C (Honeywell, 1990). The observed change in output of 0.3 kPa reported by the authors for their outdoor unit represents 0.3% of full-range output, which could be explained by as little as 12 °C variation in ambient conditions by appealing only to the temperature sensitivity of the pressure sensor. The approximately 0.1 kPa variation noted in the indoor unit (Fig. 2 of Nyhan and Drennon, 1990) could be explained by 4 °C variation in temperature, which is also plausible, given the authors’ note that the fluctuation in the laboratory-mounted device corresponded to the daily operational period of the laboratory air conditioner.

It is worth noting that not all electronic pressure transducers are subject to such severe inaccuracies. A similar device manufactured by Motorola, for instance, exhibits only ±1% variation through a range of 85 °C, 2.5 times smaller than that of the Micro Switch device. When selecting a pressure transducer, additional consideration should be given to the pressure hysteresis and linearity, which also vary considerably between devices.

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References

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Mr. John Selker raises an interesting point in his comments about the operational characteristics of pressure transducers in terms of their suitability for use with tensiometer systems (Nyhan and Drennon, 1990). We agree that serious attention should be given to the manufacturer’s specifications in the selection of a PT in such applications and to the comment that the cost of the PT used in Nyhan and Drennon’s study is a consideration, since they vary in price by more than two orders of magnitude across the international marketplace.

The excellent review on tensiometry presented by Cassel and Klute (1986) pertains directly to Mr. Selker’s comments. Cassel and Klute point out that temperature fluctuations can cause a change in the output of a tensiometer-PT system. Some of this effect is due to (i) temperature-related effects on the PT itself, while part of the effect is due to (ii) temperature-induced expansion or contraction of the material of the tensiometer system and of the water in it, which are in turn translated into changes of pressure in the system. We point out in our note that one Micro Switch model 141PC15G PT was left detached from a tensiometer at our field site and monitored hourly for 2 yr. We indicated that no variations in PT output were detected in this configuration with time, which field and laboratory air conditioners. Obviously, this eliminates temperature effects from consideration in our study.

The data we presented in Fig. 2 (Nyhan and Drennon, 1990) were collected from tensiometer-PT systems without reference tensiometers. The Micro Switch PT was connected to a 160 cm referencemounted device correspondent to the daily operational period of the laboratory air conditioner.

The data we presented in Fig. 2 (Nyhan and Drennon, 1990) were collected from tensiometer-PT systems for which the Micro Switch PT was connected to a 160 cm hydraulic head of water (in the absence of soil) reference tensiometers did show variations with time. These results suggest that there were pressure transduced effects on the tensiometer portions of these systems. More detailed field data...