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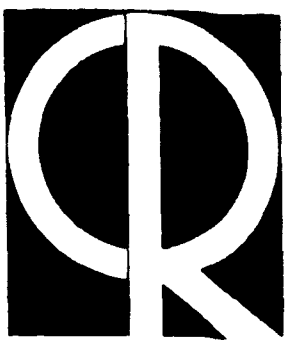
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SUPPLEMENT TO
Instrumentation for Geophysics and Astrophysics
No. 22



Research Note

Measurement Range Required of Meteorological Equipment

**ARNOLD COURT
HENRY SALMELA**

SUPPLEMENT

MEASUREMENT RANGE REQUIRED OF METEOROLOGICAL
EQUIPMENT (Instrumentation for Geophysics and Astrophysics
No. 22) by Arnold Court and Henry Salmela, August 1962.

Additional information on the "improbable extreme" rate of change of temperature and pressure, requested by some users of this publication, is provided in the following paragraphs, to be inserted as indicated.

At end of Section 3. TEMPERATURE

The maximum rate of change of temperature with time occurs during the passage of an intense front. In the infamous "cold waves" of the Great Plains, which have led to innumerable anecdotes, temperature decreases of 40 F deg in one hour are not uncommon. Even more rapid changes occur in some areas when the boundary of a foehn or chinook moves back and forth. Extreme cases have occurred on the east side of the Black Hills of South Dakota, the greatest being from -4° to $+45^{\circ}$ F in two minutes at Spearfish at 0732 on 22 January 1943.

Hence, temperature-measuring equipment should be able to record changes at the rate of 25 F deg/min, at least, so that other occurrences of such phenomena can be documented.

At end of Section 5.2 Wind Speeds

Wind fluctuations can be extremely rapid, and rarely have been measured precisely. One-second gusts can be as much as double the mean windspeed when it is less than about 50 mph, but the percentage increase is less at higher speeds.

The relation between gust speed and average speed can be expressed in various ways: the gust factor is the ratio of the gust speed to the mean speed; the gust difference is the difference in the two speeds. A very crude estimate of the gust relation is that the improbable extreme gust difference equals the windspeed up to about 50 mph, remains at 50 mph for speeds from 50 to 100 mph, then decreases 10 mph for each 50 mph increase in windspeed above 100 mph:

Wind Speed	50	100	150	200	250	300	350
Max. Gust	100	150	190	230	270	310	350
Difference	50	50	40	270	20	10	0
Gust Ratio	2.00	1.50	1.27	1.15	1.08	1.03	1.00

Thus in addition to response time sufficiently rapid to provide valid 1-second values, anemometers should have the capability of measuring fluctuations of these magnitudes, below as well as above the mean speed.

At end of Section 5.3 Atmospheric Pressure

The largest standard deviation of daily pressures about the annual mean, anywhere in the Northern Hemisphere, is about 1.3 percent. Hence, at a given station 99 percent of all pressures would be within about 4 percent of the annual value. For most places near sea level, where the average pressure is about 1000 mb, an instrument range of 950 to 1050 mb is adequate—except for tornadoes and hurricanes.

The average maximum hourly pressure change during 5 years at Washington, D.C., was 0.44 mb (0.013 inch). But the maximum possible rate of pressure change with time occurs during the passage of a tornado. From the few records of barographs over which tornadoes have passed, and current theories of tornado structure and dynamics, the maximum pressure change that can occur is estimated to be a reduction of no more than one-fourth of the pre-existing pressure. Such a change, as from 1000 to 750 mb, can occur during a period of 15 seconds, or at a rate of about 15 mb/sec.