This paper investigates the performance of Phasor Measurement Units (PMUs) under interference conditions which can appear in a power system and are not tested by the C37.118.1 standard. Three PMUs from different vendors configured for the M-class requirements were used to test three possible interference condition scenarios. In the first scenario, noise is added to the PMU input signal. The test runs a sweep of Signal-to-Noise Ratios (SNR) and the accuracy versus the noise level is obtained. The second scenario injects multiple harmonics with the input to test the influence on accuracy. The last scenario focuses on instrument transformer saturation which leads to a modified waveform injected in the PMU. This test goes through different levels of Current Transformer (CT) saturation and analyzes the effect of saturation on the accuracy of PMUs. The test results show PMU measurements will be degraded when the input signal is distorted by high noise or a saturated current waveform, but is not particularly affected by multiple harmonics. This information can be used when selecting a PMU to ensure it will provide a reliable measurement for the intended use. It can also be used for developing more robust PMUs and applications resistant to degraded measurements.