

ADVANCED TECHNOLOGY FACILITIES – VIBRATION TESTING AND MEASUREMENT OVERVIEW

For many high-tech projects – from semiconductor fabs to nanotechnology laboratories – facility vibration is a key parameter to successful manufacturing and R&D. As an “invisible contaminant”, facility vibration can be a major contributor to product loss, poor yield, and low throughput. As part of our guidance in the design of these [vibration-sensitive facilities](#), we perform standardized measurements to track the vibration environment from the greenfield condition all the way to the “At-Rest” condition with tools installed and ready for production. *Vibro-Acoustic Consultants specializes in vibration and noise design and testing in demanding settings, serving clients [around the world](#). Contact us by visiting www.va-consult.com*

Test 1: Greenfield Site Ambient Survey – This measurement is an ambient environmental vibration measurement. It is conducted on the site prior to any work. Since [environmental ground vibrations](#) cannot be mitigated by traditional structures, this test is used to evaluate site suitability and preferred setbacks for the facility from an environmental perspective. This test quantifies the effects of nearby environmental sources of vibration, such as roadways, railways, and adjacent facilities. Since this survey typically occurs prior to any excavation or site work, the data are reviewed in light of site geotechnical data. Required testing conditions include “typical” levels of activity at adjacent roads, rail lines, and/or facilities. Extra-ordinary events or activities such as road construction must be avoided. In some extreme cases, minor site preparation results in better data.

Test 2: Foundation Survey – This measurement is an ambient environmental vibration measurement. It is conducted on the completed foundation. This test is used to evaluate the effects of the foundation and to confirm that no significant problems relating to fill soil or compaction have occurred. Since the presence of the completed foundation circumvents any weak topsoil layer present during the Greenfield Site Ambient Survey, these data may be used to confirm engineering decisions made in light of those greenfield site data. Required testing conditions include the temporary suspension of major construction activities during testing, but “typical” levels of activity at adjacent roads, rail lines, and/or facilities. Light work (welding, etc.) is possible, depending on circumstances.

Test 3: Structural Evaluation – This measurement is an extraction of the dynamic properties of the structure. It is conducted on a sampling of sensitive floors and columns. This test is used to evaluate the dynamic performance of the structure and gives such data as stiffness spectra, resonant frequencies, and vibration propagation within the structure. In addition, the effects of walker-induced vibrations are tested at this time. Required testing conditions include the temporary suspension of major construction activities during testing. Light work (welding, pipefitting, electrical work, etc.) must be suspended in the vicinity of the testing, as well. Due to the time-consuming nature of this test, it is often performed overnight or on weekends, to minimize impact on construction schedule.

Test 4: As-Built Evaluation – This measurement is an ambient facility-wide vibration measurement. It is conducted at a statistically-significant sampling of locations after the installation of the major mechanical (M/E/P) systems, but prior to major tool installation activities. This test is used to evaluate the vibration impact of rotating machinery and turbulent flow in piping and ducting systems. In addition to testing the vibration performance of the sensitive floors, our staff performs a visual observation of the [vibration isolation systems on all mechanical equipment](#). A punchlist of items requiring attention by the relevant M/E/P contractors is generated. By testing facility performance and carrying out the observation at this point, corrective action may quickly be accomplished. The data from this evaluation are considered to be the “baseline” performance of the facility. Required testing conditions include the presence and operation of most base-building mechanical systems (even if at reduced capacity). It is preferred that this test occur prior to major tool move-in activities.

Test 5: At-Rest Evaluation – This measurement is an ambient facility-wide vibration measurement. It is conducted on all sensitive floors after the installation of the process tools. This test is used to evaluate the overall vibration impact of process tools, tool hookup equipment, and other vendor-supplied items. In addition to testing the vibration performance of the sensitive floors, our staff performs a visual observation of the vibration isolation systems on all mechanical equipment. This includes systems identified previously as requiring attention, as well as newly-installed systems. A punchlist of items requiring attention by the relevant M/E/P contractors is generated. Required testing conditions include all “typical” activities inside and outside of the facility.