# Preparing for a Pressure Vessel Test with Acoustic Emission

Acoustic emission testing detects defects and other damage that is 'active' at design or operating pressures. In particular, AE testing is sensitive to environmental cracking and other damage occurring in service.

The benefit of an AE test is that it provides a full, volumetric test of a vessel relatively quickly and easily. Vessel entry is not required and in many cases, the vessel can be tested on-line. The test aims to detect and locate areas of concern, follow-up inspection with a complementary NDT method is needed to identify and size any AE indications.

### Acoustic Emission and Metal Equipment

Acoustic Emission is high frequency sound from cracks and other flaws subject to increasing stress. For in-service vessels, this means increasing their operating pressure by about 10% while recording any AE activity.

In the case of new vessels, the stimulus for AE activity is from the standard hydrotest. This type of test can detect weld defects and localized yielding at hydrotest pressures, especially in non-stress relieved vessels.

Although an AE test detects cracking and similar damage, it does not determine the size or exact position of individual defects. The main purpose and benefit of an AE test is to identify localized areas in need of more in-depth inspection.

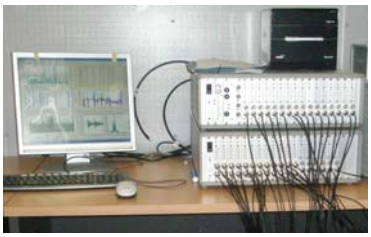
### Carrying out an AE Test

High frequency (150 kHz) acoustic sensors and specialized instrumentation detect AE activity as a vessel is pressurized. The sensors are placed 3-8m (10-25ft) apart with the aim of detecting AE from any point on the vessel.

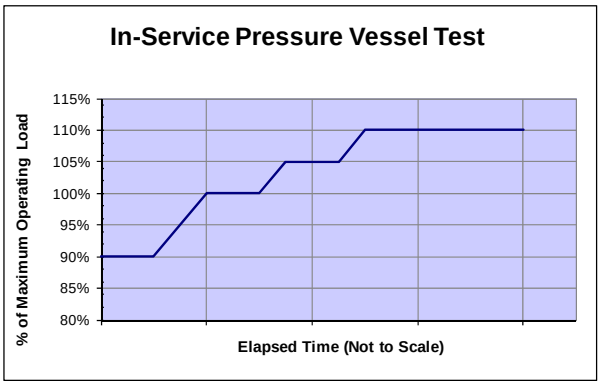
They are usually held in place with magnets. Other methods such as adhesive tape or spring clips are needed for stainless steel vessels.

Small ports are needed on insulated vessels to allow sensor mounting. In the case of vessels with surface temperatures above about 100°C it may be necessary to use acoustic waveguides. These are steel rods spring loaded onto the vessel surface to conduct AE signals to sensors on the ends of the waveguides.

The AE equipment is housed in a trailer ideally located within 30m (100') of the vessel. The AE sensor positions are marked and the sensors attached. Coaxial cables are routed back to the instrument from each sensor. The final step is to check the sensitivity of each sensor and instrument channel.



The number of sensors needed ranges from 12 to over 50 depending on the vessel type and size. Setting up generally takes 1-2 days.




In-service pressure vessels are tested from 90% to 110% of their maximum operating pressure. This may be applied with any suitable medium including nitrogen, process vapor or fluid and water (hydrotest).

After an initial hold to assess background noise, the pressure is raised in stages to the test pressure as shown. Load holds (10-minutes each) are incorporated at 100% and 105% with a final hold of 30 minutes at the 110% level.


4649 S Sam Houston Parkway E, Houston, Texas 77048 Phone: (713) 722-7177 fax: (713) 722-7677

Beaumont, TX (409) 727-2400
Deer Park, TX (281) 476-4444
Corpus Christi, TX (361) 888-4700
Tulsa, OK (918) 446-8773
Stanton, CA (714) 861-4058
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It is important to control noise sources impacting directly on the vessel. Examples include scaffold rubbing against the shell, work on connecting pipe work and pressurization noise. These and other aspects of testing need to be discussed with IRISNDT personnel during the planning stage.

AE data is monitored during the test to identify any noise issues or major problems with the vessel. Further analysis is needed to determine whether there are any areas of concern. AE sources are graded from the least to most severe ('A' to 'E') intensity levels. This is weighed with other factors such as data quality and how the AE varies with pressure and time. This allows non-structural sources of AE activity such as process or fill noise to be excluded. Only AE sources showing a response to the applied load or are otherwise considered significant should be reported.

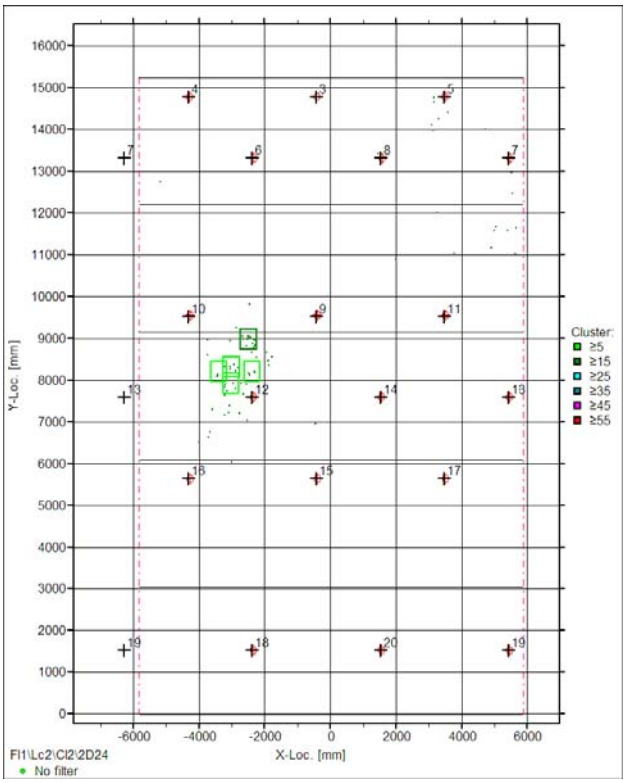
## Capabilities

- Test of an entire vessel, typically completed within three days.
- Provides information about a vessel's response to service loads. Sensitive to defects developing in service. Can also detect fabrication defects in new vessels during hydrotesting.
- Provides approximate locations or areas of sources of AE activity needing follow-up examinations. This information is qualified by intensity analysis to help determine the extent and urgency of any inspection work.

## Limitations

- Qualitative assessment only. Does not give an exact measure or location of damage.
- Requires good test conditions, susceptible to rain, wind and other noise sources in direct contact with the vessel. General plant noise is usually not a problem.
- Flaws in unstressed components including attachments and those that are structurally insignificant will not generate AE.

## Area of AE Activity on a Column




## Preparation

- Supply vessel drawings and operating history (pressure, temperature and so forth).
- Plan the test including the number of sensors, mounting method, access and means of carrying out the pressure test.

## Facilities and Services Needed

- 110V or 240V AC electrical power.
- Access to the vessel for sensor and cable installation. Roped access can be used for sensor placement.
- Insulation contractors to cut insulation ports if needed for sensor mounting.
- Arrangements for carrying out the pressure test including monitoring and controlling the pressure.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