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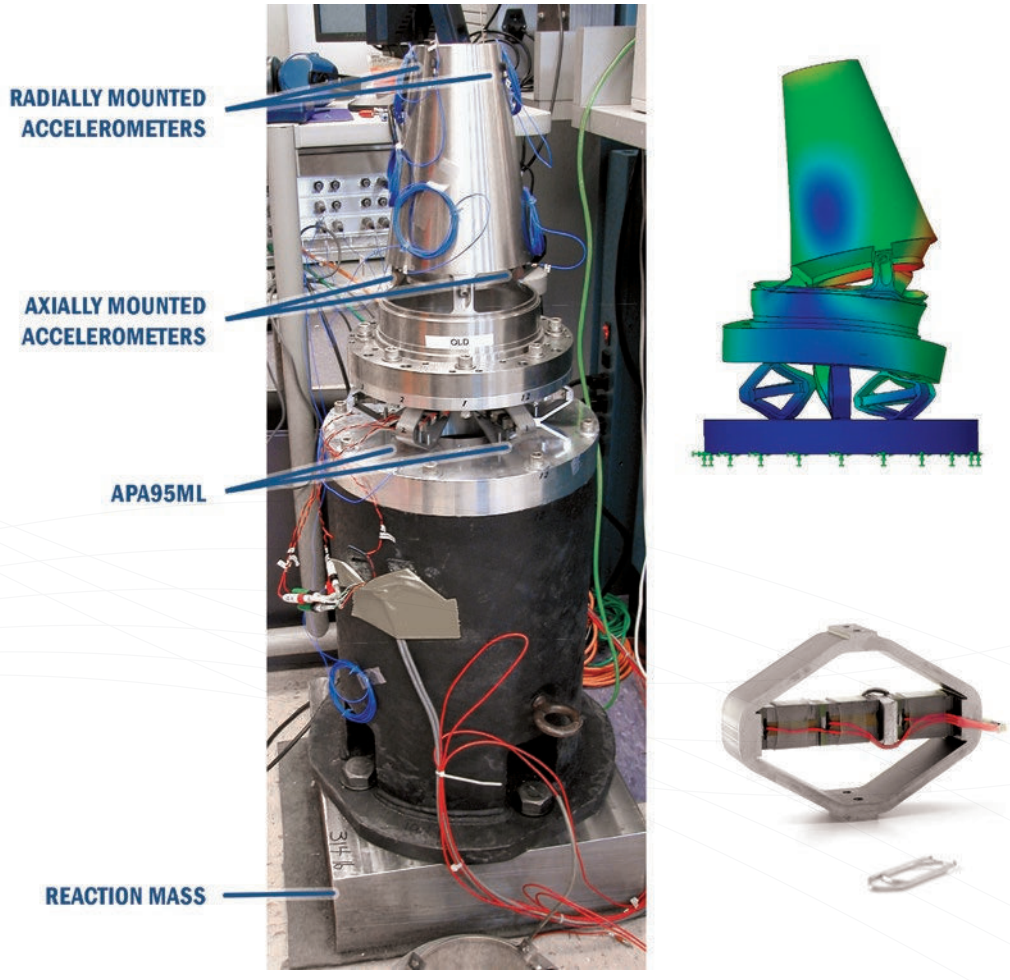
INTRODUCTION

Testing new structures and materials is an everyday challenge to ensure high quality and low level of maintenance. Mechanical tests benches (fatigue, wear, vibrations...) based on hydraulic, pneumatic & magnetic actuators are the state of the art. Piezoelectric actuators from Cedrat Technologies (CTEC) brings new and impressive possibilities.

CTEC owns the patented Amplified Piezoelectric Actuators APA® technology. APA® integrate an amplification mechanism and offer much larger strokes than conventional piezoelectric actuators. Moreover, APA® are compact, extremely dynamic, precise and very easily controllable.

The characteristics of APA® are suitable for the requirements of environmental testing. They allow to:

- Decrease the duration of the tests
- Observe high frequencies phenomena (up to 10kHz) with very clean spectrum
- Get a better accuracy & very low resolutions in the range of nanometers
- Simplify the mechanics of the benches
- Test in vacuum
- Reduce costs



APA95ML and application for vibration testing in SANDIA LAB vibrafuge (Courtesy of SANDIA LAB)

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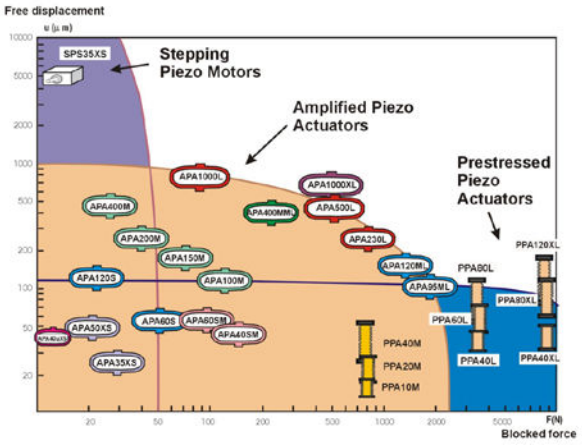
CEDRAT TECHNOLOGIES PIEZOELECTRIC ACTUATORS

CTEC designs two main types of actuators: PPA (Parallel Pre-stressed Actuators) and APA® (Amplified Piezoelectric Actuators). The main features of these actuators are :

- Compactness
- Simple internal design
- Exceptional dynamic behaviour (>>1kHz)
- Excellent resolution ~nm
- High forces (up to 10kN)

All these actuators can be controlled in open and closed loop thanks to a large range of driving electronics.



Performances of APA® & PPA piezo actuators

APPLICATIONS

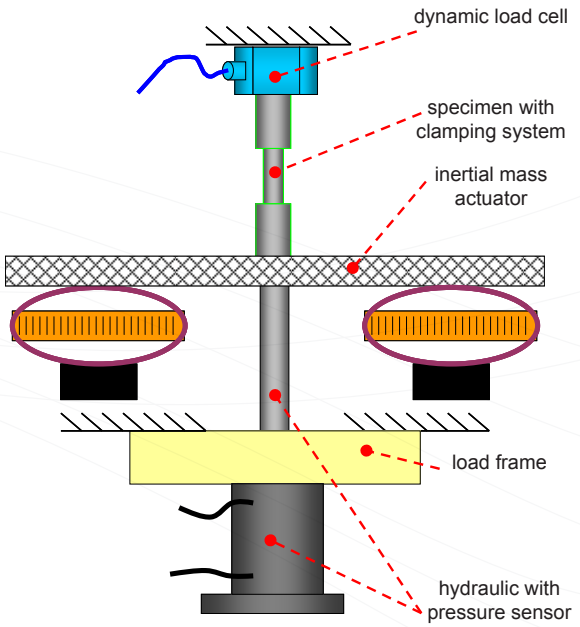
> FATIGUE

Nowadays, increasing the number of cycles in fatigue testing is a common issue. Hydraulic benches have limited dynamic behaviour, which makes these tests time-consuming and costly. Gigacycle test benches study the possibility of using faster devices. Piezo actuators offer a good potential in that sense using sonic (hundreds of Hz to thousands of Hz) and ultrasonic vibrations (>20 kHz).

Number of research works have been driven and show the feasibility of using piezo technology. CTEC can help through its range of standard products and by its expertise in sonic & ultrasonic systems.

As an example, Fraunhofer LBF (DE) developed a hybrid high cycle fatigue (HCF) testing machine used to investigate the high frequency properties of different materials. The machine is made of two stages:

- a low-frequency hydraulic actuator for a frequency band between static to 50 Hz,
- a high frequency piezo actuator system for frequencies up to 1 kHz.



Hybrid high cycle fatigue (HCF) testing machine using APA230L (Courtesy of Fraunhofer LBF)

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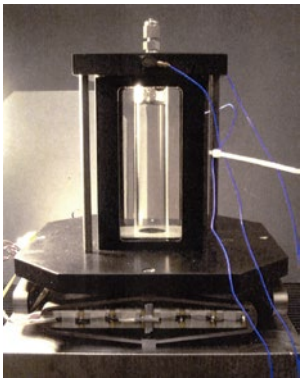
SHAKERS

Sandia National Laboratories (USA) is a multiprogram laboratory operated by Sandia corporation, a Lockheed Martin company, for the US department of energy.

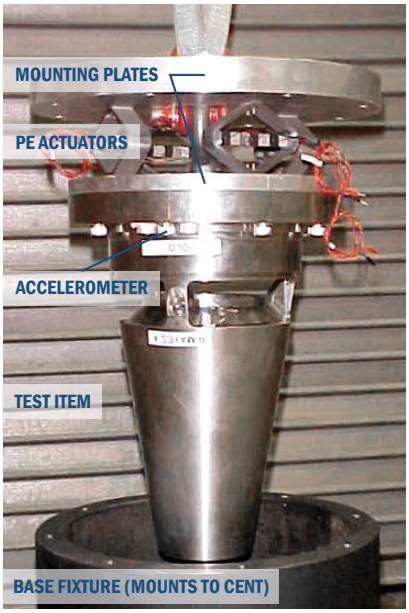
Sandia integrates our APA® actuators as shakers. Compactness, Robustness, High Frequency, Ease of use, Controllability... and Low Cost compare to traditional shakers are reasons for this craze. Single Axis Shakers & Multi Axis Shakers are developed.

A unique technique for testing in a combined vibration and centrifugal acceleration environment has also been developed, the “Vibrafuge”. APA® actuators are used in combination with Sandia’s 29-ft centrifuge facility to provide a specified vibration environment with superimposed centrifugal acceleration of up to 100g’s.

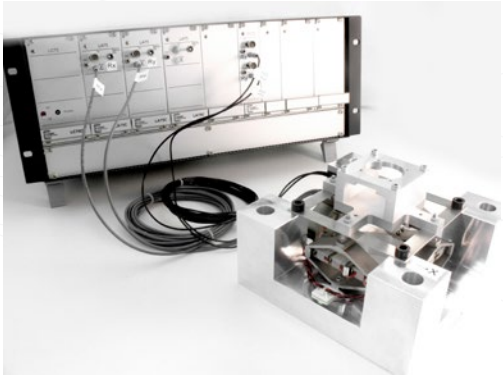
2 axis shaker accelerations up to 300G’s



Shaker based on 4 APA1000L



Vibrafuge combining vibration and centrifugal acceleration environment (Courtesy of Sandia National Laboratories)



DTT120ML-SG : Piezo based Tip Tilt shaking platform & power electronics for testing Inertial Module Unit

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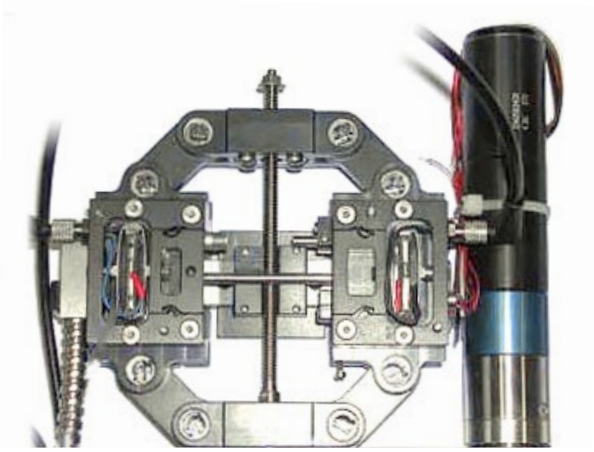
FRETTING WEAR & FATIGUE

Fretting refers to wear and sometimes corrosion damage at the asperities of contact surfaces. The damage is induced under load and in the presence of repeated relative surface motion, as induced for example by vibration. The amplitude of the relative sliding motion is often in the order of few micrometers to millimeters, but can be as low as few nanometers.

With amplitudes up to 1000 µm for APA®, nanometer resolutions and dynamic capabilities, piezo actuators from Cedrat Technologies remarkably fit to these requirements. Their intrinsic mechanical stiffness is an additional advantage for the application.

Since the introduction of our devices in that field, labs such as LAMCOS, LS3-INPG (UJF), ONERA or LMT and industrial such as AIRBUS or EPT (Electronics Precision Technology) have tested and approved our technology for fretting, traction or stress cycling.



Micro-mechanical cycling stress test machine (Courtesy of LS3-INPG (UJF))

BENEFITS OF CEDRAT TECHNOLOGIES PIEZO ACTUATORS

DYNAMIC SHAKING	FATIGUE TESTING	FRETTING WEAR & FATIGUE
High frequency	High frequency	High frequency
High resolution	High forces	Internal stiffness
Low cost / Magnetic shakers		High forces
Easy integration		
Extremely compact		
High resolution		
No maintenance		