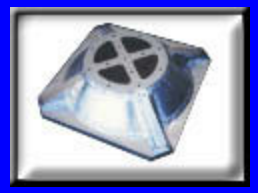
Fixture

The Intermediate Structure That Attaches a Device Under Test (DUT) to a Shaker or Shock Test Machine

Fixture Considerations

- Useable frequency range?
- Mass?
- Temperature range?
- Ease of use?
- Specific uses?



Purpose Of Fixture

- To uniformly transmit vibration to the mounting points of the Device Under Test (DUT) to levels and frequencies of the test specification

Important Terms

- **Resonance**: Resonance, a condition where the natural frequency is equal to the forcing frequency
- **Damping**: Mitigates and reduces the effects of resonance's
- **Transmissibility**: The relationship between the input amplitude and the response amplitude. When the input and response amplitude are equal the Q is said to be 1 to 1
- **Q**: the ratio of input amplitude to response amplitude
- **Decoupling**: Occurs when the Input amplitude is greater in Q than the response amplitude. This typically occurs at frequencies greater than the natural frequency of the DUT.

Fixture Design Tips

- Use materials that have high Damping indexes. The Q of the resonance is lowered, making the fixture easier to control and decoupling rates are greatly reduced
- Use light weight alloys to eliminate fixture mass
- Modulus to density ratios effect natural frequency

Fixture Construction

- **Bolting:** Bolting is fast and simple way to construct a fixture. This method is **not** recommended for tests that exceed 250 HZ. Bolts will loosen up and decoupling will occur
- **Machining:** A fixture machined from solid stock is very good, there are no joints to work loose. This is desirable for small devices but to expensive and time consuming to build with larger devices
- **Casting:** Casting yields an excellent fixture. The monolithic construction eliminates many problems. Generally to expensive and time consuming

- **Welding:** since fixtures are typically a one of a kind proposition, welding is the preferred method of fabrication

Note: plates to be welded should be thicker than specification. This will allow for machining that may be required if the material warped due to welding

Material Choices

- **Steel:** seldom used for fixtures due to its mass and poor damping characteristics

- **Aluminum:** 6061T is widely used weighing about 2/3 less than steel but with a damping index of < .2 it is more desirable for low frequency testing or special applications were low damping is required, such as pyro-shock testing

- **Magnesium:** AZ31B is the material of choice for most vibration tests due its mass 1/3 lighter than aluminum, damping index of 10.1 and is 70% more weldable than aluminum

	Weight per Cu. Inch	Specific Stiffness	Damping Index
Steel	.283	106	< .2
Aluminum	.098	106	< .2
Magnesium	.065	124	10.1

In conclusion the perfect fixture is:

- As light as possible
- Very rigid
- Highly damped
- Has perfect transmissibility within the desired frequency range (no resonance's or decoupling)
- Welded or machined

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