Vacuum Measurement Kit A7

Accessory of the KLIPPEL R&D System

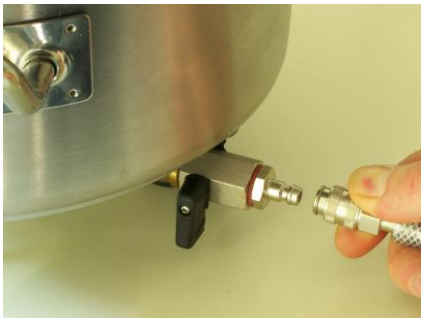
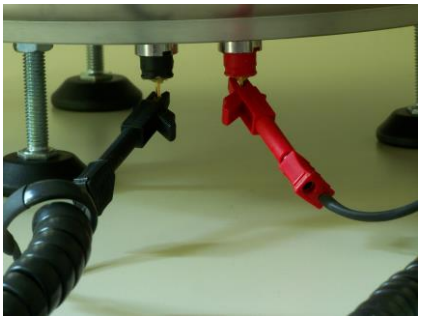
Features	
• Separate mechanical system from acoustical system • Get precise mechanical parameters • Investigate impact of radiation impedance and air load • Scanning of mechanical vibration	

Electro-acoustical transducers such as loudspeaker drivers, micro-speakers, headphones, microphones are measured in vacuum to identify properties and the parameters of the electro-mechanical system directly while the effect of air is eliminated. The vacuum measurement kit satisfies the special requirements in the loudspeaker application such as a flat vessel to accommodate loudspeaker drive units of large diameter, air sealed terminals to feed the electrical stimulus and a planar glass plate for laser scanning.

Article Numbers:	2600-010

CONTENT:

1 Components of the Vacuum Measurement Kit

VACUUM CHAMBER		A cylindrical vessel made of low magnetic stainless steel can be loaded by most kind of transducers such as woofers, tweeters, horn compression drivers, headphones and micro-speakers. The low magnetic material used will not affect the magnetic properties of the transducer. Only transducers with very strong outer B-field should be isolated from the chamber by some millimeters of air distance.
PRESSURE MANOMETER		A pressure manometer shows the pressure difference between the interior of the vacuum chamber and the ambience in bar. (1 Bar = 100 kPa = 750 Torr) Measurements should be performed between -0.8 and -1.0 Bar.
TAP WITH TUBE COUPLER		The air in the vacuum chamber is exhausted via a tap on the bottom of the vacuum chamber. The tube connected with the vacuum pump can be easily removed by using a fast coupler system.
ELECTRICAL INTERFACE		Two air sealed electrical terminals are mounted in the bottom for connecting the transducer via pin plugs (“banana”) in the interior.
GASKET		A rubber gasket is provided to seal the gap between vessel and glass plate.

TRANSPARENT GLASS PLATE		A plane plate made of acrylic glass allows laser scanning of the cone vibration of a transducer in vacuum. The plate can be easily replaced if the transparency is impaired by scratches.
AIR FILTER AND VACUUM TUBES		A special air filter is provided to protect the vacuum pump against any kinds of particles which may damage the vacuum pump.
VACUUM PUMP		Klippel offers an oil free diaphragm vacuum pump for laboratory use. The oil free diaphragm technique needs no periodical services. Ultimate vacuum: 15 mBar absolute Delivery: 16 l/min at atm. pressure LxHxW: 361/141/90mm, weight: 3.95 kg 230 V / 50 Hz or 110 V / 60 Hz – 100 W Klippel Part-Nr.: 2600-030

2 Safety Requirements

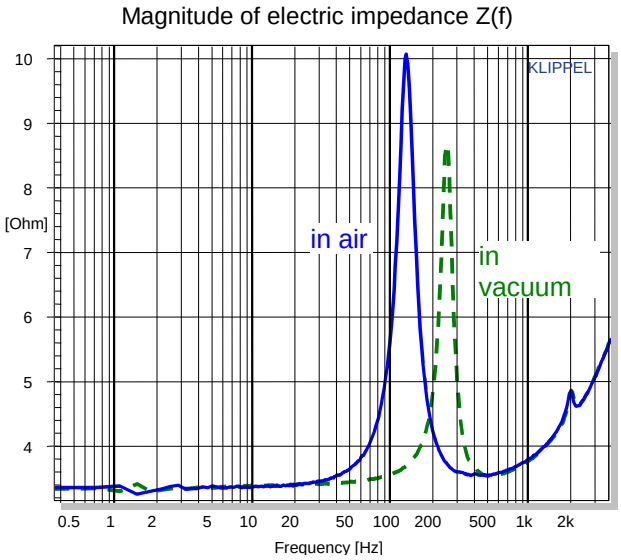
WEAR EYEGLASSES AND GLOVES	The user of the vacuum chamber shall follow safety regulations as used for equipment under vacuum. Always wear goggles and gloves to protect eyes and other human surfaces to avoid any bodily damage when the glass plate breaks. Handle the glass plate with care and replace it if shows any indications of damages (scratches). KLIPPEL GmbH takes no responsibility for any kind of damage caused by the Vacuum Measurement Kit and improper use.

3 Specifications

Parameter	Symbol	Min	Typ	Max	Unit
Diameter of inner space in vessel	D_{inner}		280		mm
Height of inner space in vessel	h_{inner}		130		mm
Width of glass plate	a		320x320		mm
Thickness of glass plate	t		15		mm
Total height (vessel + glass plate)	h_{total}		200		mm
Inner diameter of tubes	d_{tube}		9		mm
Length of the tubes	l_{tube}		3		m

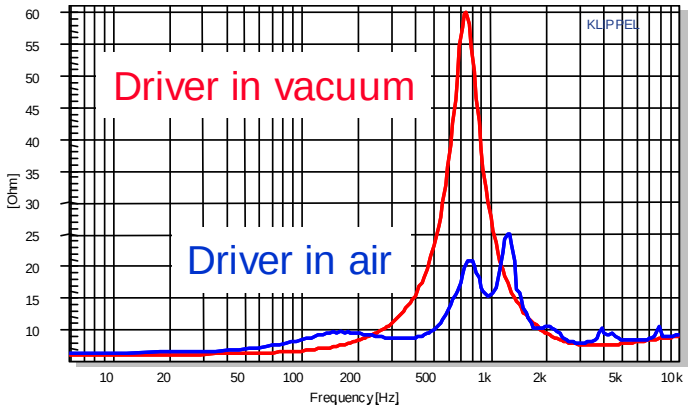
4 Applications

SEPARATION OF MECHANICAL AND ACOUSTICAL PARAMETERS

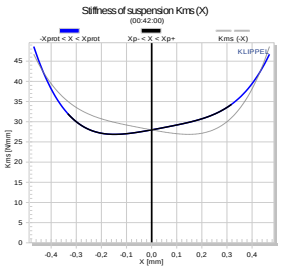


The lumped parameters of the mechanical system (moving mass M_{ms}, stiffness K_{ms} and mechanical resistance R_{ms}) can be measured more accurately by performing the measurement in vacuum. Comparing the pure mechanical parameters with the parameters measured in air allows to separate the contribution of the air to the measurement in free air.

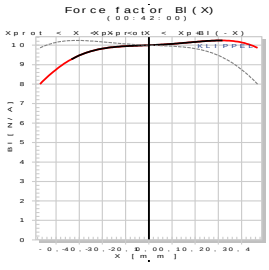
SUPPRESSION OF ACOUSTICAL RESONANCES



Some transducers such as horn compression drivers, tweeters, headphones, micro-speakers and microphones cannot be represented by a 2nd-order mechanical resonator comprising a single mass, spring and resistance only. Cavities, small ports and additional acoustical damping material may cause a higher-order impedance function when the transducer is operated in free air. The acoustical resonances can be sufficiently suppressed when the driver is operated in vacuum and standard techniques for measuring the linear Thiele-Small parameter (LPM module) and the nonlinear parameters (LSI module) can be applied.

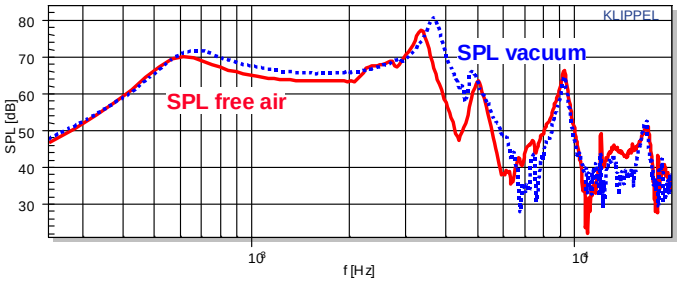


Nonlinear stiffness $K_{ms}(x)$ of a horn compression driver measured in vacuum

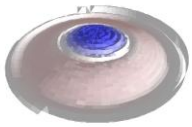


Nonlinear force factor characteristic Bl(x) of a horn compression driver measured in vacuum

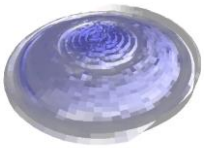
INFLUENCE OF THE AIR ON THE CONE VIBRATION



SPL response of a headphone predicted by using cone vibration measured in free air (solid line) and in vacuum (dotted line). Note that the moving mass of the air load shifts the natural frequency of the first bending mode from 3.8 kHz found in vacuum down to 3.4 kHz in air and causes a different vibration pattern as shown below.



Measured at 3.8 kHz in air



Measured 3.8 kHz in vacuum.

Find explanations for symbols at:

http://www.klippel.de/know-how/literature.html

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