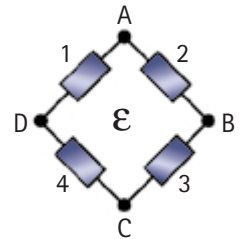
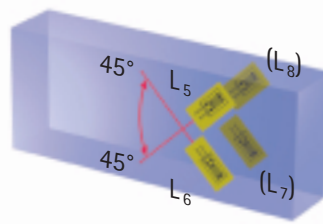


Central bar (Detail)



# Strain gages in a wind tunnel

Wind tunnel balance using HBM strain gages in a Romanian wind tunnel

To measure and analyze the forces and moments acting in all three axes ( $x, y, z$ ) on aircraft test models in a wind tunnel requires special balances of the utmost precision that have the ability to withstand the most severe test conditions.

Such balances are specially made by installing strain gages (SGs), offering a great many advantages: compactness, ease of installation, remote-controlled measurement options, reliability, etc.

An original balance for aircraft models being tested in a supersonic wind tunnel is shown in Figure 1. The axial force is measured by four short lateral arms close to the middle (AA') of the balance interior. The other five components are measured in two symmetrical sections each consisting of a casing with three beams. This complicated structure was developed with the aid of Finite Element Analysis; the loads from 722 isoparametric elements and the displacement of 1,536 nodes were calculated by computer.



Fig. 2:  
Internal 6-component  
wind tunnel balance  
(color plate)

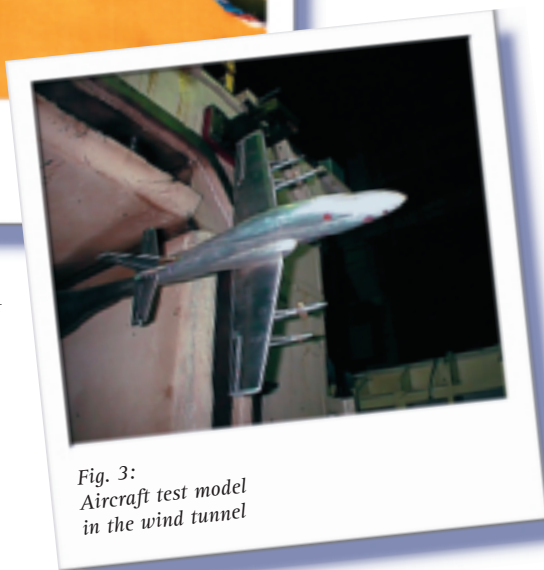


Fig. 3:  
Aircraft test model  
in the wind tunnel

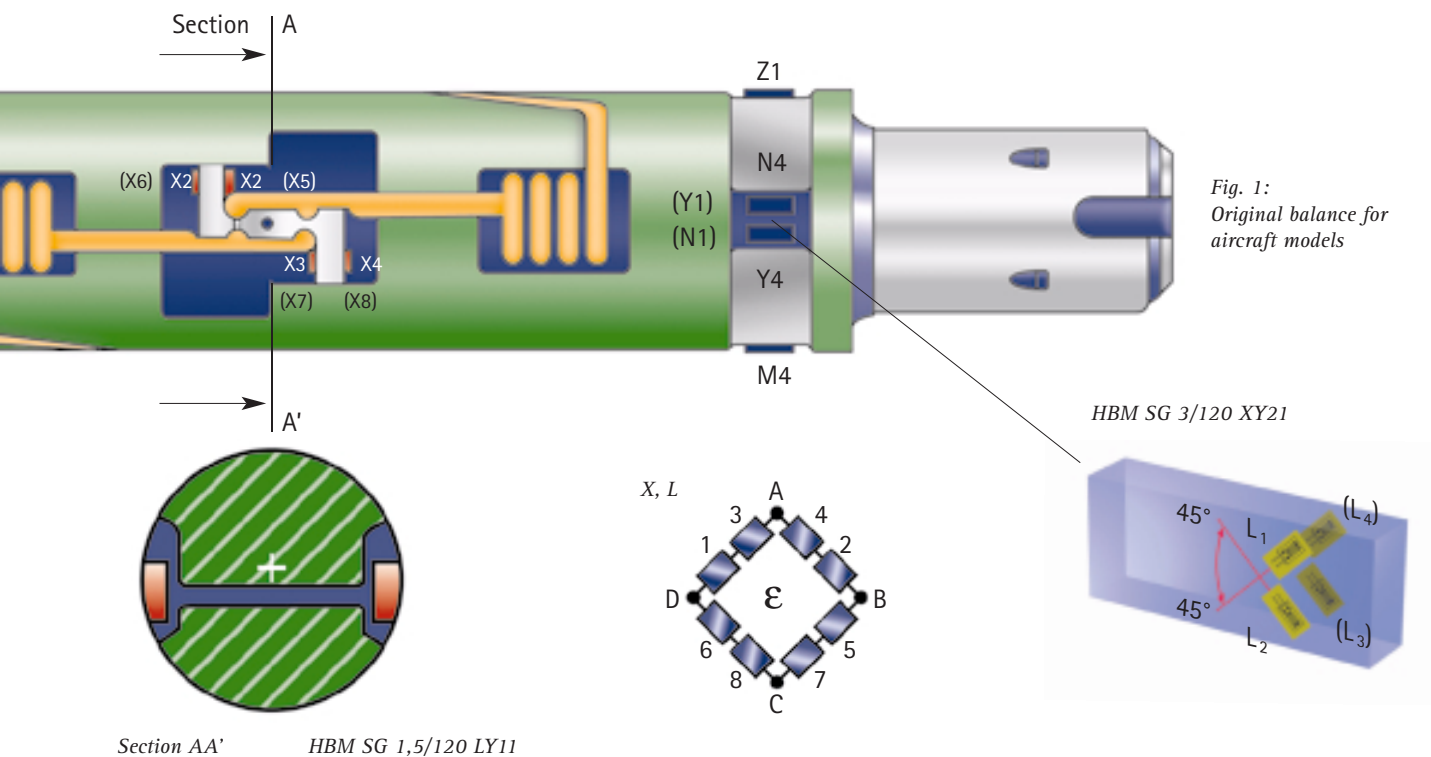


Fig. 1:  
Original balance for  
aircraft models

HBM SG 3/120 XY21

Section AA' HBM SG 1,5/120 LY11

# application

The elastic tail of the balance was manufactured to the highest possible accuracy by electroerosion from a single piece of ARMCO 17-4PH and metallurgically treated to ensure a permissible tensile strength in excess of 400 MPa (N/mm<sup>2</sup>). It is 353 mm long and 50.8 mm in diameter.

In view of two conflicting requirements, the choice went to HBM's Y series foil SGs with standard resistances as follows: 120Ω in view of space restrictions; 350Ω in view of the total power supply (not exceeding 5V) of the six Wheatstone bridges with four or eight active SGs (Fig. 1).

Complex mechanical and electrical analysis was carried out in relation to the optimum method of attaching and connecting the SGs to the wind tunnel balance in order to increase sensitivity and compensate for disturbing influences. HBM's transparent covering material SG 250 (Fig. 2) was used for additional protection.

Initial tests on the stability and sensitivity of the SGs were carried out by HBM using a simple version of the KWS-6T/5 multi-channel measurement amplifier which, despite its age, still functions perfectly.

The balance was then connected over a standard interface to the HBM data acquisition system on the trisonic wind tunnel. Fig.3 shows an aircraft model in the wind tunnel.

This integral solution offers the best relation between capacity and volume, since the interplay between forces and/or moments is accurately specified by calibration. Maximum operating loads are as follows for the individual components:

Forces:		Moments:	
axial	X = 2,850 N	Roll	l = 320 Nm
lateral	Y = 9,650 N	Pitch	m = 820 Nm
normal	Z = 14,700 N	Yaw	n = 760 Nm

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