STRAIN GAGE BALANCES AND BUFFET GAGES

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One-piece strain gage force balances have been developed at NASA Langley Research Center for use in the National Transonic Facility (NTF). This was accomplished by studying the effects of the cryogenic environment on materials, strain gages, cements, solders, and moisture proofing agents, and selecting those that minimized strain gage output changes due to temperature. In addition, because of the higher loads that may be imposed by the NTF, these balances are designed to carry a larger load for a given diameter than conventional balances. Full cryogenic calibrations have been accomplished, and wind tunnel results that were obtained from the Langley 0.3-Meter Transonic Cryogenic Tunnel were used to verify laboratory test results.

CRYOGENIC FORCE INSTRUMENTATION

NEW REQUIREMENTS

- WIDER OPERATING TEMPERATURE RANGE
- INCREASED LOAD-TO-DIAMETER RATIO (NTF)

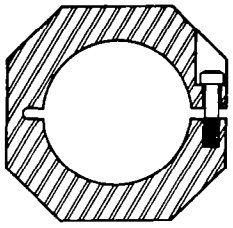
BALANCE MATERIALS

NTF

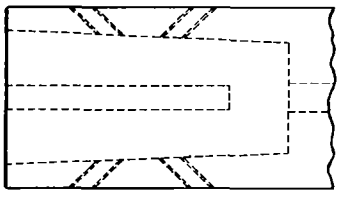
MATERIAL	TENSILE STRENGTH (KSI)		IMPACT STRENGTH CHARPY-V (FT-LBS)	
	YIELD	ULTIMATE	ROOM	77K
MARAGING 200	212	216	29	17
MARAGING 250	260	270	15	11
CONVENTIONAL				
17-4 PH	175	190	7	2
MARAGING 300	291	299	12	7

NTF-101 BALANCE

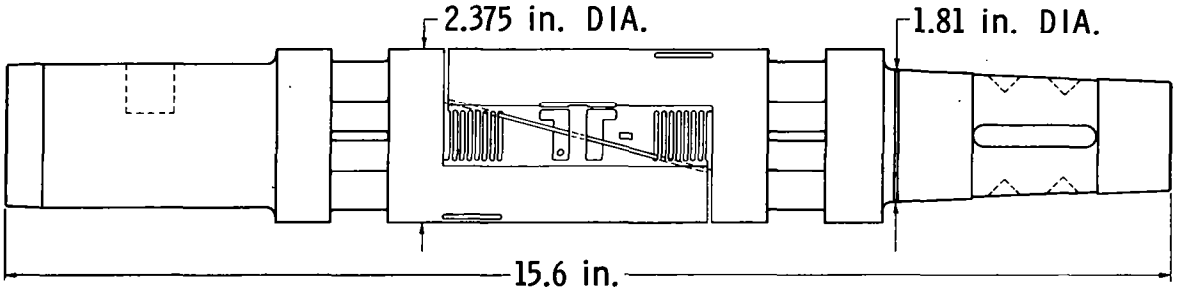
6500 lb NORMAL



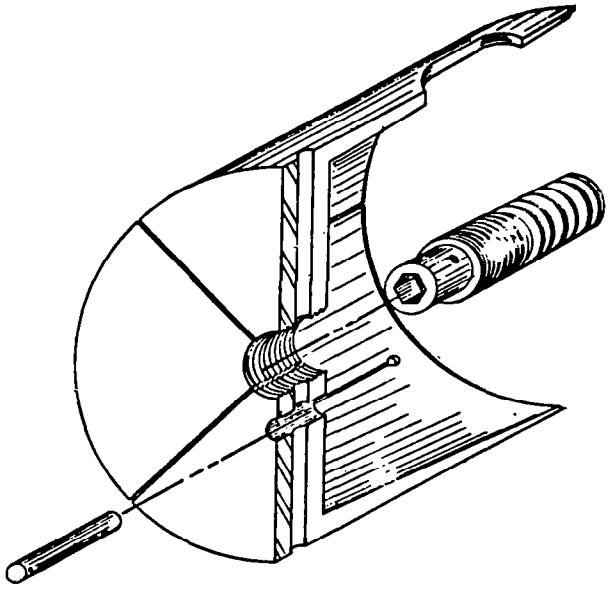
TYPICAL MODEL ADAPTOR FOR NTF-101 BALANCE



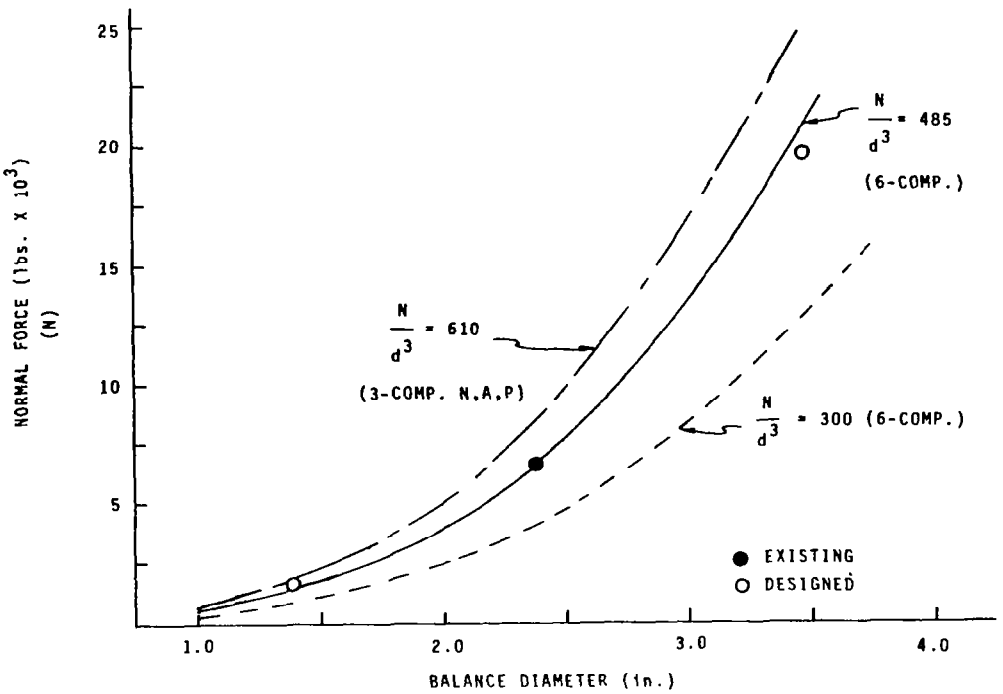
TYPICAL STING ATTACHMENT FOR NTF-101 BALANCE



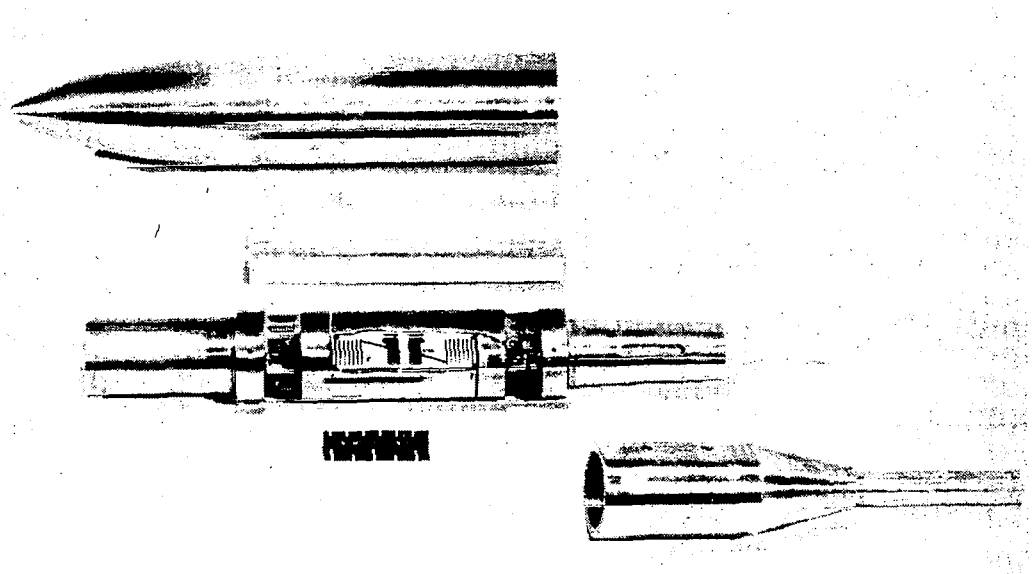
MODEL END EXPANDER



BALANCE LOAD vs DIAMETER



NTF-101 BALANCE AND ASSOCIATED 0.3-m TCT HARDWARE

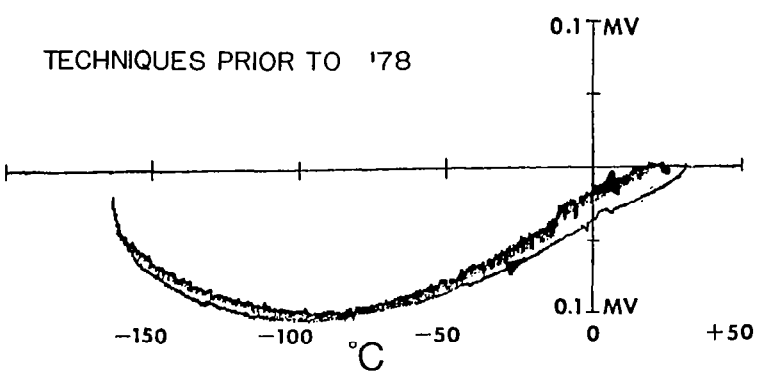


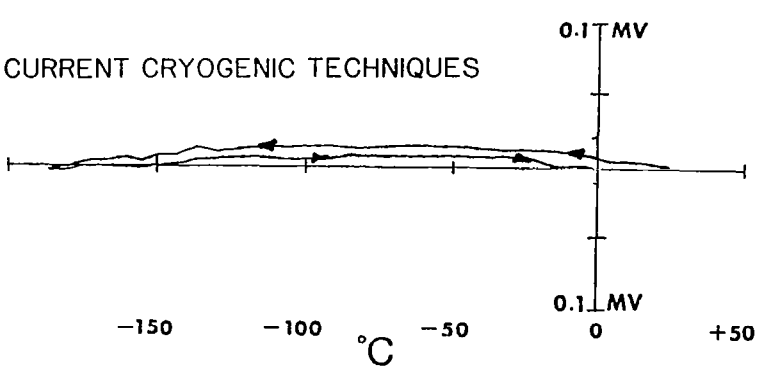
GAGE MATCHING PROCEDURE

- TEMPORARY BONDING
- DATA ACQUISITION AND MATCHING
- DISBONDING AND INSTALLATION

IMPROVED STRAIN GAGING TECHNIQUES

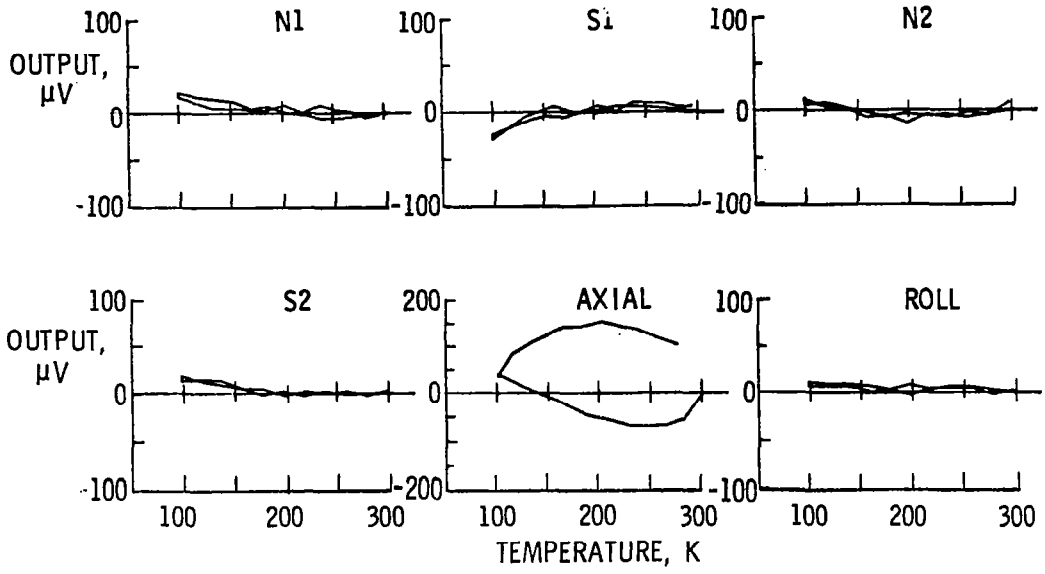
THERMAL RESPONSE OF A FOUR-ARM BRIDGE



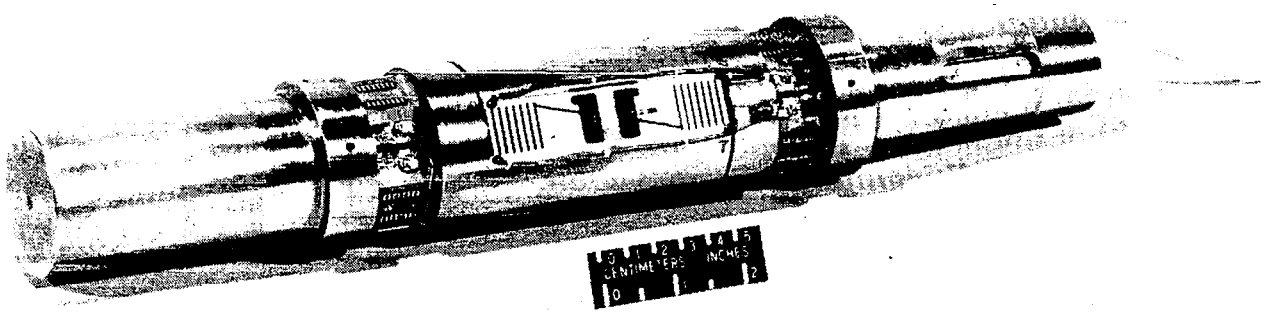


NTF-101 BALANCE

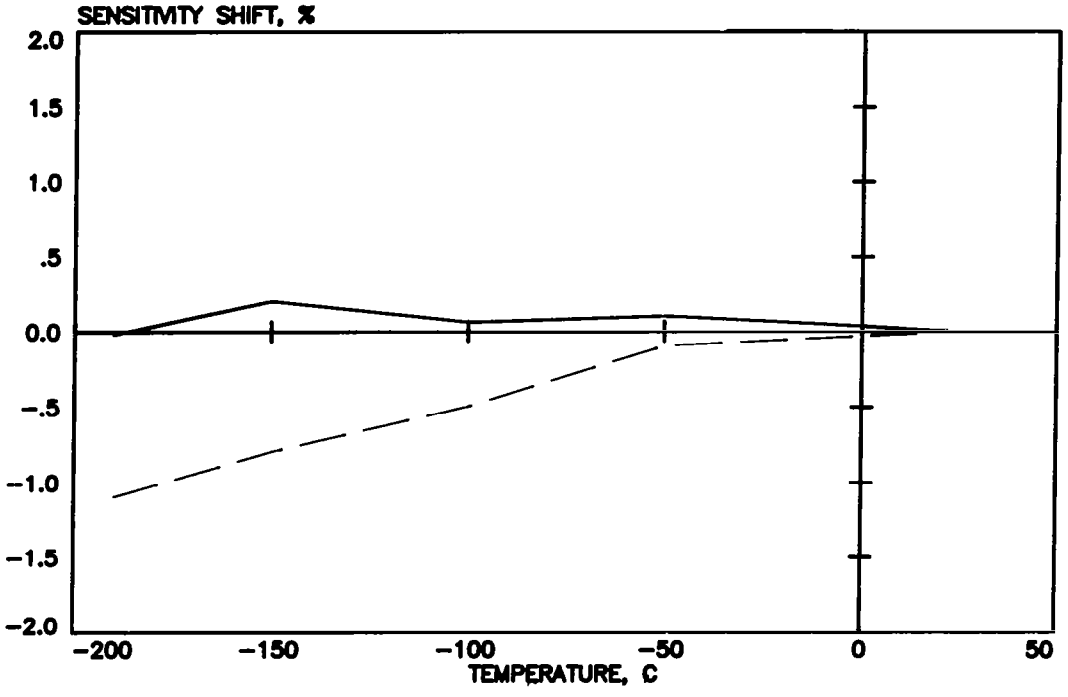
OUTPUT VERSUS TEMPERATURE



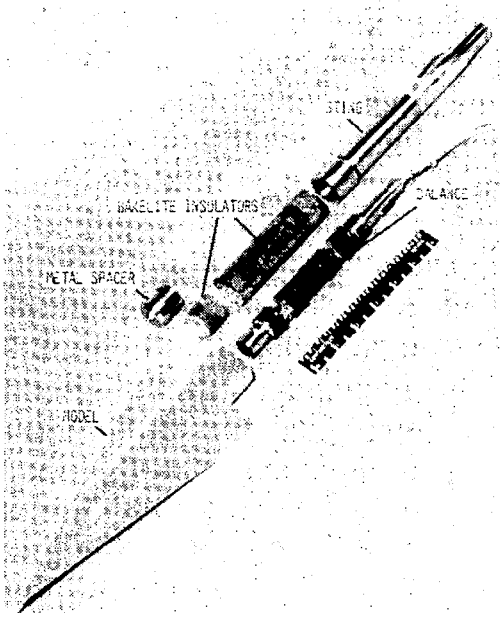
NTF-101 BALANCE

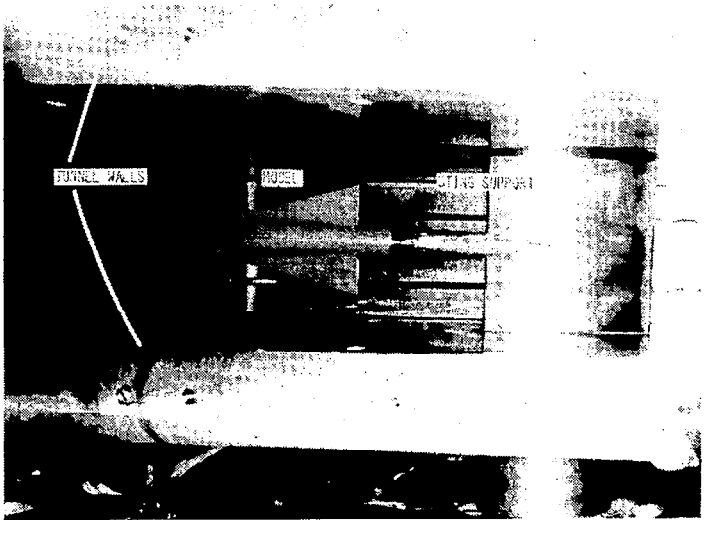


SENSITIVITY SHIFT VS TEMPERATURE

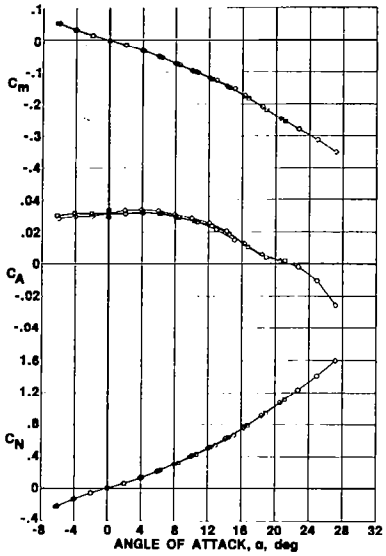


0.3-m TCT EVALUATION TESTS





0.3m CRYOGENIC WIND TUNNEL TEST RESULTS



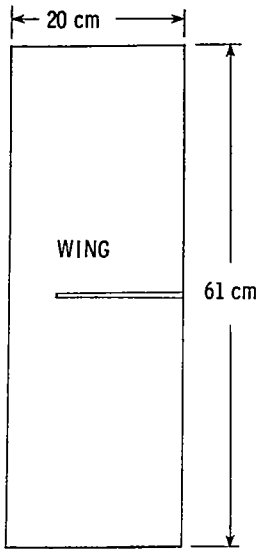
TEMP. K	M = 0.5 Re/m ×10⁶	P_t ATM	HEATERS
○ 300	48.1	4.8	OFF
□ 200	48.1	2.8	OFF
◇ 110	48.1	1.2	OFF

NTF BALANCES

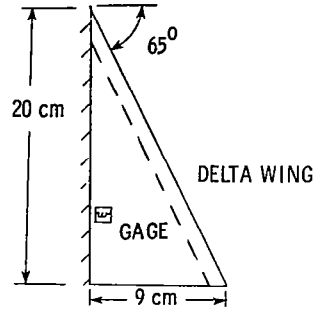
BALANCE DESIGNATION	SIZE DIAM IN	COMPONENT N LBS	A LBS	m IN-LBS	ℓ IN-LBS	n IN-LBS	Y LBS
NTF101-A	2-3/8	6,500	700	13,000	9,000	6,500	4,000
NTF101-B	2-3/8	6,500	700	13,000	9,000	6,500	4,000
NTF102	2	3,000	600	6,000	600	600	300
NTF103	2	1,500	300	3,000	300	300	150
NTF104	2	3,400	300	10,000	5,000	5,000	1,000
NTF105	2	2,000	175	6,000	3,000	3,000	700
NTF106	2	3,700	550	11,500	2,000	2,000	500
NTF107	3/4	160	50	400	100	200	80
NTF108	1-1/2	1,600	125	3,000	1,500	1,500	500

BUFFET WINGS FOR 0.3m TRANSONIC CRYOGENIC TUNNEL

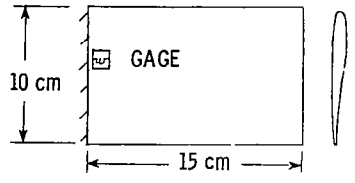
2-D TEST SECTION



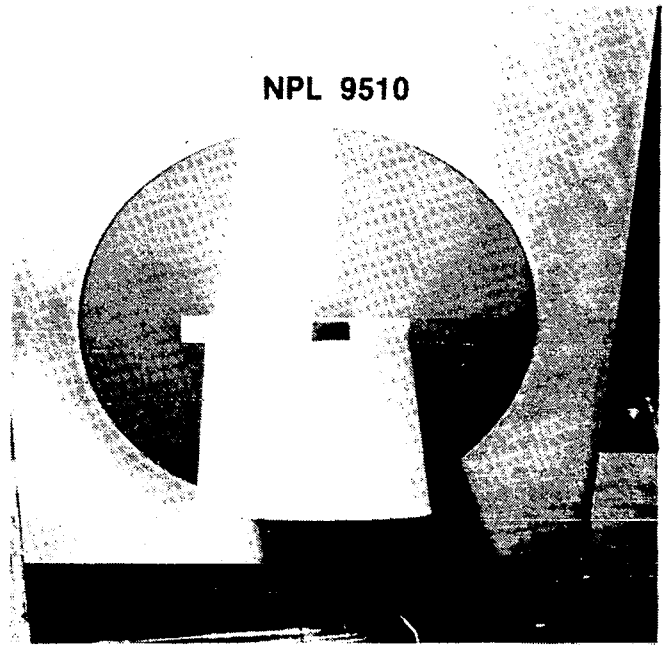
BUFFET WINGS



RAE(NPL) 9510



BUFFET MODELS TESTED IN 0.3-m TCT



CONCLUSIONS

- MATERIALS HAVE BEEN SELECTED FOR CRYOGENIC USE
- GAGING TECHNIQUES HAVE BEEN DEVELOPED TO MINIMIZE TEMPERATURE INDUCED OUTPUT
- MATERIALS AND TECHNIQUES HAVE BEEN VERIFIED IN CRYOGENIC WIND TUNNEL TESTS