NASA Technical Memorandum

NASA TM -86557

DETERMINATION OF SOLID ROCKET MOTOR (SRM) CASE SEGMENT GROWTH

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July 1986

National Aeronautics and Space Administration

George C. Marshall Space Flight Center

TECHNICAL REPORT STANDARD TITLE PAGE

1. REPORT NO.	2. GOVERNMENT ACCESSION NO.	3. RECIPIENT'S CATALOG NO.
NASA TM-86557		

4. TITLE AND SUBTITLE	5. REPORT DATE
Determination of Solid Rocket Motor (SRM) Case Segment Growth	July 1986
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S)	8. PERFORMING ORGANIZATION REPORT #
Lisa Hanks Mitchell	
9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. WORK UNIT NO.
George C. Marshall Space Flight Center Marshall Space Flight Center, Alabama 35812	11. CONTRACT OR GRANT NO.
	13. TYPE OF REPORT & PERIOD COVERED
12. SPONSORING AGENCY NAME AND ADDRESS	Technical Memorandum
National Aeronautics and Space Administration Washington, D.C. 20546	14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

Prepared by Materials and Processes Laboratory, Science and Engineering Directorate.

16. ABSTRACT

This report presents an assessment of case growth for two D6AC steel SRM case segments with multiple flight use and a comparison of these two cases with two new cases. Dimensional changes in the sealing diameter areas were recorded for the used cases and after each hydroproofing of the new cases.

17. KEY WORDS	18. DISTRIBUTION STATEMENT
SRM Case Segment Growth	Unclassified – Unlimited

19. SECURITY CLASSIF. (of this report)	20. SECURITY CLASSIF. (of this page)	21. NO. OF PAGES	22. PRICE
Unclassified	Unclassified	14	NTIS

MSFC - Form 3292 (May 1969)

ACKNOWLEDGMENTS

This investigation was performed with the assistance of:

F. Blevins	RMO/MTI
W. Bringhurst	AFPRO
H. McIntosh	PM/MTI
D. Call	SRM/MTI
Case Growth Team	MTI
D. DeFoe	QA/Rohr
J. Hudson	MMA

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DETERMINATION OF SOLID ROCKET MOTOR (SRM) CASE SEGMENT GROWTH

INTRODUCTION AND PURPOSE

The purpose of this investigation was to assess dimensional changes in the Solid Rocket Motor (SRM) case segments as a result of multiple hydroproofs and flight uses. Two segments (S/N 0000022 and S/N 0000056) were shipped to Rohr Industries in San Diego so that measurements taken at final machining buy off could be exactly duplicated. In addition, two new lightweight case segments (S/N 00000121 and S/N 00000122) were hydroproofed once at Rohr, measured and sent to Morton Thiokol, Clearfield, Utah, for further hydroproof testing and remeasuring. Of most interest was any dimensional change inthe vicinity of the tang and clevis which could have an adverse effect on O-ring squeeze.

PROCEDURE

This assessment was based on the evaluation of four SRM case segments. Two case segments, S/N 0000022 and S/N 0000056, had been exposed to prior uses and two case segments, S/N 00000121 and S/N 00000122, were new. See Table 1 for S/N 0000022 and S/N 0000056 specific stack placement history.

Case segment S/N 0000022, exposed to five prior uses, and case segment S/N 0000056, exposed to four prior uses, were mounted and measured on the tooling set-ups used initially at Rohr during machining. These tools placed the cases in a near true rounded condition so comparison data could be taken. All original measurements made for buy off final machining were repeated at the same locations and recorded. The same pi tape used for the original readings was furnished by Rohr for this investigation. All measurements were performed by skilled personnel, witnessed by on-site MSFC and Thiokol assessment engineers, and verified by resident Rohr quality control personnel.

Case segments S/N 00000121 and S/N 00000122, both new cases, were hydroproofed once at Rohr and all original measurements were repeated and recorded. These segments were then shipped to Morton Thiokol, Clearfield, hydroproofed five more times with case measurements being taken after each hydroproof. These measurements were also performed by skilled MTI quality personnel and witnessed by MSFC, Thiokol and Rohr assessment engineers.

All diameter readings were made using pi tapes, accurate to ±0.002 in. The same pi tape, S/N 81300, was used to take the measurements at Rohr and Morton Thiokol (Figs. 1 and 2). The measurement procedure, as outlined in MTI Department Instructions DI-I-277, was used at both Rohr and MTI. Horizontal length measurements were taken using a tesamike while an English micrometer was used for vertical length measurements. Thickness measurements were taken with a deep throat micrometer with an accuracy to ±0.001 in. A Federal Bore Gauge, with accuracy ±0.001 in., was used to take gap readings (Fig. 3).

RESULTS

The clevis and tang both show positive dimensional changes in the sealing surface areas. The average tang thickness on segments S/N 0000022 and S/N 0000056 was less than that originally recorded by Rohr. The O-Ring clevis gaps on all four SRM case segments show positive dimensional growth (Figs. 4 and 5). Figure 6 and Table 2 shows the growth after each hydro for the new case segments, S/N 00000121 and S/N 00000122, in the unrestrained condition.

TABLE 1. S/N 0000022 AND S/N 0000056
CASE SEGMENT HISTORY

S/N 22		S/N 56	
6 hydro		5 hydro	
3 flights		3 flights	
2 static		1 static	
Flight	**Position**	**Flight**	**Position**
DM 3:4	Aft Fwd - Ctr	-	-
QM 3:4	Aft Fwd - Ctr	QM 1:3	Fwd Fwd - Ctr
SRM 5A:2	Aft Fwd	SRM 3B:3	Fwd Fwd - Ctr
SRM 13B:1	Fwd Fwd	SRM 13A:1	Fwd Fwd
SRM 22B:1	Fwd Fwd	SRM 22A:1	Fwd Fwd

QM - qualification static firing test

DM - demo motor firing

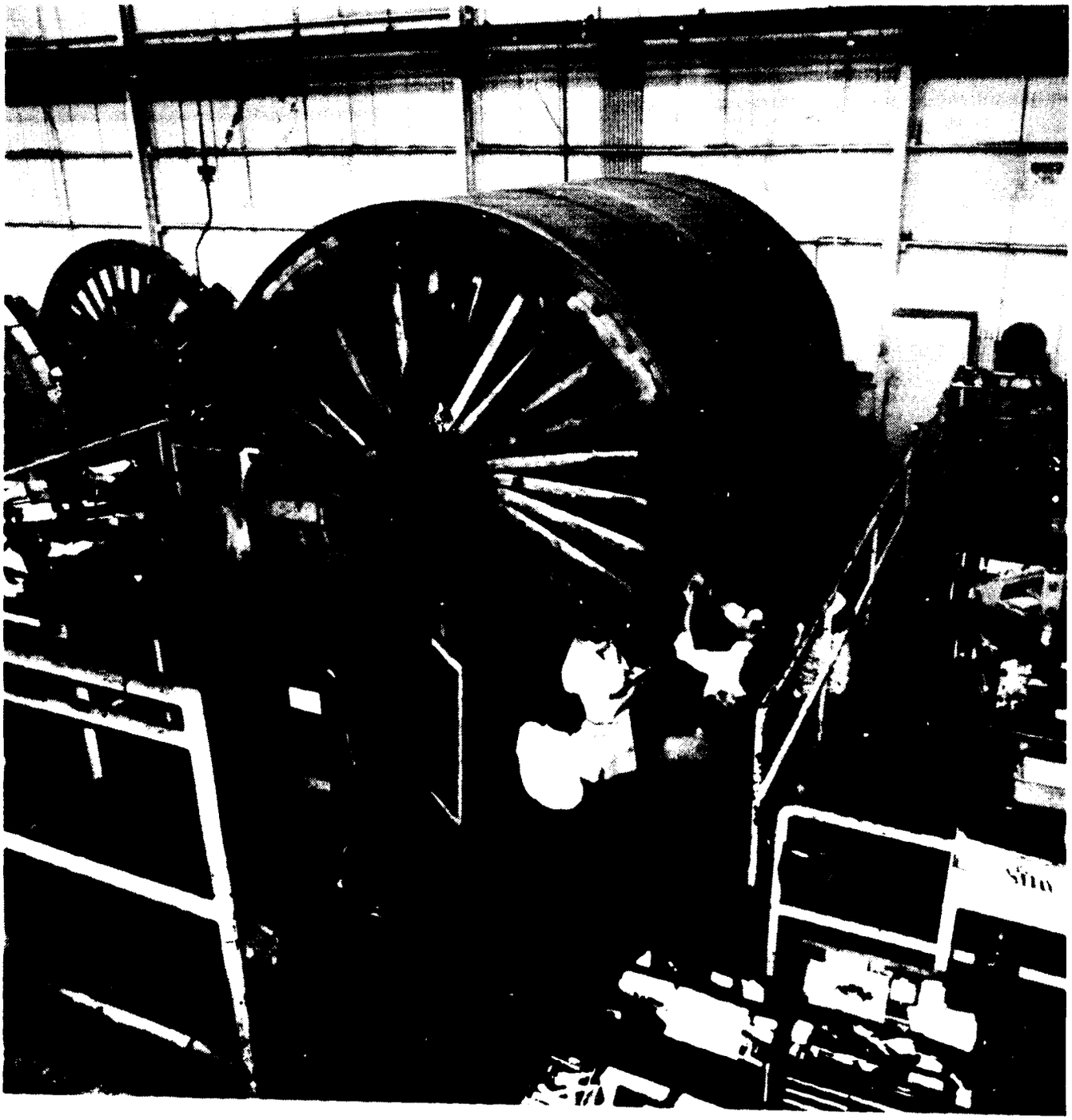


Figure 1. Pi tape measuring (restrained).

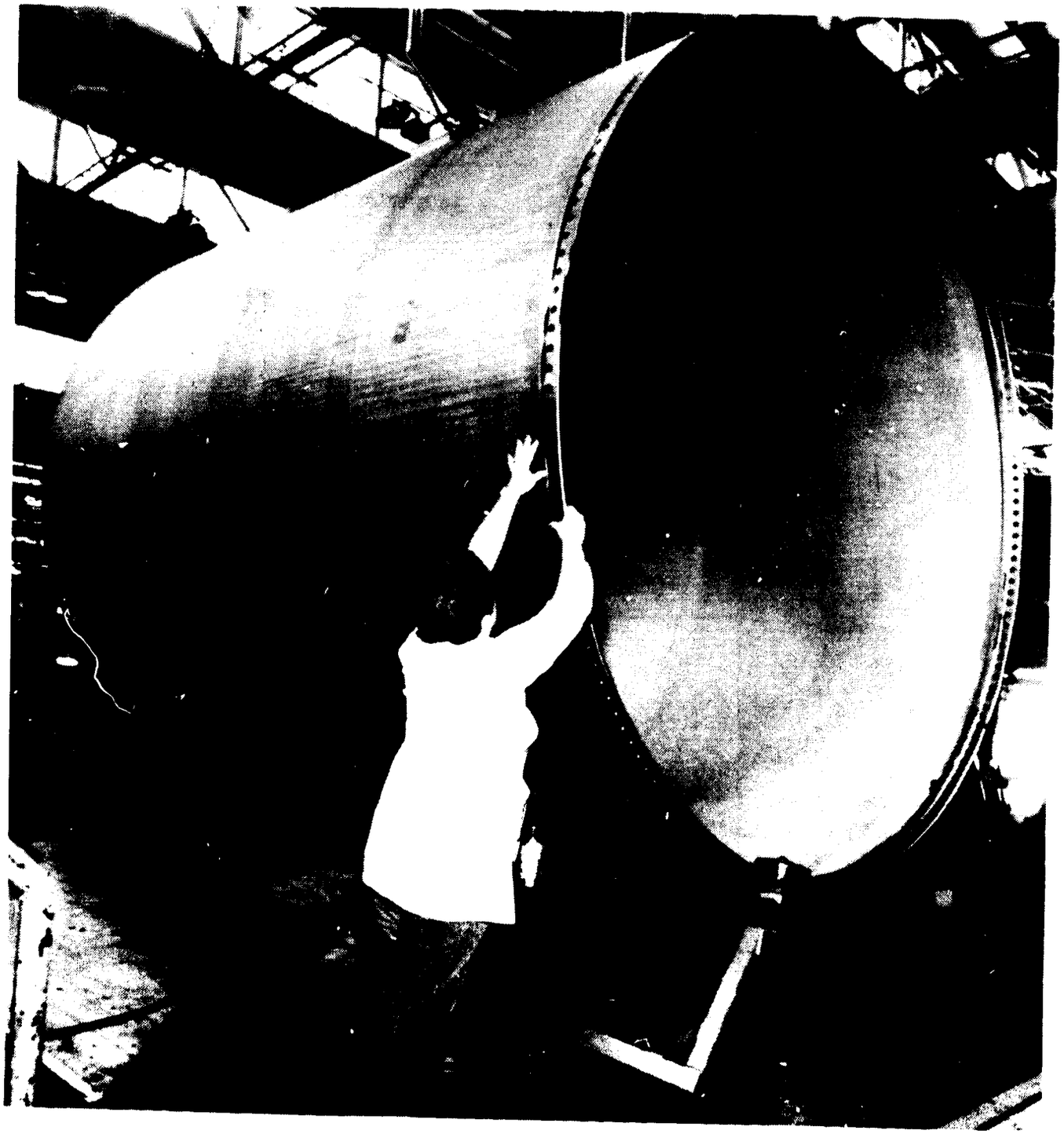


Figure 2. Pi tape measuring (unrestrained).

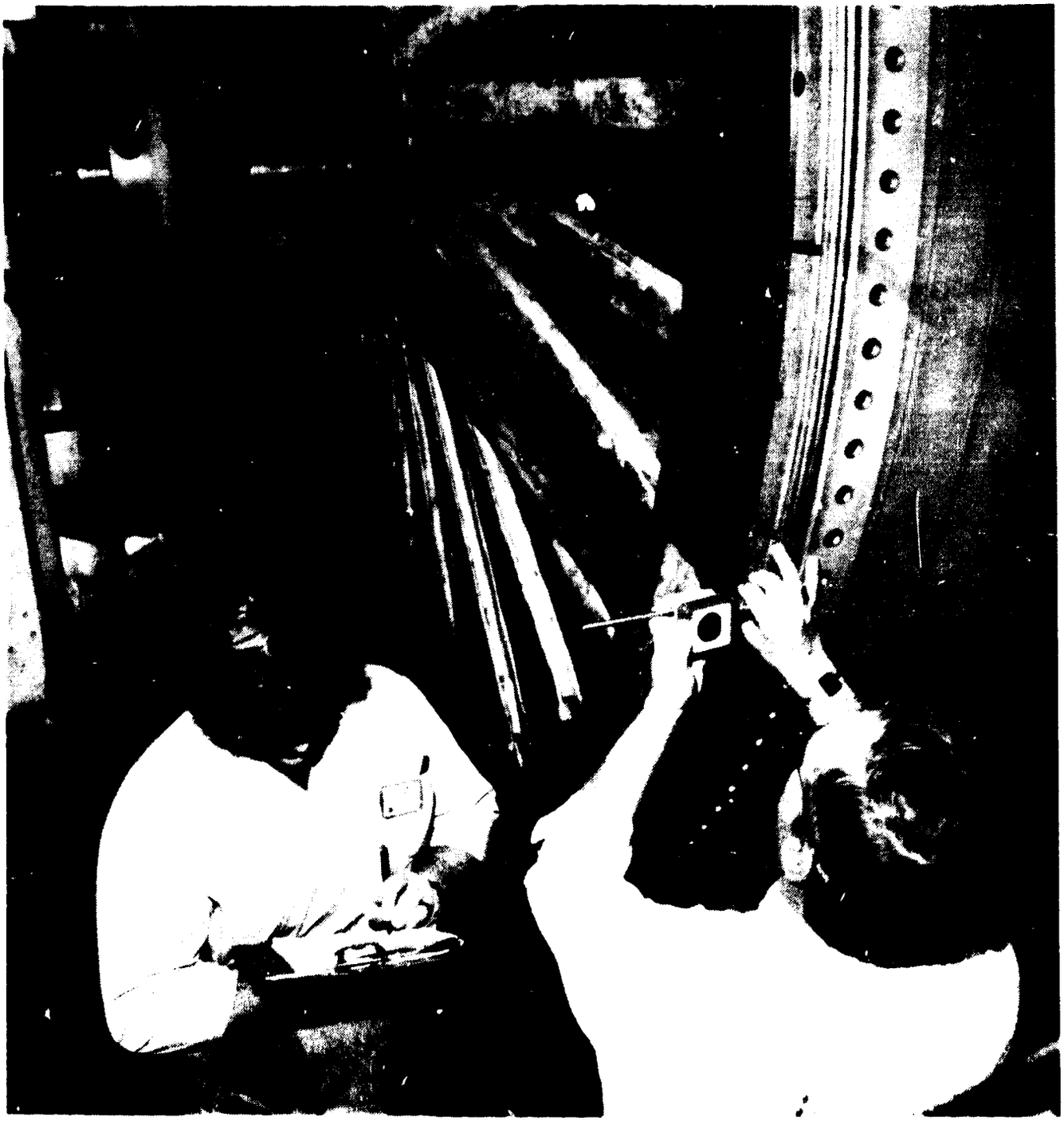
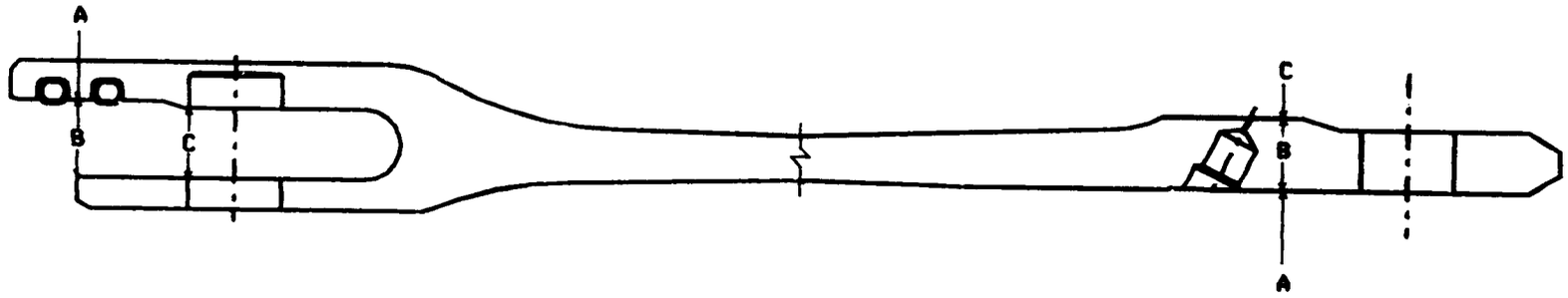


Figure 3. Clevis gap measuring.



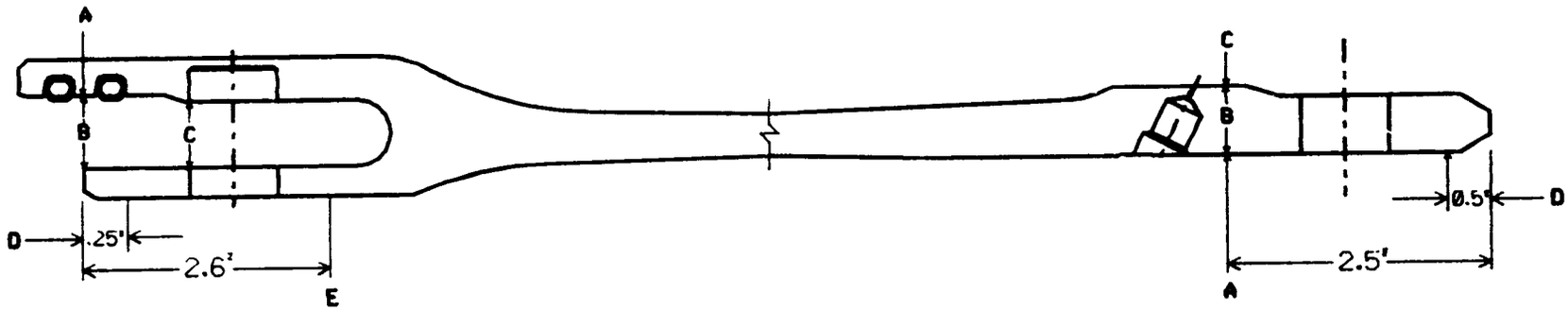
CLEVIS END RESTRAINED

	S/N 0000022			S/N 0000056		
MEASUREMENT LOCATION	ROHR ORIGINAL	AFTER 5 USES	DELTA	ROHR ORIGINAL	AFTER 4 USES	DELTA
CLEVIS DIA AT O/R (A)	144.561	144.595	+.034	144.563	144.595	+.032
CLEVIS GAP AVG O/R (B)	.8338	.8389	+.0059	.8368	.8427	+.0069
CLEVIS GAP AVG INNER (C)	.7518	.7578	+.0052	.7545	.7578	+.0025

TANG END RESTRAINED

	S/N 0000022			S/N 0000056		
MEASUREMENT LOCATION	ROHR ORIGINAL	AFTER 5 USES	DELTA	ROHR ORIGINAL	AFTER 4 USES	DELTA
TANG OD MACH SURFACE (A)	146.137	146.158	+.021	146.142	146.162	+.020
TANG AVERAGE THICKNESS (B)	.78425	.7887	-.0036	.7835	.7823	-.0012
TANG ID SEAL SURFACE (C)	144.5685	144.5966	+.0281	144.575	144.5974	+.0224

Figure 4. Case dimensional measurement at Rohr, S/N 0000022 and S/N 0000056 (restrained).



CLEVIS END RESTRAINED

	S/N 00000121			S/N 00000122		
MEASUREMENT LOCATION	ROHR ORIGINAL	AFTER 6 HYDRO'S	DELTA	ROHR ORIGINAL	AFTER 6 HYDRO'S	DELTA
CLEVIS DIA AT O/R (A)	144.571	144.587	+.016	144.564	144.586	+.022
CLEVIS OUTER LEG .25" (D)	146.904	146.930	+.026	146.895	146.927	+.032
CLEVIS OUTER LEG 2.6 AFT END (E)	146.903	146.914	+.011	146.898	146.909	+.011
CLEVIS GAP AVG O/R (B)	.8320	.8367	+.0047	.8291	.8327	+.0036
CLEVIS GAP AVG INNER (C)	.7561	.7564	+.0003	.7514	.7514	0

TANG END RESTRAINED

	S/N 00000121			S/N 00000122		
MEASUREMENT LOCATION	ROHR ORIGINAL	AFTER 6 HYDRO'S	DELTA	ROHR ORIGINAL	AFTER 6 HYDRO'S	DELTA
TANG .5" FROM END (D)	146.149	146.175	+.026	146.149	146.177	+.028
TANG OD SEAL SURFACE (A)	146.146	146.161	+.015	146.146	146.163	+.017
TANG AVERAGE THICKNESS SEAL SURFACE (B)	.7880	.7870	-.001	.7907	.7877	-.003
TANG ID SEAL SURFACE (C)	144.570	144.587	+.017	144.565	144.588	+.023

Figure 5. Case dimensional reassessment at Rohr, S/N 00000121 and S/N 00000122 (restrained).

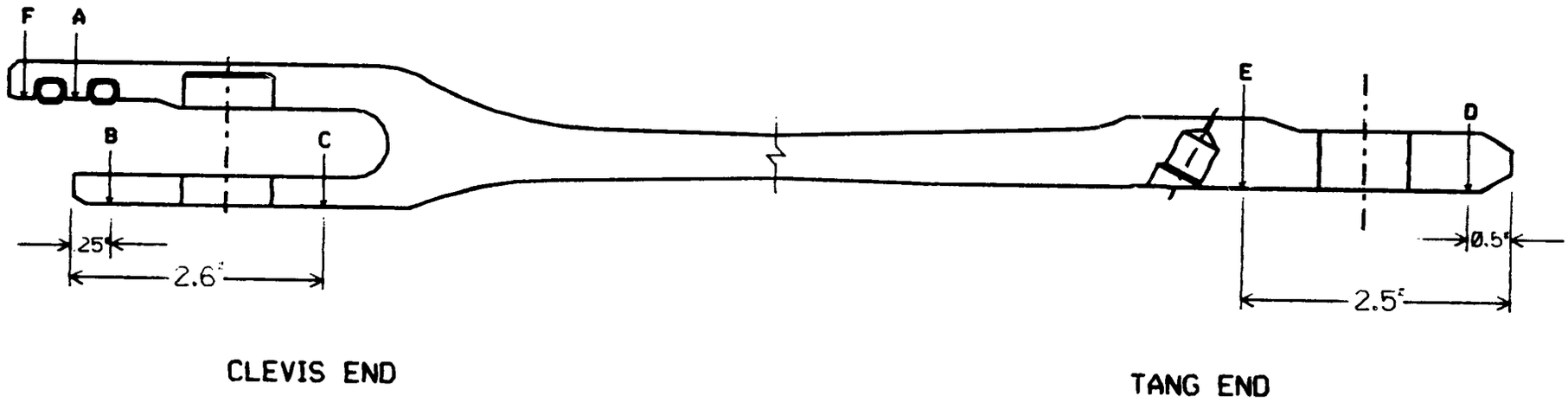


Figure 6. Unrestrained case dimensional locations (see Table 2).

TABLE 2. UNRESTRAINED CASE COMPARISON

SERIAL #	CLEVIS END BETWEEN O/R 'A' DIMENSION				TANG SEAL SURFACE 'E' DIMENSION (IO)				CLEVIS OD OUTER LEG (.25") 'B' DIMENSION			
	PRE HYDRO	HYDRO #	POST HYDRO	DELTA	PRE HYDRO	HYDRO #	POST HYDRO	DELTA	PRE HYDRO	HYDRO #	POST HYDRO	DELTA
00000121	144.571	1	144.580	+.009	144.570	1	144.580	+.010	146.904	1	146.920	+.016
	144.577	2	144.583	+.006	144.580	2	144.582	+.002	146.922	2	146.925	+.003
	144.583	3	144.585	+.002	144.582	3	144.581	-.001	146.925	3	146.929	+.004
	144.585	4	144.584	-.001	144.581	4	144.581	0	146.929	4	146.927	-.002
	144.584	5	144.586	+.002	144.581	5	144.582	+.001	146.927	5	146.928	+.001
	144.586	6	144.584	-.002	144.582	6	144.583	+.001	146.928	6	146.928	0
		CUM		+.016		CUM		+.013		CUM		+.022
00000122	144.564	1	144.583	+.019	144.565	1	144.576	+.011	146.895	1	146.917	+.022
	144.582	2	144.582	0	144.574	2	144.581	+.007	146.917	2	146.919	+.002
	144.582	3	144.581	-.001	144.581	3	144.583	+.002	146.919	3	146.922	+.003
	144.581	4	144.584	+.003	144.583	4	144.582	-.001	146.922	4	146.923	+.001
	144.584	5	144.584	0	144.582	5	144.583	+.001	146.923	5	146.924	+.001
	144.584	6	144.584	0	144.583	6	144.583	0	146.924	6	146.922	-.002
		CUM		+.021		CUM		+.020		CUM		+.027
0000022	144.561	5	144.595	+.034	144.569	5	144.597	+.028				
0000056	144.563	4	144.595	+.032	144.575	4	144.597	+.022				

TABLE 2. (Concluded)

SERIAL *	CLEVIS OUTER LEG 2.6' 'C' DIMENSION				TANG .5' FROM END 'D' DIMENSION (OD)				CLEVIS FOWARD OF PRIMARY O-RING 'F' DIMENSION			
	PRE HYDRO	HYDRO *	POST HYDRO	DELTA	PRE HYDRO	HYDRO *	POST HYDRO	DELTA	PRE HYDRO	HYDRO *	POST HYDRO	DELTA
00000121	146.903	1	146.910	+.007	146.149	1	146.164	+.015		1		
	146.909	2	146.912	+.003	146.166	2	146.171	+.005	144.581	2	144.583	+.002
	146.912	3	146.913	+.001	146.171	3	146.173	+.002	144.583	3	144.585	+.002
	146.913	4	146.912	-.001	146.173	4	146.173	0	144.585	4	144.585	0
	146.912	5	146.913	+.001	146.173	5	146.172	-.001	144.585	5	144.585	0
	146.913	6	146.913	0	146.172	6	146.173	+.001	144.585	6	144.585	0
		CUM		+.011		CUM		+.022		CUM		+.004
00000122	146.898	1	146.910	+.012	146.149	1	146.166	+.017		1		
	146.903	2	146.907	+.004	146.166	2	146.173	+.007	144.582	2	144.583	+.001
	146.907	3	146.908	+.001	146.173	3	146.175	+.002	144.583	3	144.584	+.001
	146.908	4	146.907	-.001	146.175	4	146.175	0	144.584	4	144.585	+.001
	146.907	5	146.907	0	146.175	5	146.175	0	144.585	5	144.585	0
	146.907	6	146.908	+.001	146.175	6	146.176	+.001	144.585	6	144.585	0
		CUM				CUM		+.027		CUM		+.003
0000022					146.137	5	146.182	+.045				
0000056					146.142	4	146.193	+.051				

APPROVAL

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The information in this report has been reviewed for technical content. Review of any information concerning Department of Defense or nuclear energy activities or programs has been made by the MSFC Security Classification Officer. This report, in its entirety, has been determined to be unclassified.

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☆U.S. GOVERNMENT PRINTING OFFICE 1986—631-068/20166