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ENGINEERS AND CONTRACTORS

SINCE 1827

Pantex Plant

TAIL STOCK STUDY

SANL 712-122

H. D. Johnson

April, May, June 1970

MASTER

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ATOMIC ENERGY COMMISSION ★ UNITED STATES OF AMERICA ★

DEVELOPMENT DIVISION

Tail Stock Study

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This project is to investigate and determine minimum, safe, and reproducible tail stock forces appropriate for use in the fabrication of creep and tensile specimens for HE.

ABSTRACT

The survey conducted revealed that tensile specimens were machined with a tail stock force of approximately 60 psi. The tail stock force was reduced to 6 psi by incorporating center holes in the machining operation.

Comparison tests between tensile specimens fabricated with a tail stock force of 10 psi and 50 psi clearly indicated that the specimens fabricated with 50 psi of tail stock force received some damage.

DISCUSSION

Some discrepancies were found in the tensile creep test results which brought about this investigation of the tail stock forces. Four techniques for ascertaining reproducible axial loading forces were examined and are shown below:

1. Live center with calibrated spring
2. Live center with load cell and strain gage indicator (Figs. 1, 2, & 3)
3. Calibrated torque wrench
4. Live center with Airmatic Control (Fig. 6)

After examining the four techniques above, it was decided that the live center with the load cell is probably the most versatile and accurate for experimental investigations. The load cell that was designed for this system has a range of 0 to 35 pounds (Fig. 2). Using the Tinius Olsen to apply a known load in pounds to the load cell and the Baldwin strain indicator to measure the strain at different loads, we were able to produce the calibration curve shown in Fig. 5. The error in reproducing the curve from 0 to 12 pounds is less than 1%.

A survey was conducted in the Development Division at Pantex using four technicians to determine the present amount of tail stock force being used in tensile fabrication. Each technician machined at least two tensile specimens; one without center hole and one with center hole (Fig. 4). There was a variation of approximately 25.6 to 29.1 pounds, or in this case, 51 to 58 psi of tail stock force used in the fabrication of tensile specimens without center holes. Results showed that it was possible to keep the axial loading force below 5 pounds or 10 psi using center holes. Three tensile specimens were machined using only 6 psi of axial loading force. Results of the survey are shown in Table I.

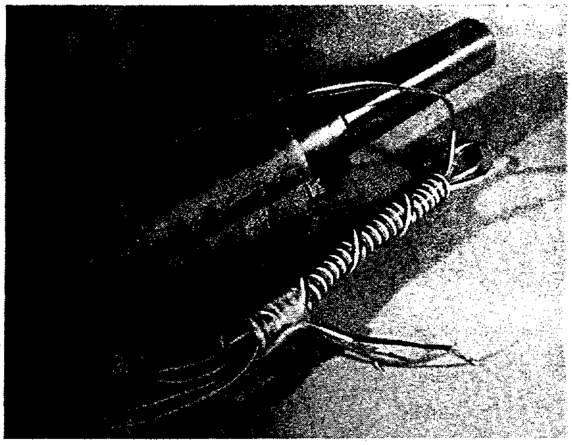

Fig. 1. Live Center with Load Cell

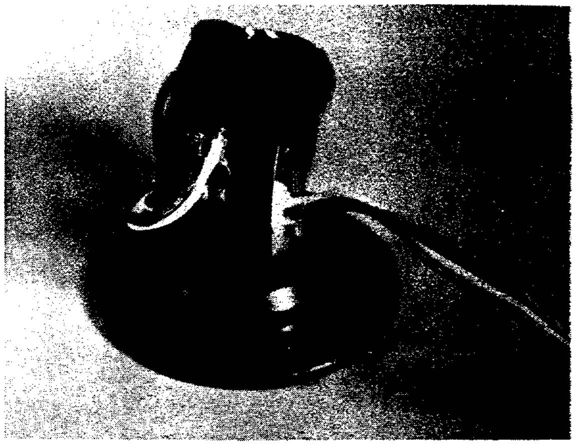

Fig. 2. Load Cell

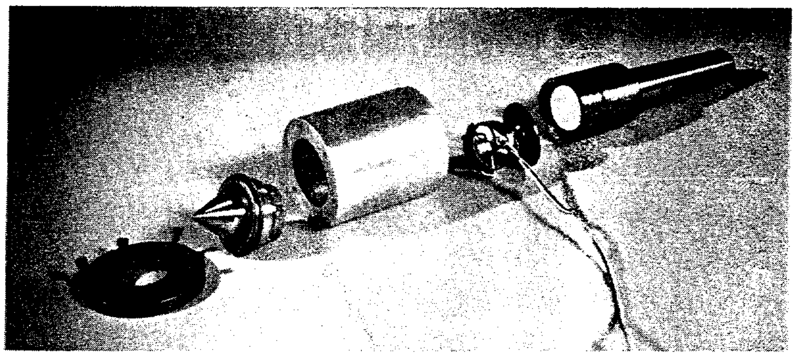

Fig. 3. Live Center Assembly

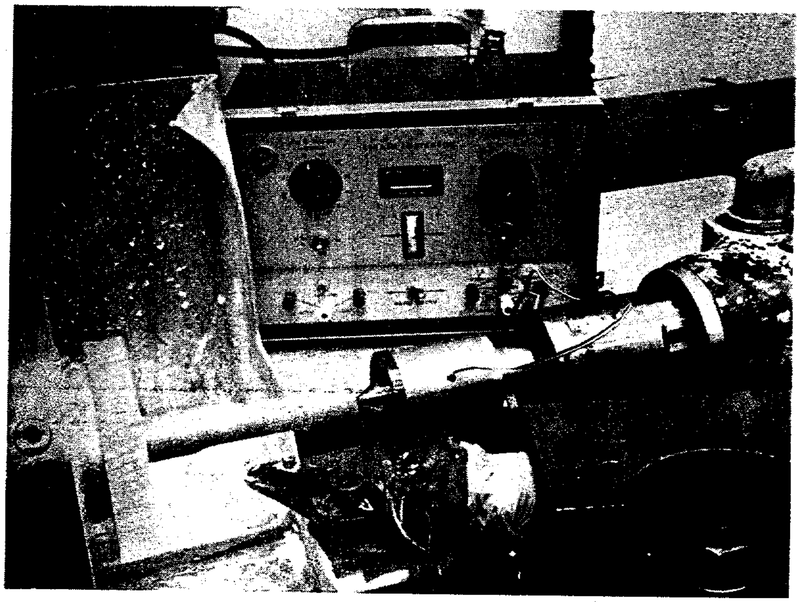

Fig. 4. Tail Stock with Live Center

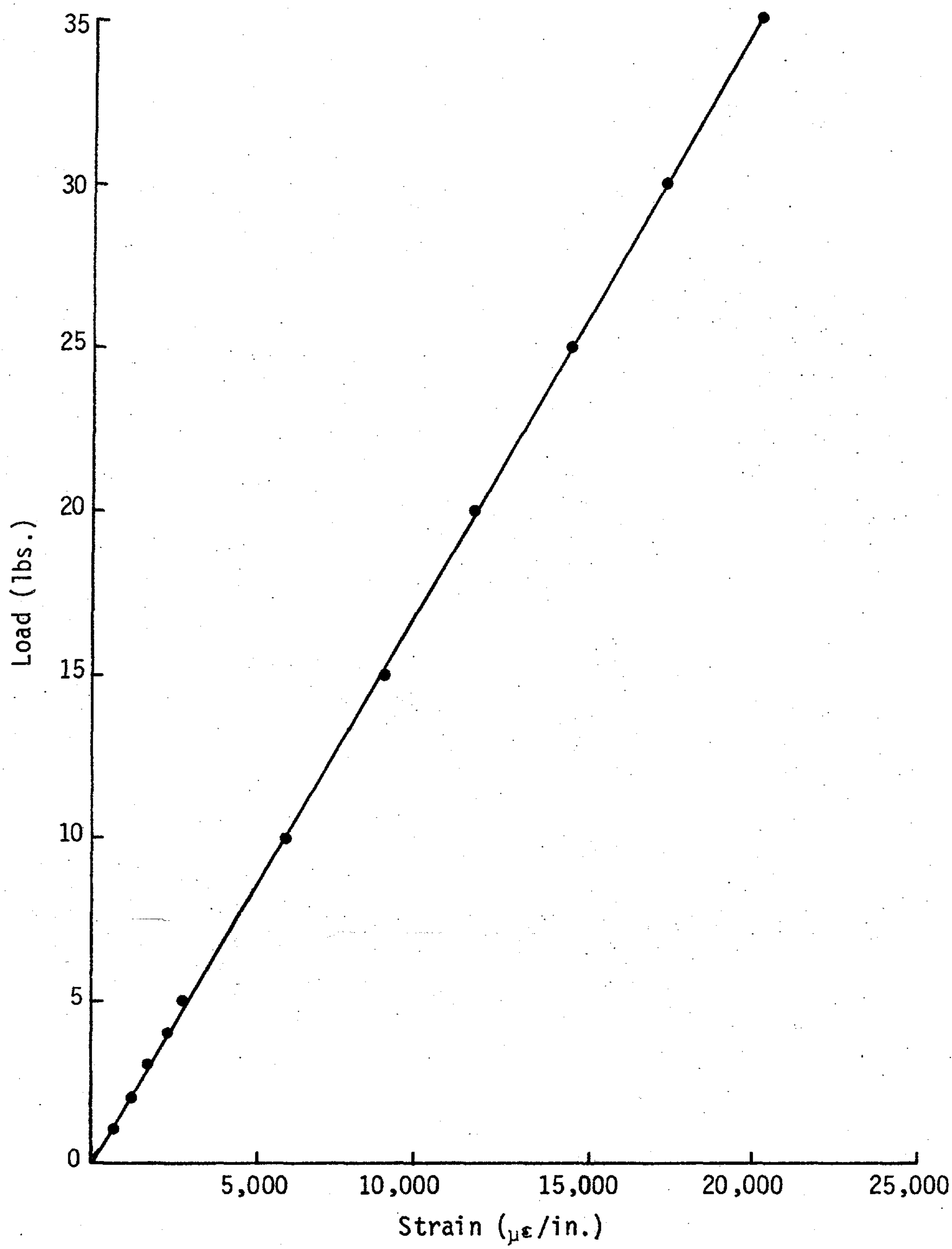

Fig. 5

Live Center Load Cell Calibration Curve

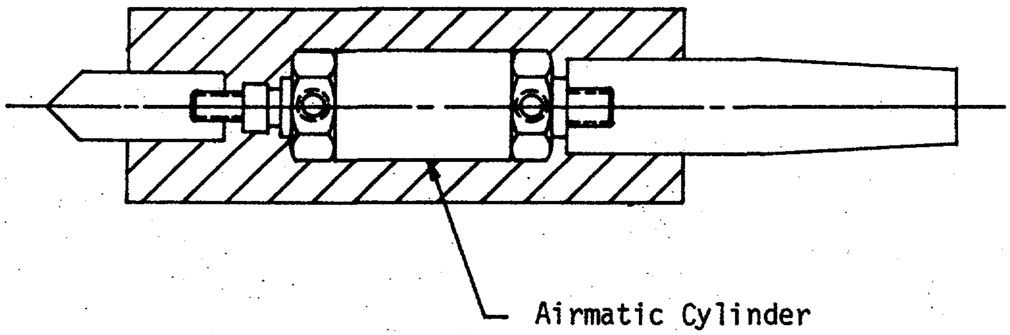

Fig. 6

Live Center with Airmatic Cylinder

Table I

Tail Stock Force in Tensile Fabrication

Engineer Technician	Maximum Axial Loading (psi) With Center Hole	Maximum Axial Loading (psi) Without Center Hole	Turning Rate (rpm)	Feed Rate (in./min.)
1	10	51	287	.0069
2	10	55	287	.0069
3	10	58	377	.0034
4	10	53	227	.0069

A comparison test was made using the four tensile specimens fabricated with a tail stock force of 10 psi and the four tensile specimens fabricated with a tail stock force of approximately 50 psi. All tensile specimens were creep tested at 120°F with a load of 20 psi. The test data at failure (Tables II and III), show that the tensile specimens fabricated with low tail stock pressure have less data scatter than the tensile specimens fabricated with high tail stock pressure. Using the data in Tables II and III, one could say, with 85% confidence, that the specimens fabricated with a tail stock force of 50 psi or greater sustained damage. However, it is realized that with this small sample size, it is not clear whether all tensile specimens fabricated with a tail stock force of 50 psi or greater will sustain damage.

For general information, it should be noted that compression specimens are fabricated without using any tail stock in the Development Division at Pantex.

Table II

Tail Stock Force Equal to 50 psi or Greater
Tensile Creep at 120°F at 20 psi

Piece No.	10 Min. Creep (μin./in.)	30 Min. Creep (μin./in.)	Failure (μin./in.)	Time to Failure (min.)	Time to Rupture (min.)	90% Rupture Strain (μin./in.)
2-1	1580	2590	4040	75.6	76.9	3830
1-1	1320	2090	3500	82.2	93.1	3550
1-3	1450	2310	3230	38.8	65.8	3250
1-6	1410	2340	3840	81.6	84.5	3200
Avg.	1550	2332	3652	74.5	80.1	3457
Std. Dev.	108	204	359	10	11	292

Table III

Tail Stock Force Equal to 10 psi
Tensile Creep at 120°F at 20 psi

Piece No.	10 Min. Creep (μin./in.)	30 Min. Creep (μin./in.)	Failure (μin./in.)	Time to Failure (min.)	Time to Rupture (min.)	90% Rupture Strain (μin./in.)
1-8	1310	2160	3750	89.5	96.4	3650
1-4	1290	2210	3855	85.2	86.6	3710
1-2	1730	2790	3670	50.4	54.0	3600
2-3	1960	2480	3920	65.4	74.7	3990
Avg.	1572	2410	3798	72.6	77.9	3737
Std. Dev.	328	289	110	18	18	174

FUTURE WORK; COMMENTS; CONCLUSIONS

Improvement of the present design of the live center with the load cell is needed. The system presently in use was a quick design for immediate use only, and would be somewhat inconvenient if accepted for permanent use. It is realized that this method requires a strain gage null indicator, which is excellent for precision measurement for production; however, it may be convenient to maintain tail stock pressure pneumatically, then the strain gage indicator could be used periodically for calibration of the system. It should also be noted that this system can be used to read or record tail stock axial forces of higher magnitudes by simply replacing the removable load cell with a load cell of the appropiate range.

For production purposes, the pneumatically controlled system with a load cell would probably be much easier to use.