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WRITTEN BY R. Cygan* <i>RC</i>		ATOMICS INTERNATIONAL A Division of North American Aviation, Inc. TECHNICAL DATA RECORD	TDR NO. 4934
SECTION Sodium Reactors			GO 7508
GROUP Sodium Components			LEDGER ACCT. 3621
UNIT Coolant System Equipment			SUB-ACCT. 4910
APPROVED BY: <i>J. Leppard</i> (SUPERVISOR)		PROGRAM HNPf	TWR 5272
OTHER		PROJECT Sodium Components	DATE February 10, 1960
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TO: B. P. Brooks*

COPIES TO: J. C. Cochran
H. A. Ross-Clunis
H. B. Holz
R. W. Dickinson*

W. J. Hallett*
J. A. Leppard* *JL*
F. C. Gronemeyer

SUBJECT: 14-Inch Swing Check Valve Test

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I STATEMENT OF PROBLEM

The check valve for HNPf employs a knife-edge bearing for the flapper in place of the usual journal-type bearing. Mechanical cycling in sodium at 600°F was carried out to check operation of this bearing.

II SUMMARY OF RESULTS

A total of 309 mechanical cycles was completed during the testing with no apparent malfunctioning of the valve. Of these, 276 cycles were carried out with relatively clean sodium (diffusion cold trap temperature maintained at 220°F). For the remaining cycles the cold trap temperature was held at 440°F. There was no significant change in back leakage during the test period. Measured average leakage rates were as follows: 0.46 gpm at 0.93 psig, 0.73 gpm at 3.4 psig, and 0.32 gpm at 5.9 psig. No problem areas have been indicated during this testing.

III METHOD USED & DESCRIPTION OF EQUIPMENT

The test apparatus consisted of two 700 gallon tanks connected together with piping containing the test valve. The system is shown schematically in Figure 1. The supply tank was elevated six feet above the storage tank to permit gravity return of the sodium. The short test duration made it more economical to transfer sodium with nitrogen gas rather than to build a sodium pump. The sodium piping was sized according to the maximum flowrate supplied by the gas manifold regulating station. Because the maximum operating temperature was limited to 600°F the system was constructed of mild steel.

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The gas system utilized for pumping the sodium is shown in Figure 2. Actuation of the solenoid gas valves was controlled by a rotary cam switch which programmed the timing and function sequence. The cycling operation was automatic except for daily changing of gas bottles and weekly cleanout of the vapor traps.

No extraordinary cleanliness precautions were taken during system construction. Although sandblasting of inside surfaces to remove rust and mill scale was carried out, no further cleaning was done. No operating problems resulted from use of these methods.

During testing the system contained approximately 450 gallons of sodium which was maintained at 600°F. At the start of a typical mechanical cycle the sodium was in the storage tank. The air-operated sodium bypass valve was closed. The exhaust valve from the supply tank was opened to vent cover gas from said tank. Immediately after, the nitrogen inlet valve to the storage tank was opened admitting 10 psig gas. The sodium from the storage tank was forced through the check valve into the supply tank. This step took from two to four minutes depending on the condition of the supply tank vapor trap. To assure that the full sodium charge was transferred the time for this portion of the cycle was set at five minutes. After closing the storage tank gas inlet and the supply tank gas vent a five minute idle period occurred in the cycle. Following this, valves were opened in this order: the storage tank vent, air-operated sodium bypass, and supply tank inlet. Although gravity was sufficient to drain the sodium back to the storage tank, a small bleed of nitrogen was maintained into the supply tank to prevent the supply tank from operating below atmospheric pressure. This portion of the cycle lasted twenty-five minutes. After closing the storage tank vent, the air-operated sodium bypass, and the supply tank inlet (in that order) the system was ready for the start of another cycle.

Leakage checks were made by first pumping all the sodium into the supply tank. Sodium in the piping on the storage tank side was drained out through the leak-measuring tank by purging the piping with nitrogen through the piping vent valve. The latter is located close to the bypass valve. Cooling coils on both sides of the bypass valve were turned on. Leak testing was started when the bypass valve temperatures were below the freezing point of sodium. Leakage rate was measured by checking the change in sodium level in the leak measuring tank as a function of time. This procedure was carried out at several different pressures. Repeatability between successive measurements at a given pressure differential was $\pm 10\%$.

Any change in check valve functioning could be observed from either the flow characteristics or the leakage rate. An increase in the time required to transfer the full sodium charge (vapor trap clean) would imply an increase in bearing friction, however no such change was observed. Similarly an increase in leak rate for the same pressure differential might be associated with a like change. More probably it would indicate change in contour of either the seat ring or the flapper. Since no change in leakage rate was observed, neither occurrence took place. On the basis of the tests carried

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out no malfunctioning of the check valve is indicated.

No visual inspection of the bearings was possible at the time the valve left the test site. If sufficient interest is evidenced, this inspection can be made at the manufacturer's plant after the top cap has been removed. The latter will be done in order to repair the seat faces prior to installation in the HNPF. It might be pointed out that the seat faces did not pass leakage requirements before the test valve was shipped from the factory. There was no change in leakage characteristics during this testing.

FIGURE 1
TEST INSTALLATION

FIGURE 2
GAS SYSTEM SCHEMATIC