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FEB 14 1962

File No: TX-53, P-19
T-18355
Test Completed: 1-22-62

MR. E. I. BRUCE - 7117
Attn: L. E. Baker

Re: Evaluation of a Pot-O-Seal and an Injectable Sealant for a Riveted Case Joint (U)

Summary

Two cylinders were made up shown in Figures 1 and 2, to perform leak rate tests on this injectable sealant (polysulphide sealer, 3C401-B2, manufactured by Churchill Chemical Corp., Los Angeles, Calif.). The sealant was injected in the "Vee" band groove of cylinder number 1, and was injected into the seal groove of number 2 cylinder. Division 7117 refer to #1 seal as a "Pot-O-Seal", and #2 as an injected seal.

Test cylinder number 1 had 4 orifices to inject the sealant through and cylinder number 2 had 30 orifices at each of the two joints to inject sealant material.

Test cylinder number 1 was tested for leakage first at room temperature and followed bya leakage test after temperature cycling at +160°F and -65°F. The initial argon leak rate was 5.4×10^{-5} cc/sec. stp. at 23 psia, pressure differential in the chamber at +80°F. The leak rate after temperature cycling at +160°F and -65°F could not be determined because of excessive leakage. The unit was removed from the chamber and checked for bubble leaks, using alcohol. Small bubbles were detected in the area of (3) of the (4) injection ports or orifices.

The second cylinder had 2 rivited junctions and (2) injectable seal areas shown in Figures 2 and 2A. This unit was checked in the same manner as test unit number 1. The initial leak rate at room temperature was less than 7.1×10^{-7} cc/sec stp. with two atmospheres of pressure differential, which is the minimum detectable leak rate of the high vacuum chamber and C.E.C. model 120 leak detector. The unit was then subjected to +160°F and -65°F temperature cycling.

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After stabilization at -65°F the unit was returned to the high vacuum chamber. This transfer period was less than 5 minutes. The chamber would not evacuate after 2 hours pump time, low enough to obtain a leak rate (later shown to be due to frost on the unit and dolly). The cylinder pressure was 12.2 psig argon. The unit was then removed from the vacuum chamber and the pressure was raised to 17 psig, using helium. Then the unit was probed for leakage, using a Veeco MS 9AB leak detector and probe. There was no indication of any helium leakage. The unit was stabilized to room temperature and again probed for leakage, there was no indication of leakage.

Then the shroder valve was blanked off and the unit put in the vacuum chamber and checked for an argon leak rate. The leak rate was less than 7.1×10^{-7} cc/sec. stp. at 29.2 psia pressure differential at 78°F.

The unit was removed from the high vacuum chamber and subjected to +160°F and -65°F temperature cycling for approximately 60 hours. After this temperature environment the unit was transfered to the vacuum chamber and checked for an argon leak rate, with the unit stabilized at -65°F. The leak rate was less than 7.1×10^{-7} cc/sec. stp. with a pressure differential of 29.2 psia.

The above tests were following by another temperature environment of +160°F and -65°F cycling test of the unit, which lasted approximately 160 hours. The cycles consisted of 4 hours to go from one temperature to the other and then remained at that temperature for 10 hours. Again the unit was transferred from the climatic chamber to the vacuum chamber and checked for an argon leak rate. The leak rate was less than 7.1×10^{-7} cc/sec. stp with a pressure differential of 29.2 psia. This was followed with a helium leak rate check. The helium leak rate was less than 8.5×10^{-7} cc/sec. stp with a pressure differential of 29.2 psia.

The unit was stabilized at room temperature and checked for argon and helium leak rates. The argon leak rate was less than 7.1×10^{-7} cc/sec. stp and the helium leak rate was less than 8.5×10^{-8} cc/sec. stp. The pressure differential was 29.2 psia and the temperature was +78°F.

Division 4631-1 performed the leak rate tests and Division 7323-2 performed the temperature environmental tests.

Object of Test

The object of this test was to evaluate the pot-o-seal and an injectable type seal, which have a probable use in sealing a riveted case joint.

Authorization for Test

This test was authorized in a Work Order request from Division 7117 to Division 7321, dated December 29, 1961. The consultant was L. E. Baker.

Setup for Test

The large Conrad chamber was used to provide the temperature environments, located in Bldg. 6630, Area III. The large high vacuum chamber in conjunction with the C.E.C. model 120 leak detector, located in Area III. Bldg. 6630 was used to check leak rates, and a MS 9 AB Veeco leak detector with probe was used for the probe tests.

Procedure and Results

The consultant had two cylinders built up, joining them in the manner the TX-53 forward section will be attached to the main body. See Figures 1, 1A, 2 and 2A.

The first cylinder, Figure 1 weighed approximately 300 pounds, fabricated out of aluminum 7079-T6. The cylinder is one foot long and 33 inches in diameter, closed on each end with a head and sealed with aluminum O-rings.

Four 1/8" NPT orifices were provided, 90° apart for injecting the sealant (Shell Epon-6 with type A curing agent). The injection procedures used a high pressure cylinder and piston unit at 250 psig., injecting through one hole and allowing flow for 1/2 of the circumference.

These tests were performed by Division 4631-1 personnel, using the large high vacuum chamber in Bldg. 6630, Area III. Division 7323-2 performed the temperature environments using the dual chamber Conrad facility in Bldg. 6630, Area III.

Test cylinder number 1 was pressurized to 11 psig of helium at room temperature. The unit was probed for leaks first to ascertain there were no leaks through the riveted joints, shrader valve and between the heads and the cylinder. There was an excessive amount of leakage at the shrader valve to fixture connection. The shrader valve was sealed by replacing the valve and applying fresh glyptol to the threaded connections.

The rubber seals were removed from between the heads and the cylinder and replaced with soft aluminum O-rings. The O-rings were polished very slightly with fine steel wool and a thin film of DC-4 grease was applied to the O-rings and mating surfaces on the heads and cylinder before being reassembled. The 80 bolts attaching each of the two heads to the cylinder were torqued to 30 inch-pounds. The cylinder was then pressurized to 11 psig with 100% argon. The unit was then placed in the high vacuum chamber. The chamber was evacuated to 3×10^{-5} torr. Using a C.E.C. model 120 leak detector a leak rate was obtained. The argon leak rate was 5.4×10^{-5} cc/sec. stp at 23 psia differential in the chamber at +80°F.

After this first test the cylinder was repressurized to 25 psig and checked for leakage. The leak rate was 5.7×10^{-5} cc/sec stp at 37 psia differential at +80°F.

After the above two tests, the entire unit was moved into the Conrad temperature chamber and subjected to the following temperature cycling environment.

The chamber was brought to -65°F in one hour, the chamber remained at this temperature for the next four hours, then the chamber was brought to 160°F in 1/2 an hour. The chamber remained at this temperature for four hours. The next 16 hours the chamber was shut down and the temperature went to -65°F in the next 3/4 of an hour and remained at this temperature for two hours.

After this temperature enivornment the unit was removed from the Conrad chamber and placed in the high vacuum chamber. This operation took less than 5 min.

The argon leak rate of the first cylinder after the above temperature environment could not be determined, due to an excessive amount of leakage of the entire unit. The vacuum chamber could not be evacuated to a readable pressure.

The unit was removed from the vacuum chamber and checked for leaks, using alcohol. Bubble leaks were detected through three of the four filler holes. Further testing of this cylinder was cancelled by the consultant.

The second cylinder tested, see Figure 2 and 2A was tested in the same manner as the first cylinder. The injectable material used was polysulphide sealer, 30401 B2, manufactured by Churchill Chemical Corp., Los Angeles, Calif.

The injection procedures followed are called out in Dwg. SS-175204, Issue A, paragraphs 7 and 8.

The cylinder was pressurized to 12.2 psig argon and placed in the high vacuum chamber. The chamber was evacuated to approximately 3×10^{-5} torr (mm HG). The leak rate was less than 7.1×10^{-7} cc/sec stp with 2 atmospheres differential at 78°F. This is the minimum leak that can be detected by the equipment. The equipment is a C.E.C. model 120 leak detector in conjunction with the high vacuum chamber. After the initial leak rate test of this second cylinder it was subjected to temperature cycling environment of -65°F and +160°F at completion of temperature cycling the unit remained at -65°F an extra 2 hours. After this stabilization period the unit was moved into the vacuum chamber, this was done in less than 5 minutes.

A leak rate test was performed. The chamber would not evacuate low enough to obtain a leak rate, (later shown to be due to frost on unit and dolly).

The unit was removed from the vacuum chamber and pressurized to 17 psig, using helium. The unit was then probed for leakage, using a Veeco MS 9 AB, leak detector. There was no indication of any helium leakage. The unit remained at room temperature and stabilized. Again this unit was probed for leakage with the pressure at 17.0 psig, there was no detectable leakage.

The shrader valve was removed and a blank plug was installed and the unit put back in the high vacuum chamber to check for argon leakage at room temperature. The argon leak rate was less than 7.1×10^{-7} cc/sec stp at 29.2 psia differential at 78°F.

The unit was again subjected to temperature cycling. The cycling was changed to 4 hours from room temperature to +160°F and remained at +160°F for 10 hours, then 4 hours to -65°F and remained at -65°F for 10 hours. Four of these cycles of temperature environment was performed and the unit was transferred to the high vacuum chamber, this transfer took less than 5 minutes. The argon leak rate after pumping down for 2 hours was less than 7.1×10^{-7} cc/sec stp with a differential of pressure of 29.2 psia. The vacuum chamber was vented to atmospheric pressure and reactivated. Again, after pumping for 2 hours the argon leak rate was less than 7.1×10^{-7} cc/sec. stp with a differential of pressure of 29.2 psia. The helium leak rate was checked following this argon leak rate test and the helium leak rate was less than 3.1×10^{-7} cc/sec. stp. These tests were performed with the unit at -65°F.

The unit was removed from the high vacuum chamber and placed in the Conrad temperature chamber again and subjected to 160°F and -65°F temperature cycling. The cycling consisted of 4 hours from room temperature to +160°F, remained at +160°F for 10 hours and then 4 hours to -65°F, remaining at -65°F for 10 hours. This last temperature environment lasted for 160 hours. The unit was removed from the climatic chamber, stabilized at -65°F to the high vacuum chamber in approximately 5 minutes.

The cylinder was checked for argon leak rate. The leak rate was less than 7.1×10^{-7} cc/sec stp with a pressure differential of 29.2 psia. Then a helium leak rate was taken and it was 8.5×10^{-7} cc/sec stp with a differential of 29.2 psia pressure. These tests were performed with the unit at -65°F.

The unit was stabilized at room temperature approximately 64 hours. The argon leak rate was less than 7.1×10^{-7} cc/sec. stp with a differential of 29.2 pressure at 78°F. The helium leak rate was less than 8.5×10^{-8} cc/sec. stp with a pressure differential of 29.2 psia at 78°F. End of test.

A. R. Alberts

7321 Project Engineer: A. R. ALBERTS - 7321-5

Approved By: R. S. HOOPER - 7321-5

AKA:mw

Encl: Figs. 1, 1A
2, 2A

Copy to:
G. M. Haughness, 4631-1
Attn: F. Castillo
J. M. Wiesen, 1442
D. S. Bliss, 2344
E. B. Copeland, 7321
C. L. Johnson, 7523
R. K. Smeltzer, 3421-3
A. K. Alberts, 7321-5

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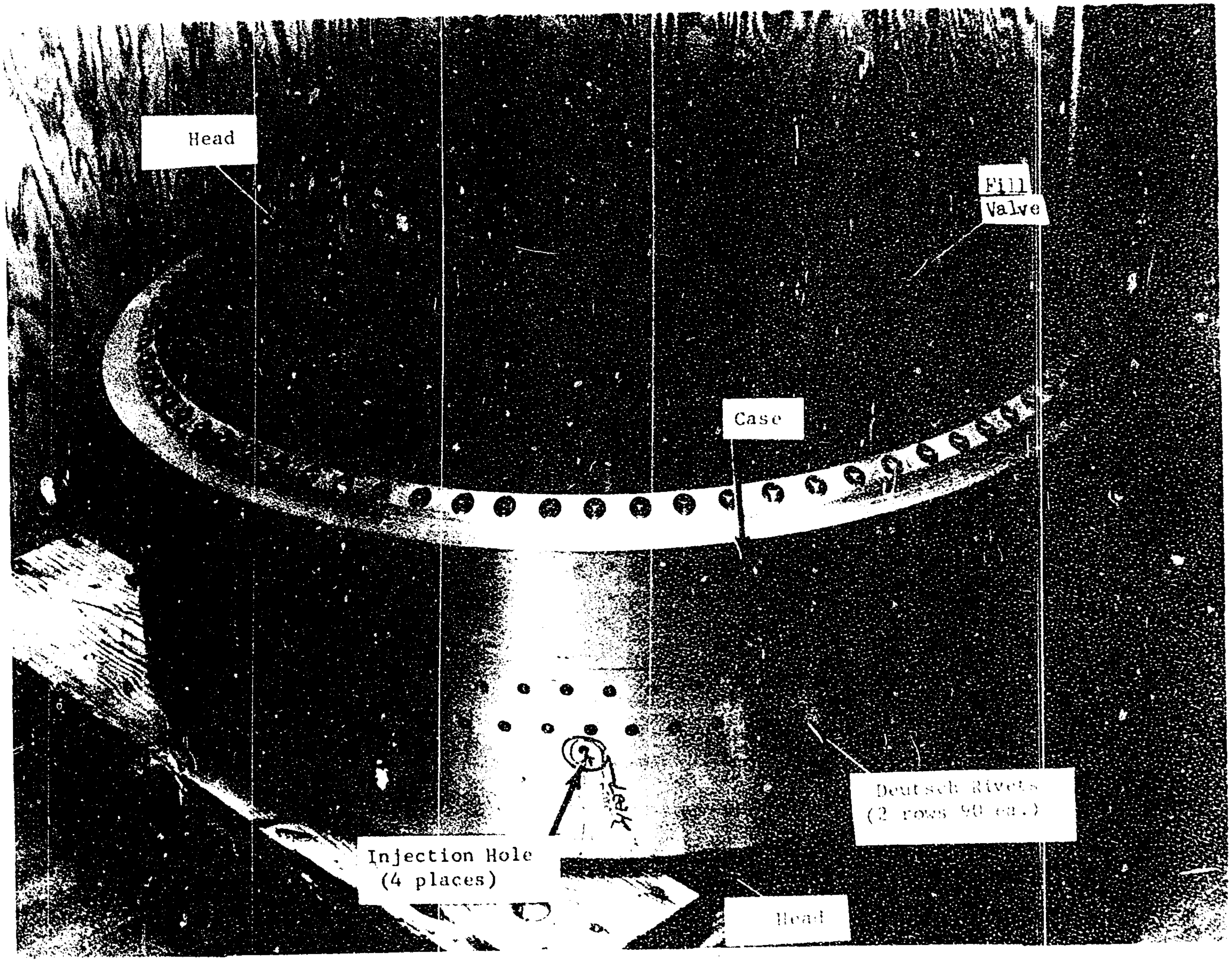

FIGURE 1 - CYLINDER NUMBER 1, SHOWING ONE POT-O-SEAL JOINT

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FIG. 1A

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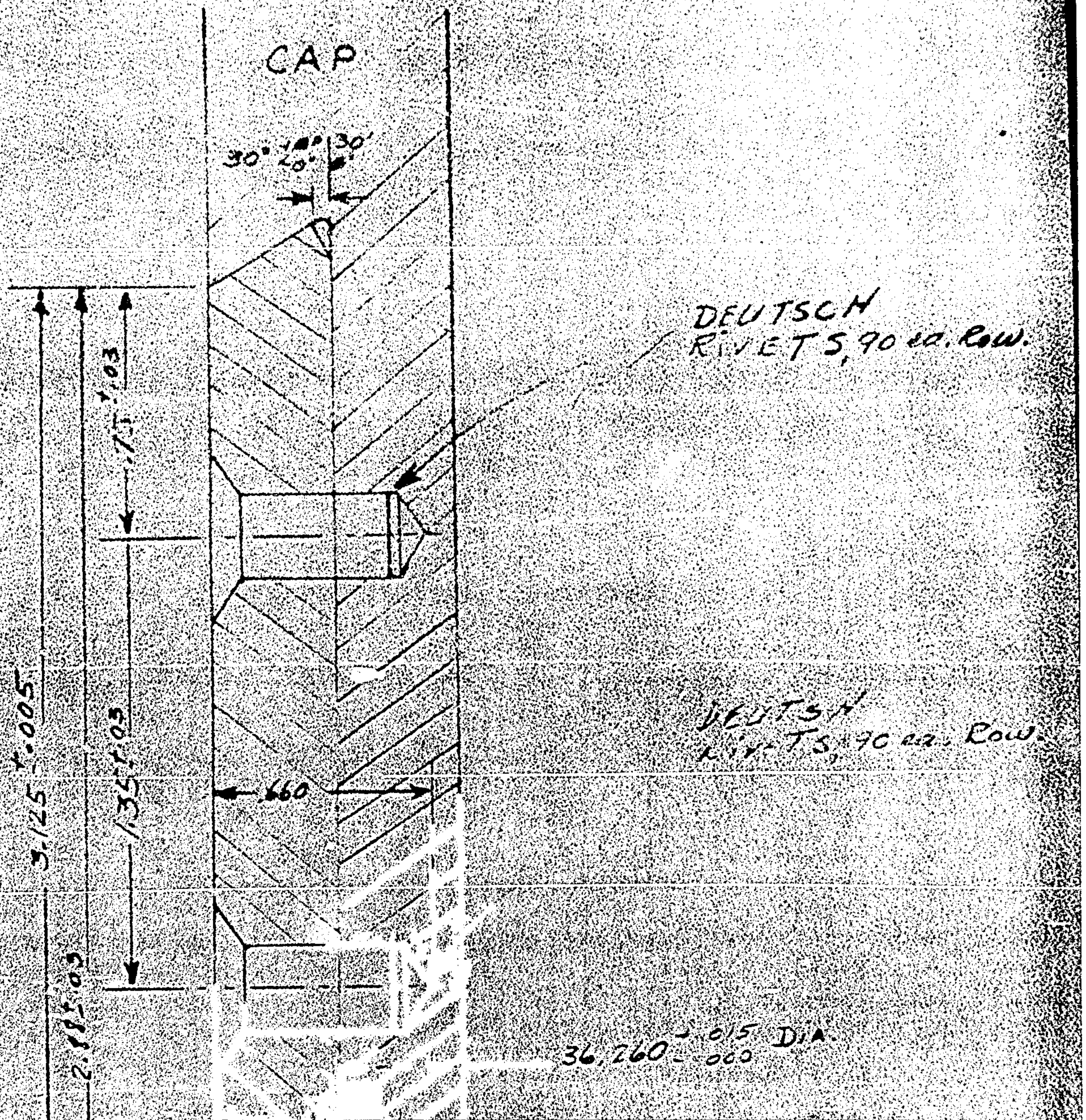

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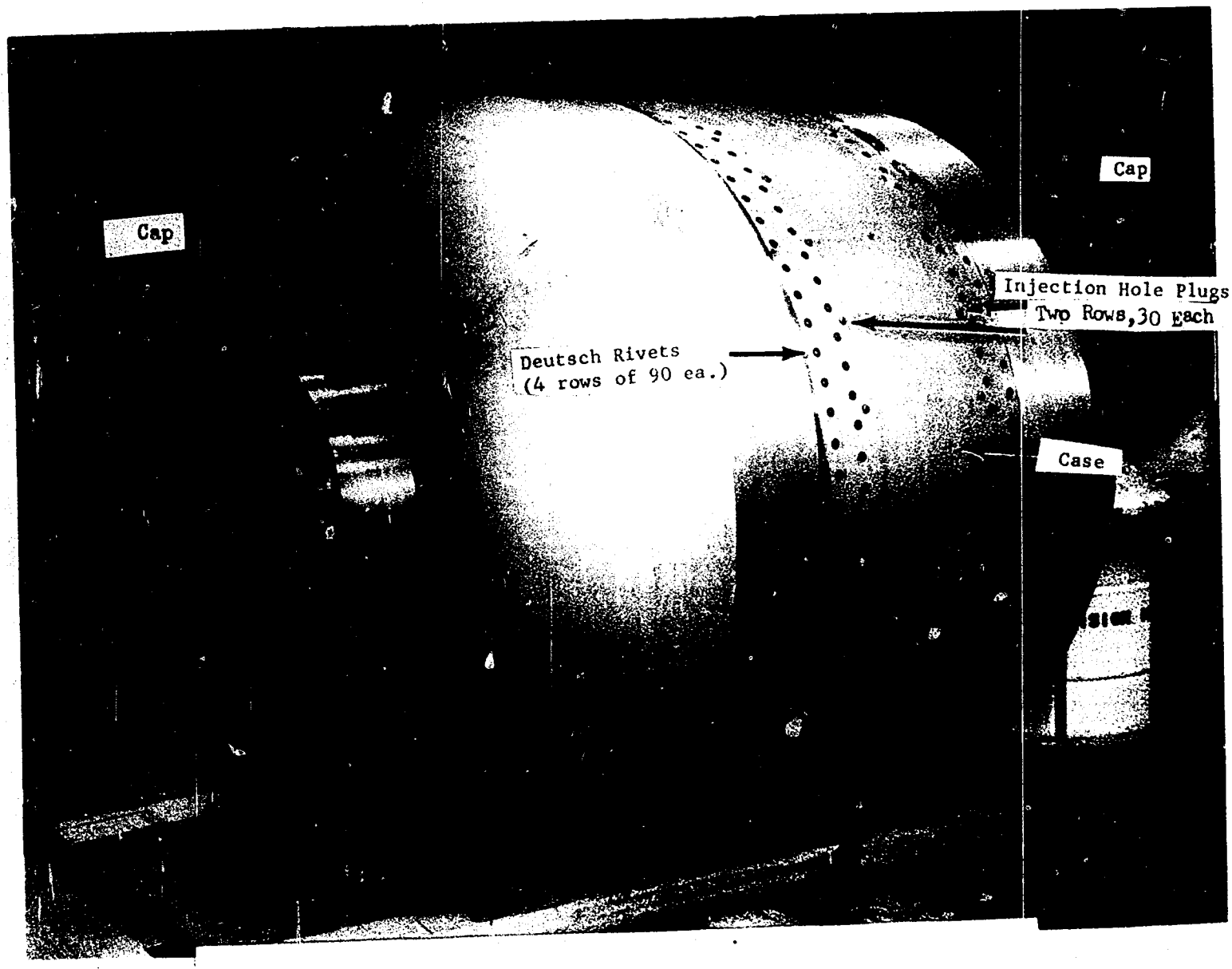

FIGURE 2 - TEST CYLINDER NUMBER TWO, WITH TWO INJECTED TYPE SEALS

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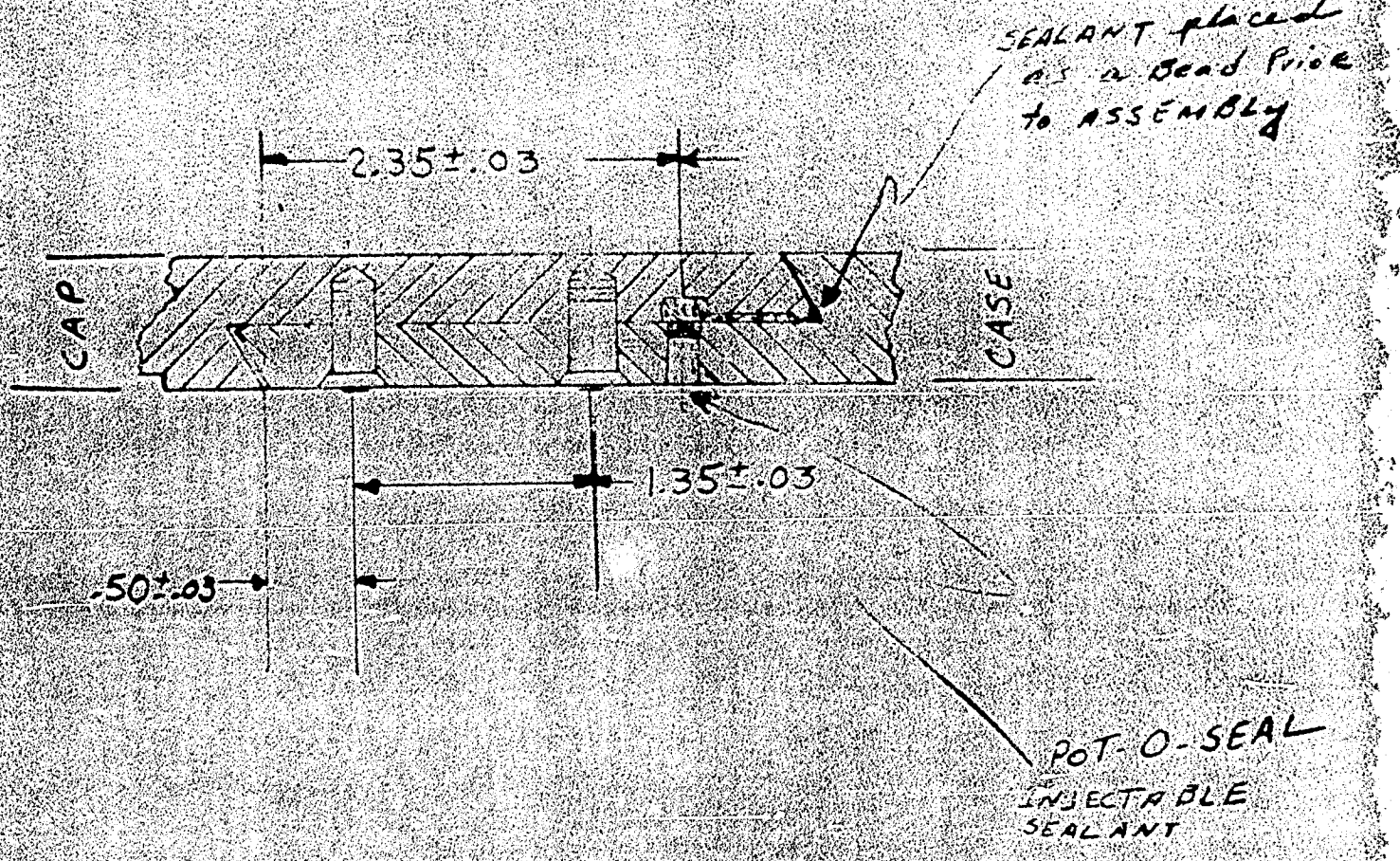
SEALANT placed as a Bead Prior to ASSEMBLY
2.35±.03
CAP
CASE
1.35±.03
.50±.03
POT-O-SEAL
INJECTABLE SEALANT