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Forwards suppl, "Hardness Data", to 781020 rept by SW Res Inst #02-5389-991, "Metal-
lurgical Investigation of Cracking in a Reactor Vessel Nozzle Safe-End. Interim Rept."
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LEE LIU

SENIOR VICE PRESIDENT - ENGINEERING

November 27, 1978

Mr. Harold Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Denton:

On October 27, 1978, we forwarded to you the Southwest Research Institute (SwRI) interim report titled "Metallurgical Investigation of Cracking in a Reactor Vessel Nozzle Safe-End. SwRI Project 02-5389-991, Interim Report" dated October 20, 1978. That report provided initial data regarding the SwRI analysis of safe-end - N2A.

Enclosed herewith is one original and 39 copies of a supplement, titled "Hardness Data," to be attached to the above SwRI interim report.

Additional data will be forwarded as it becomes available.

Very truly yours,



Lee Liu
Senior Vice President, Engineering

LL/KAM/lw

cc: K. Meyer
D. Arnold
R. Lowenstein
R. Clark (NRC)
H. Rehrauer
B-3lc

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SOUTHWEST RESEARCH INSTITUTE

6220 CULEBRA ROAD • POST OFFICE DRAWER 28510 • SAN ANTONIO, TEXAS 78284

Department of Materials Sciences
October 25, 1978

METALLURGICAL INVESTIGATION OF CRACKING IN REACTOR VESSEL NOZZLE SAFE-END

SwRI Project 02-5389-001

Supplement to Interim Report dated October 20, 1978

Hardness Data

Microhardness measurements were made within the safe-end base metal, thermal sleeve base metal, welds and heat affected zones on Section 5-5. The particular locations of the traverses are indicated in Figure 1. All measurements were made employing a Knoop elongated pyramid indenter with a 200 g load. The results of these measurements are plotted as Knoop Hardness Number (KHN) vs distance in Figures 2 through 6. The zones marked "HAZ" in these figures represent the heat-affected-zones that are visually evident in photomicrographs of the metallographic section.

In general, the hardness values measured near the weld fusion lines were noticeably higher than those for base metal (KHN 240-280 vs KHN 184-191). At each weld, the hardness in the HAZ decreased fairly uniformly with distance from the fusion line. The range of hardness beyond the visible HAZ for all traverses was KHN 200-240. This range of hardness is somewhat higher than that measured for safe-end base metal at points remote for the weld.

These hardness traverses indicate that the welding operations have resulted in a general hardening effect in the vicinity of the thermal sleeve attachment. However, the indicated increase is not considered sufficient to markedly influence the toughness or crack susceptibility of the safe-end material.



SAN ANTONIO, HOUSTON, CORPUS CHRISTI, TEXAS, AND WASHINGTON, D.C.

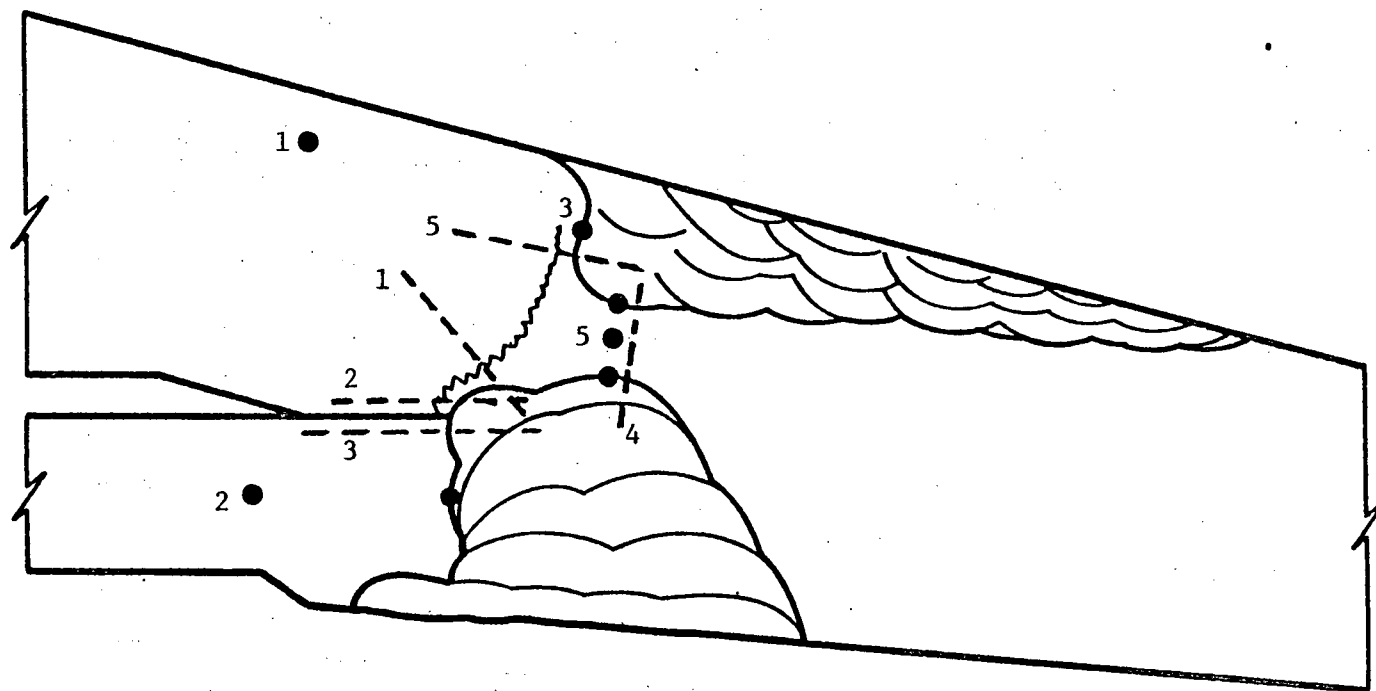


FIGURE 1. DIAGRAM OF REPRESENTATIVE SECTION THROUGH THERMAL SLEEVE ATTACHMENT AREA. Numbered circles indicate metallographic locations. Dashed lines indicate hardness traverses.

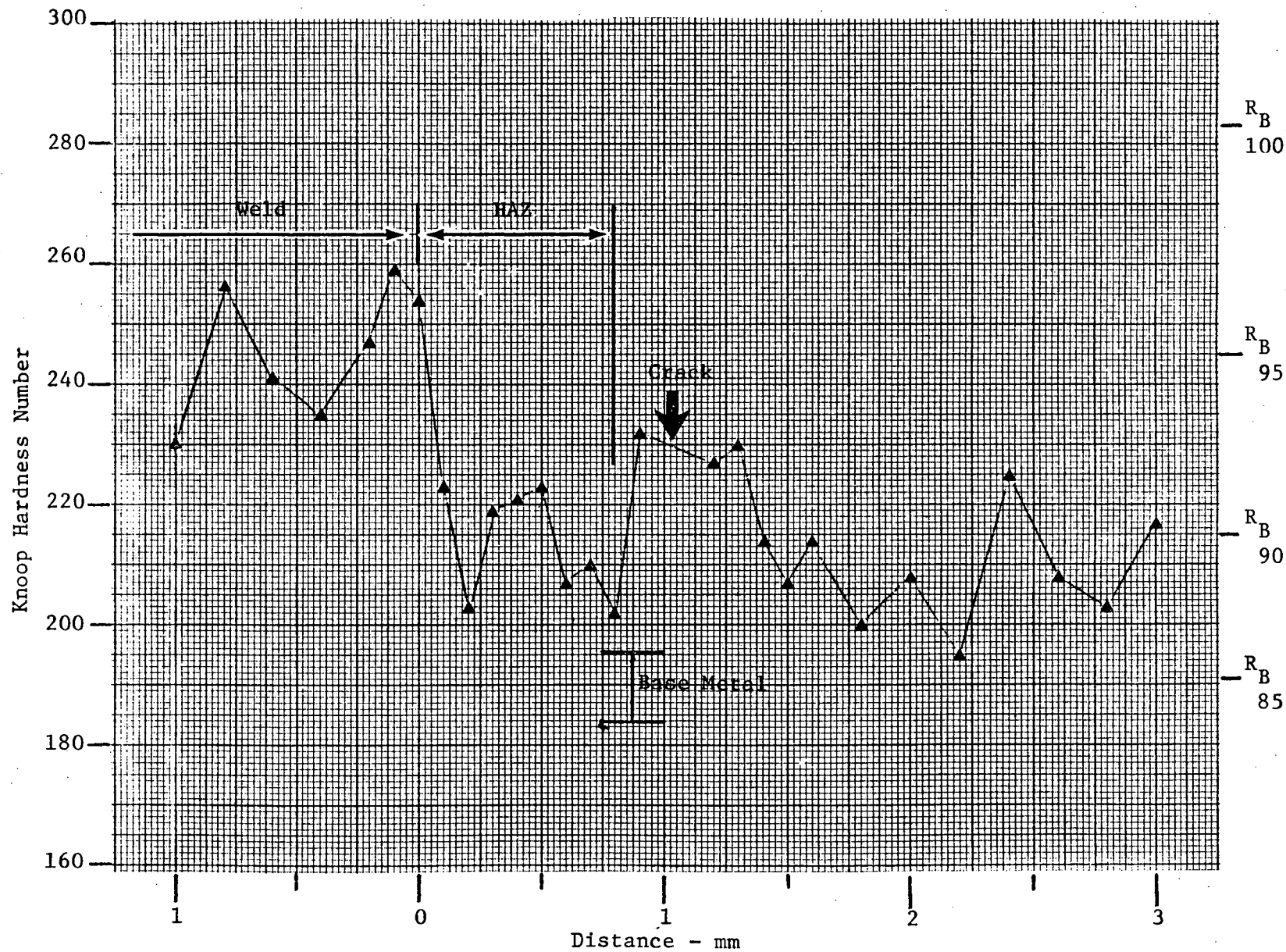


FIGURE 2. HARDNESS TRAVERSE NO. 1. Section 5-5 Thermal sleeve weld to safe-end base metal across crack path.

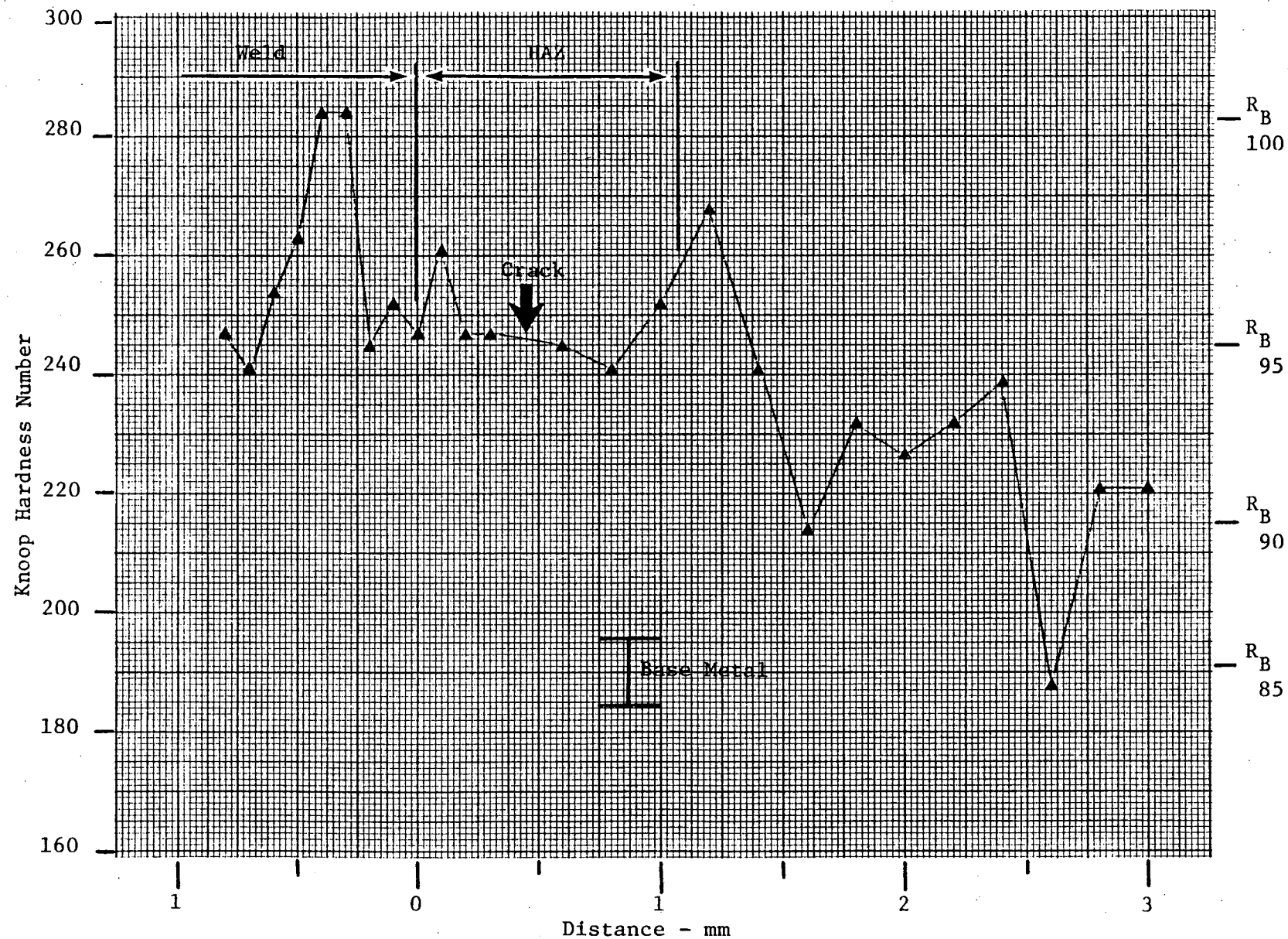


FIGURE 3. HARDNESS TRAVERSE NO. 2. Section 5-5. Thermal sleeve weld to safe-end base metal along crevice.

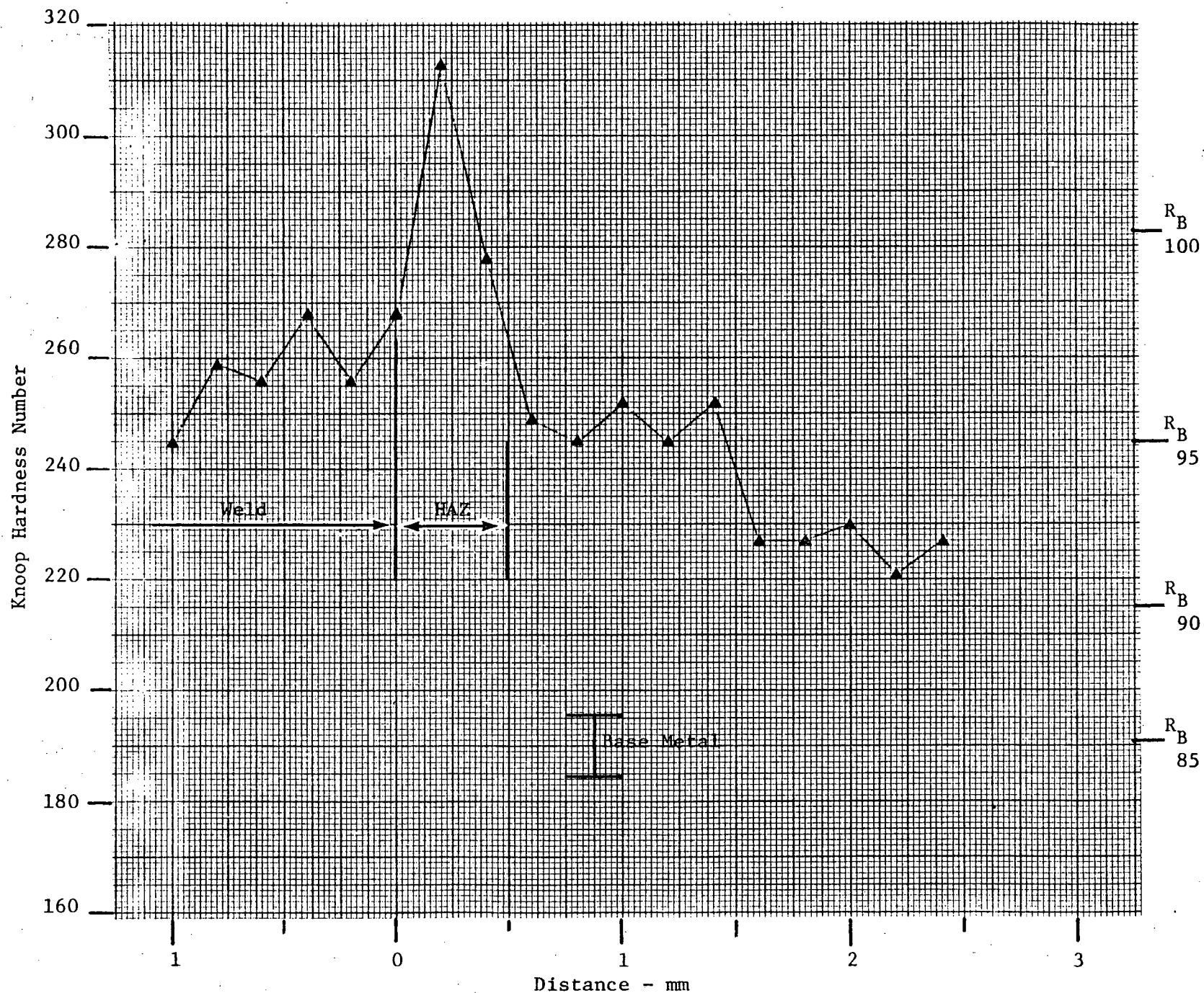


FIGURE 4. HARDNESS TRAVERSE NO. 3. Section 5-5. Thermal sleeve weld to thermal sleeve base metal.

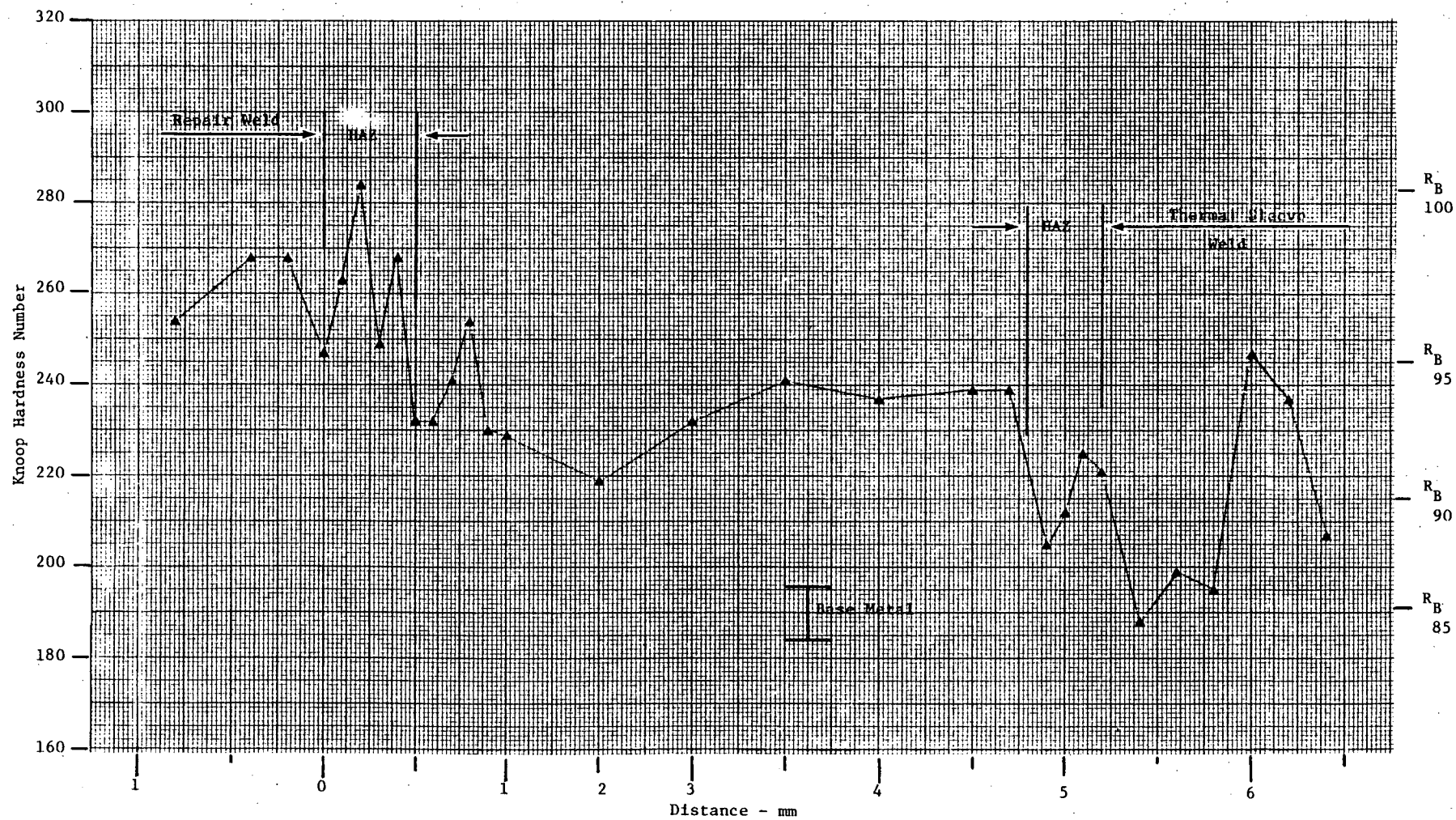


FIGURE 5. HARDNESS TRAVERSE NO. 4. Section 5-5. Repair weld to thermal sleeve weld.

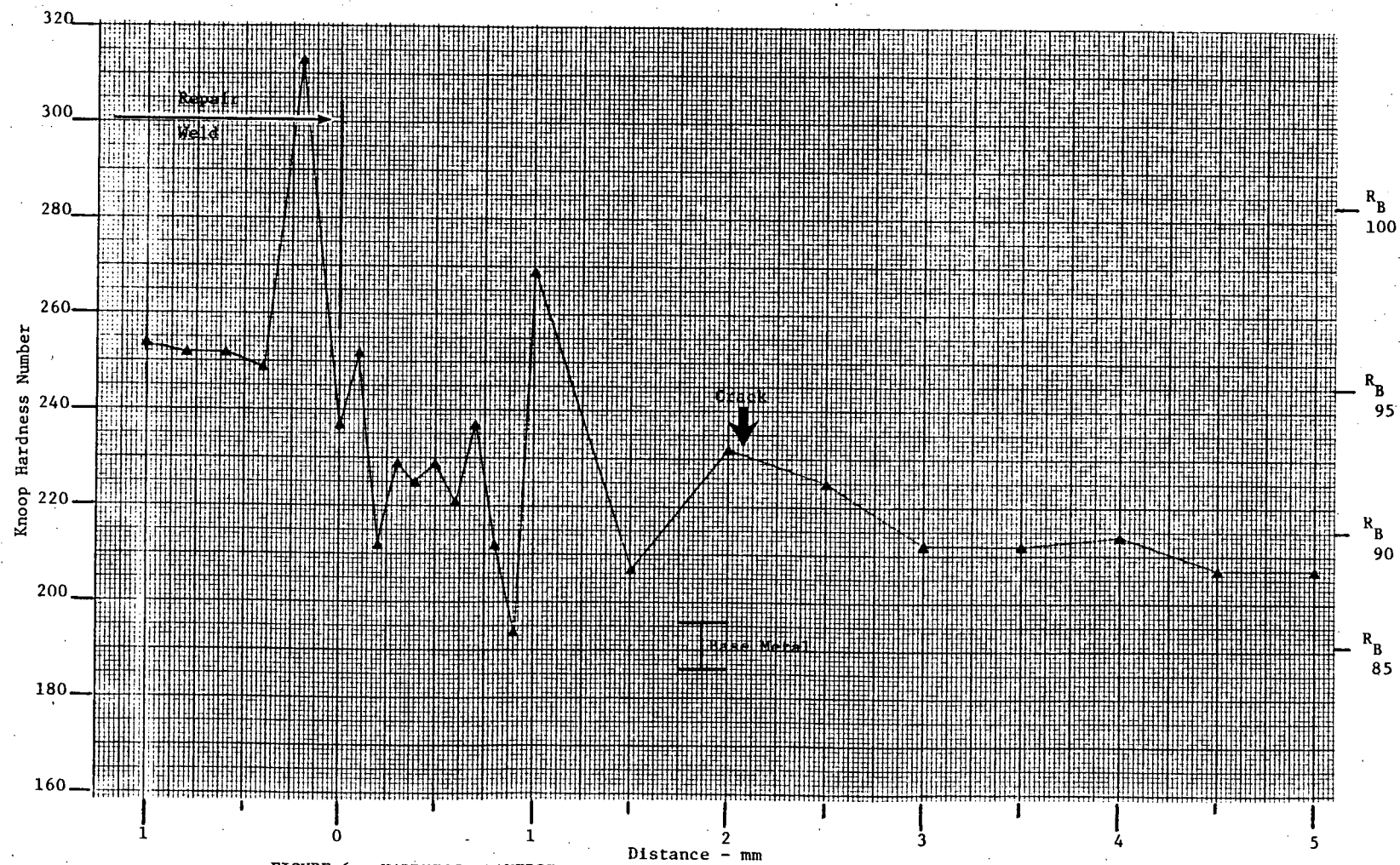


FIGURE 6. HARDNESS TRAVERSE NO. 5. Section 5-5. Repair weld to safe-end base metal.