THE BABCOCK & WILCOX COMPANY

POWER GENERATION GROUP

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NON-PROPRIETARY VERSION

BASELINE INSPECTION OF
OTSG SLEEVED TUBES

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DWN BY	CH'D BY		SCALE	DATE 11/26/84
PASSED BY	APP'D BY	Baseline Inspection of OTSG Sleeved Tubes	DWG NO	A-0

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Baseline Inspection of OTSG Sleeved Tubes

INTRODUCTION

The work presented in this report was performed to document the inspection capabilities of an eddy current examination system employing a standard bobbin coil probe, for the baseline examination of newly installed OTSG sleeves. A primary area of concern was the ability to detect flaws which are located at the expansion transitions, parent tube flaws at the edge of the 15th tube support plate (TSP), and parent tube flaws at the sleeve end edge.

SUMMARY

It is concluded that the bobbin coil inspection system results in an adequate baseline examination of OTSG mechanical sleeves. The and system is capable of detecting all the flaws in standard 49108 (drawing attached - Figure 2) except the 40% through wall (TW) hole at the sleeve end edge. Detectable flaws include a 40% TW hole in the parent tube at an expansion transition, a 40% TW hole in the sleeve at an expansion transition and parent tube flaws at the TSP edge. The area at the sleeve end edge is not considered to be a critical inspection area for the baseline exam because of the preinstallation EC exam, and the fact that no stresses are induced in the tube at this location during installation. For subsequent inspections, it is recommended that any other new applicable developments be evaluated for detecting parent tube flaws at the sleeve end edge.

EVALUATION PROGRAM

Figure 1 is a drawing of a typical installed OTSG mechanical sleeve. Figure 2 is a drawing of the sleeved tube calibration standard used in this evaluation. Figure 3 is a drawing of the "clean" expansion standard which was used to generate mixes to suppress the expansions.

A diameter, differential, bobbin coil probe was used in all examinations. A MIZ-12 and a MIZ-18 inspection system, both with 250 feet of remote cabling and any applicable pre amps, were both evaluated. Several different frequencies and frequency mixes were tried employing each system. Frequencies of between 25 and 250 kHz were evaluated for parent tube defects. Frequencies between 100 and 600 kHz were evaluated for sleeve defects. Various 2, 3 and 4 frequency mixes employing frequencies between 25 and 600 kHz were evaluated for detecting flaws masked by expansions and TSPs. The best system

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and frequencies for detecting all of the defects in the sleeved standard was selected and plots of the flaw indications were made.

RESULTS

Both the MIZ-12 and MIZ-18 were capable of detecting flaws in the sleeve and parent tube in the free span areas. A examination was found to be optimum for and quantifying sleeve defects in the free span areas, using either the MIZ-12 or MIZ-18. A examination was able to best detect parent tube flaws in the free span areas using either system. The exam however, resulted in poor phase separation between flaws of different depths making quantification of flaw depth difficult. (48° between 20% and 100% through wall parent tube flaws). Using the system, the expansion signals saturated unless the gains were set extremely low. Saturated signals are not mixable; therefore, the resulting low gain expansion mix needed for the MIZ-12 system could not detect parent tube flaws. The large dynamic range of the system allows for mixing of the expansion signals without decreasing sensativity. An inspection using the with a mix was capable of detecting a 40% TW hole in the sleeve at the expansion transition (defect B in Figure 2), and a 40% TW hole in the parent tube at the expansion transition (defect A in Figure 2). The mix was set up to suppress the larger expansion in the standard in Figure 3. A second mix was capable of detecting all of the flaws in the parent tube free span while positioning the edge of a TSP sample other each flaw, after mixing to suppress a TSP sample.

Figures 4 through 8 are plots of the EC signals generated from sleeve flaws in the free span region (flaws L, K, J. I and H respectively in Figure 2). All flaws are readily detectable and quantifiable. Figures 9 through 13 are plots of the EC signals generated from the parent tube flaws in the free span region (flaws G, F, E, D and C respectively in Figure 2). All flaws are readily detectable.

Figure 14 shows a plot of the mix EC signal from the 40% TW parent tube flaw in the free span (flaw D in Figure 2).

Figure 15 shows a plot of the mix EC signal from the composite of an expansion and 40% TW parent tube flaw at the center of the expansion (flaw M in Figure 2). Figure 16 shows the center of the expansion only, which clearly reveals the 40% TW parent tube indication. This flaw is easily detectable.

Figure 17 shows a plot of the mix EC signal from the residual of the suppression of the larger "clean" expansion shown in Figure 3. Figure 18 shows the first transition of the "clean" expansion only. Figure 19 shows the second transition of the "clean" expansion only.

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Figure 20 shows a plot of the mix EC signal from the composite of an expansion with a 40% TW parent tube flaw at the first transition and a 40% TW sleeve tube flaw at the second transition (flaws A and B respectively in Figure 2). Compare this signal to Figure 17. Figure 21 shows the 40% TW sleeve flaw at the first transition only. Compare Figure 21 to Figure 18. Figure 22 shows the 40% TW parent tube flaw at the second transition only. Compare Figure 22 to Figure 19. Both of these flaws are detectable.

The differences between the clean expansion EC signal and one with a flaw at the transition is clearly evident. However, it would be beneficial for the analyst to compare any subsequent inspection data to the baseline EC signals from the expansion regions.

Figure 23 shows the mix EC signal to the 40% TW sleeve flaw in the free span (flaw I in Figure 2) from the expansion suppression mix.

Figure 24 shows the EC signal from the TSP sample. Figure 25 shows the EC signal from the TSP edge placed over the 20% TW parent tube flaw (flaw c on Figure 2). Figure 26 shows the TSP suppression mix at the same area as shown in Figure 25. The TSP signal is completely suppressed and the flaw is readily detectable. All of the flaws approximately 20% in the parent tube free span located at a TSP edge were readily detectable.

The only flaw not detectable in the standard in Figure 2 was the 40% TW parent tube flaw at the sleeve end edge (flaw N). Two frequency mixes resulted in large residual signals. Three frequency mixes could suppress the end of sleeve signal but were then not sensitive to the parent tube flaws. Increasing the taper to approximately in length did decrease the residual end of sleeve signal, but not sufficiently. A diameter bobbin with a was available for a limited evaluation. The did give increased sensitivity to parent tube flaws at and was lower in sensitivity at high frequencies to the expansions. A larger diameter probe specifically designed for sleeve inspections may give better results for detecting parent tube flaws at the sleeve end. any new development in the area of sleeved tube examinations may also prove beneficial for better quantification of parent tube flaws.

CONCLUSIONS

The system can be used to suppress expansion signals and still detect flaws at expansion transitions while the system cannot. Therefore, all further conclusions are based on the system using a diameter differential bobbin coil.

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ASME type flaws in the sleeve free span of 20% TW or greater can be detected and quantified.

ASME type flaws in the parent tube free span of 20% TW or greater can be detected and semi-quantified.

ASME type flaws in the parent tube of 40% TW or greater can be detected in the center of expansions and at expansion transitions.

ASME type flaws in the sleeve of 40% TW or greater can be detected at expansion transitions.

ASME type flaws in the parent tube of 20% TW or greater located at TSP edges can be detected.

The I and system can provide an adequate baseline inspection of OTSG mechanical sleeves.

RECOMMENDATIONS

The primary inspection frequency for unsleeved OTSG tubes is. Therefore, for the full length inspection of sleeved tubes, it is recommended that the system be used employing inspection frequencies of

Subsequent examinations should include the same inspection frequencies as the baseline exam and also a review of the baseline data at the expansion regions.

probes should be evaluated for better quantification of parent tube flaws and the detection of parent tube flaws at the sleeve end.

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Figure 1

OTSG MECHANICAL SLEEVE

FIGURE 1

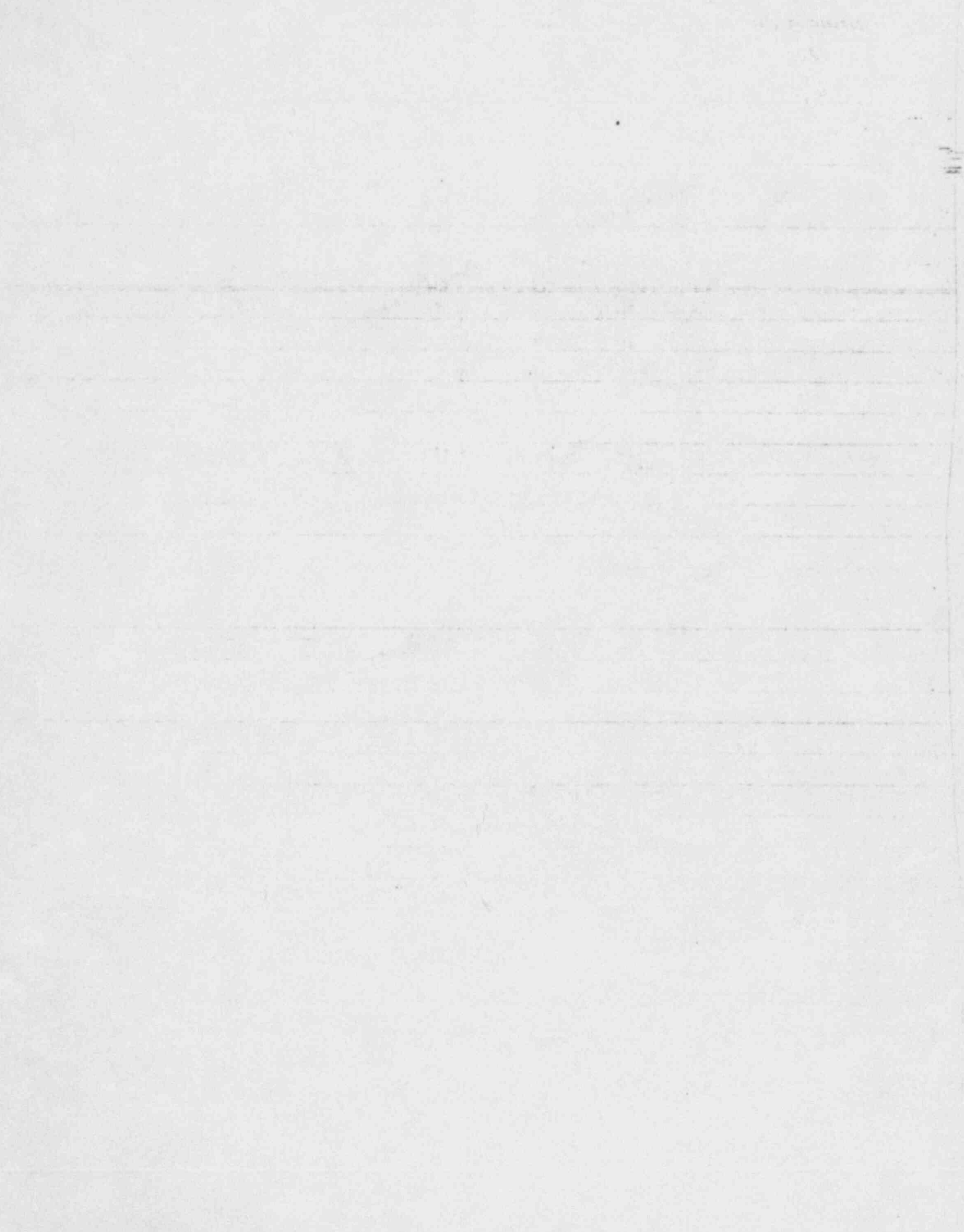

FIGURE 2

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FIGURE 3

AS BUILT

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Issued By	Appd By	OTSG Expansion Standard	

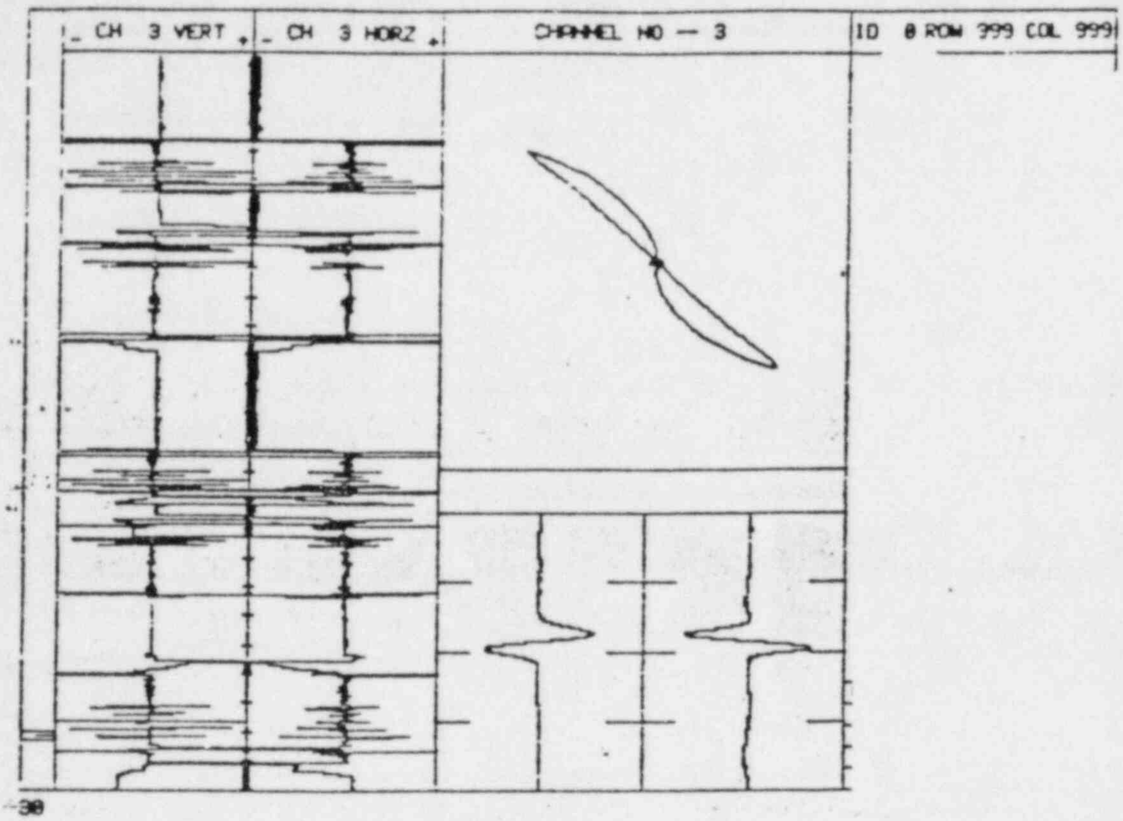

FIGURE 4 - 100% TW, Sleeve Free Span (Flaw L)

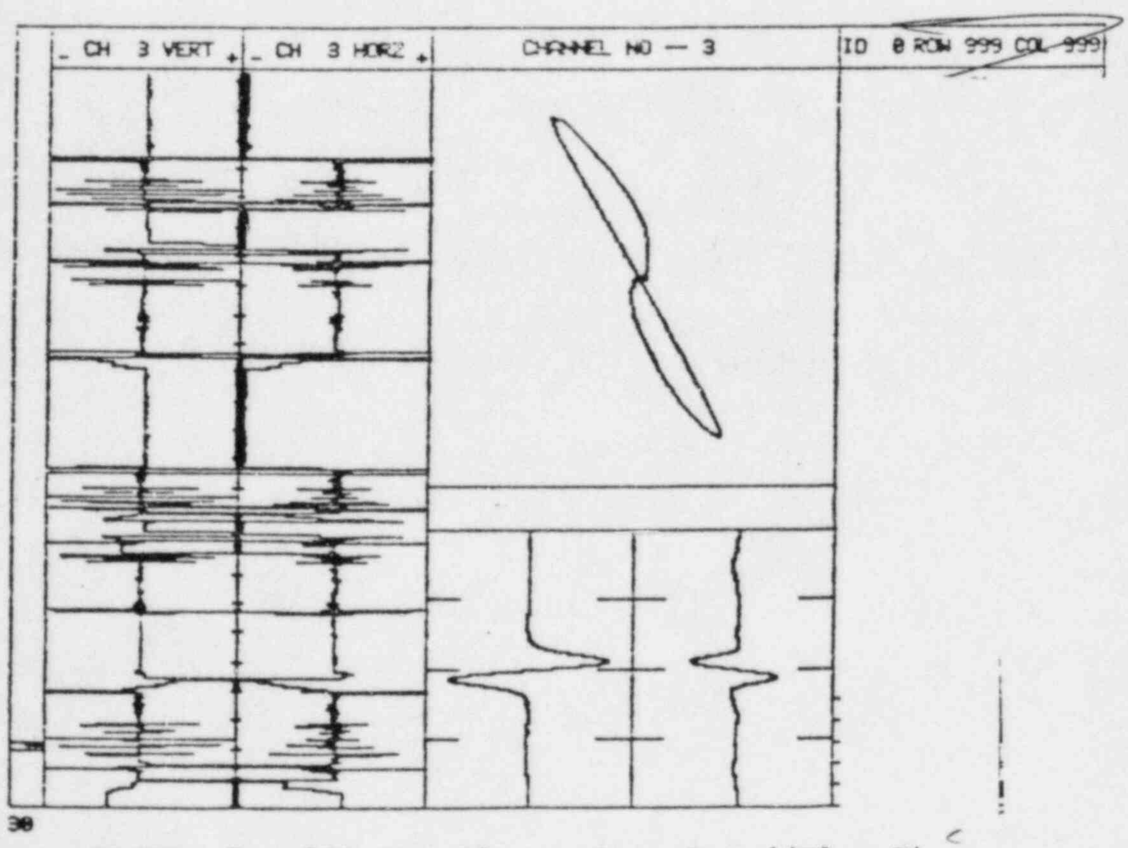

FIGURE 5 - 80% TW, Sleeve Free Span (Flaw K)

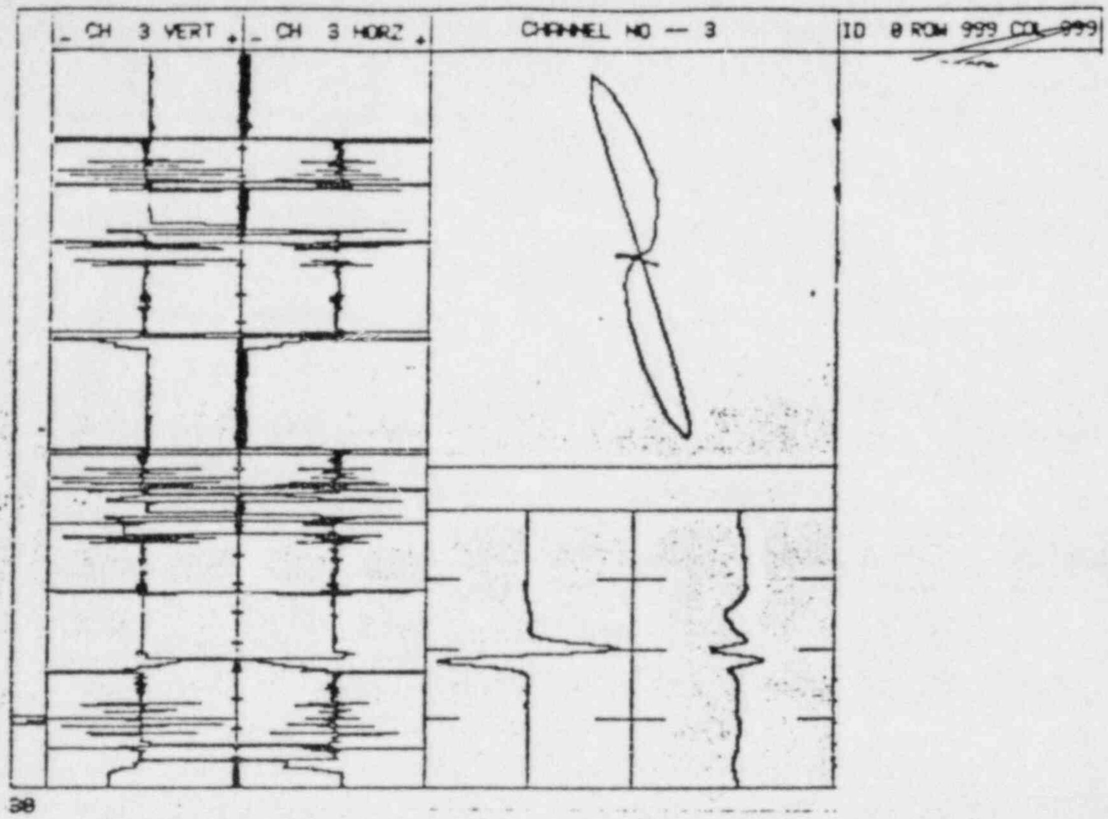

FIGURE 6 - 60% TW, Sleeve Free Span (Flaw J)

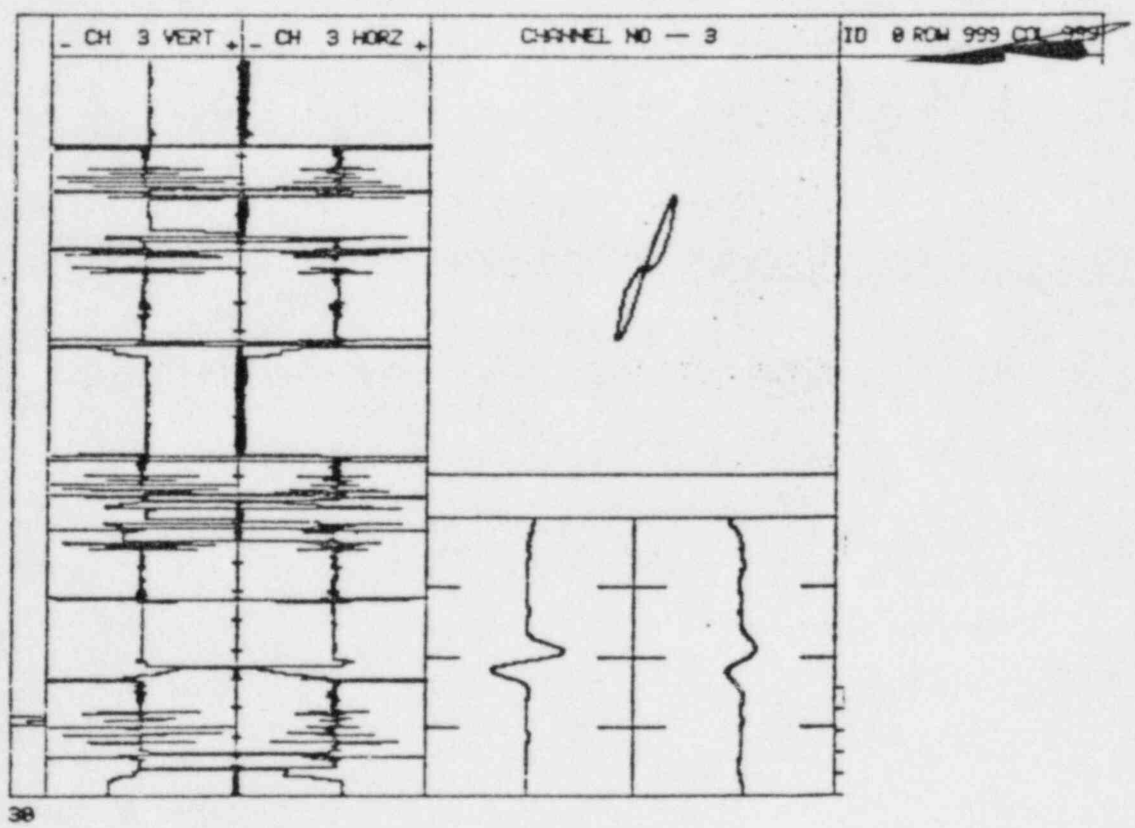

FIGURE 7 - 40% TW, Sleeve Free Span (Flaw I)

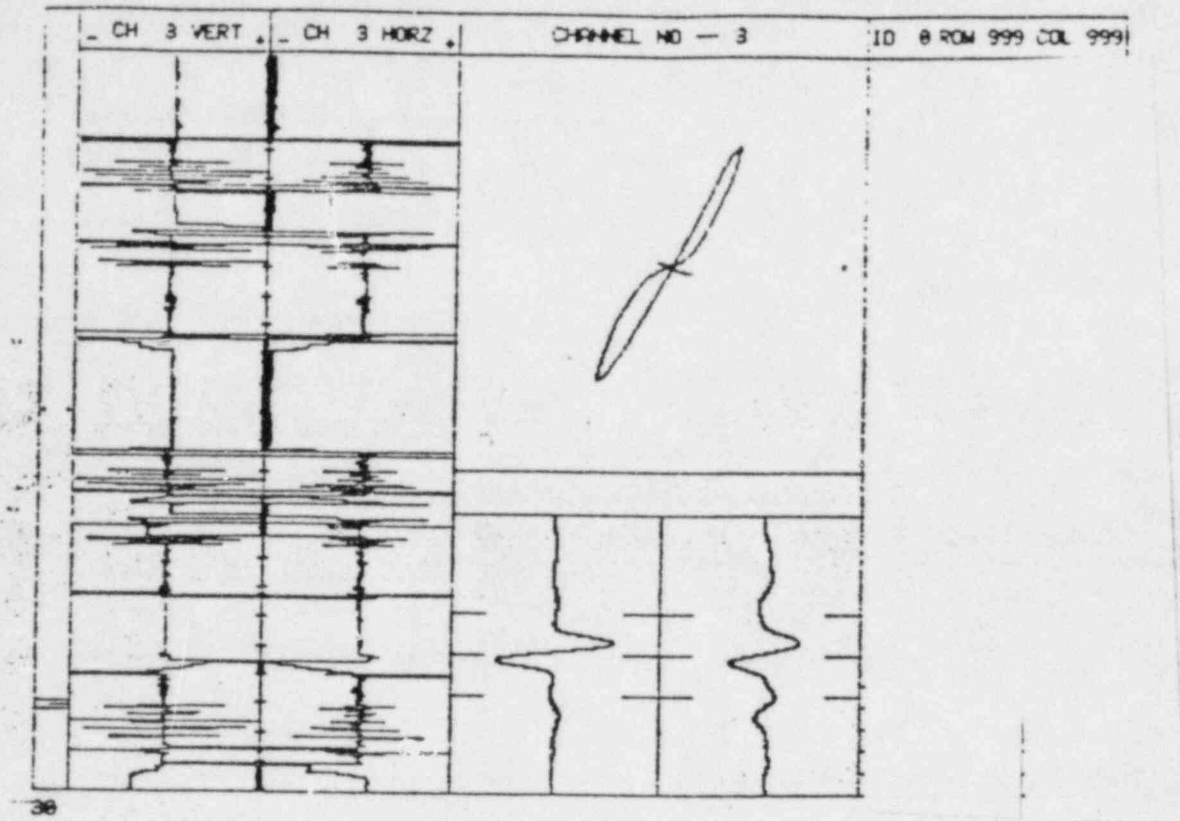

FIGURE 8 - 20% TW, Sleeve Free Span (Flaw H)

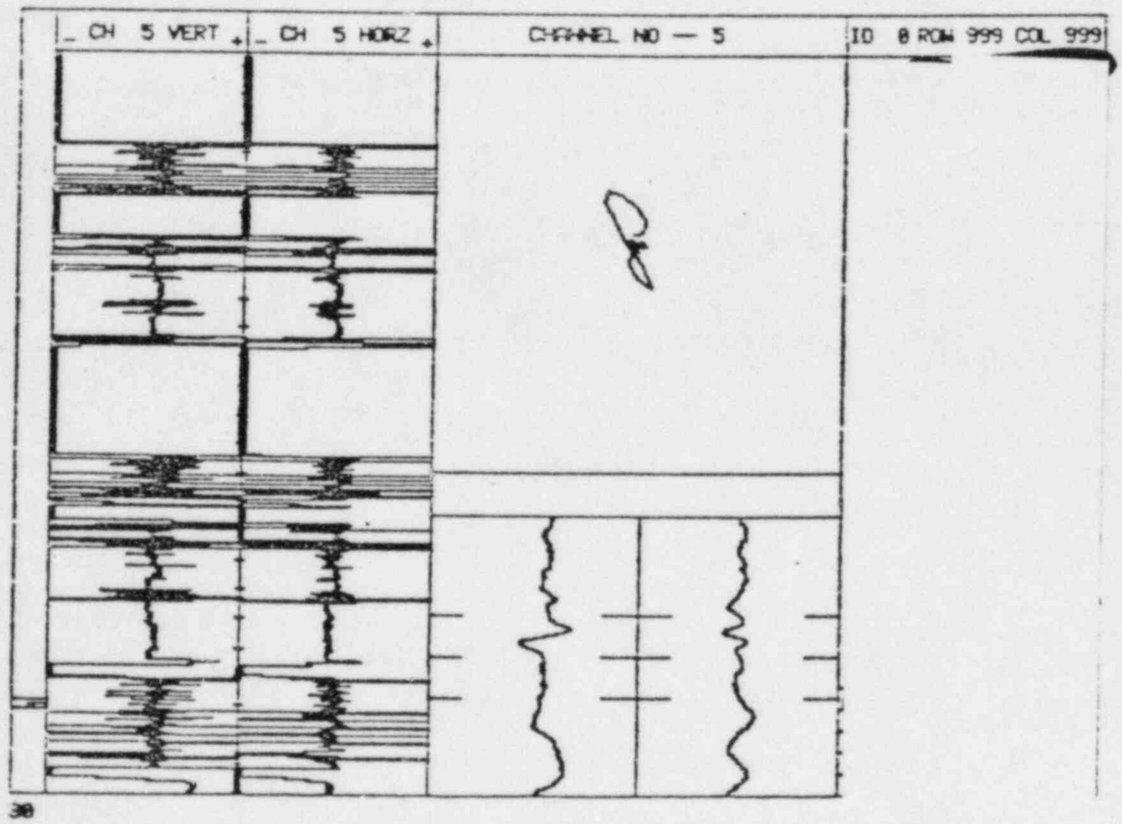

FIGURE 9 - 100T TW, Parent Tube Free Span (Flaw G)

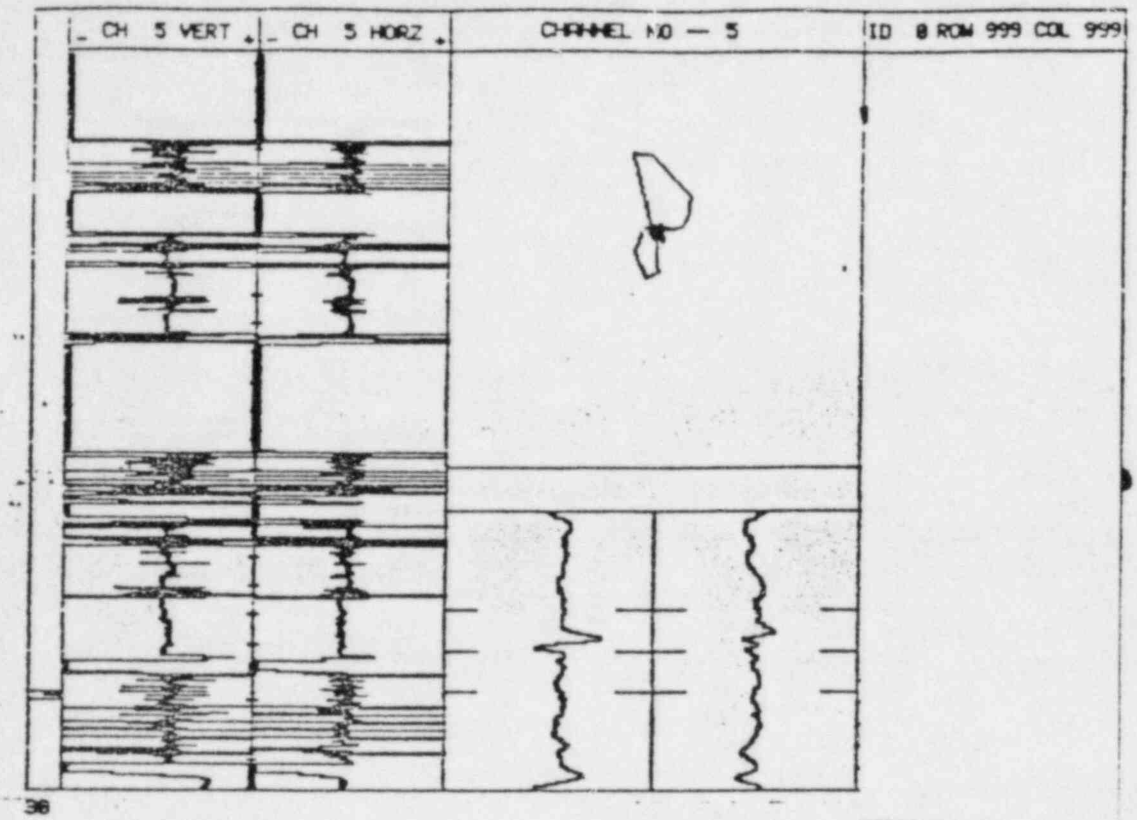

FIGURE 10 - 80% TW, Parent Tube Free Span (Flaw F)

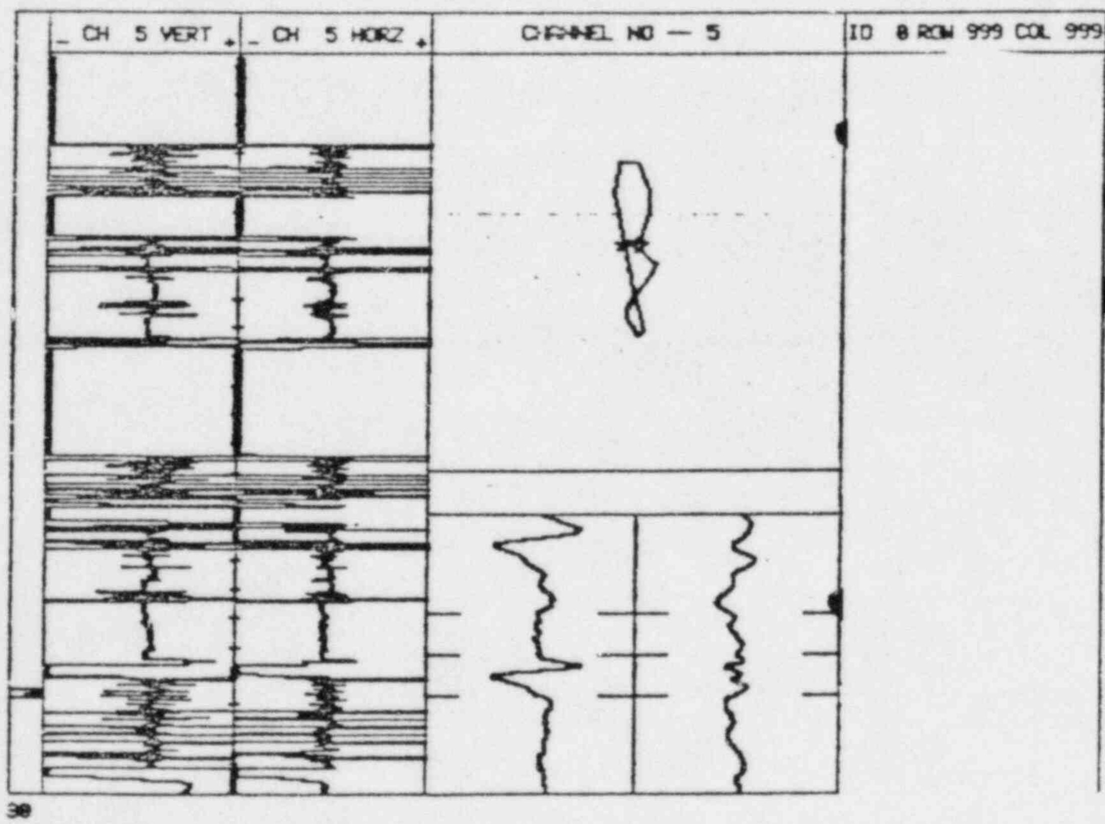

FIGURE 11 - 60% TW, Parent Tube Free Span (Flaw E)

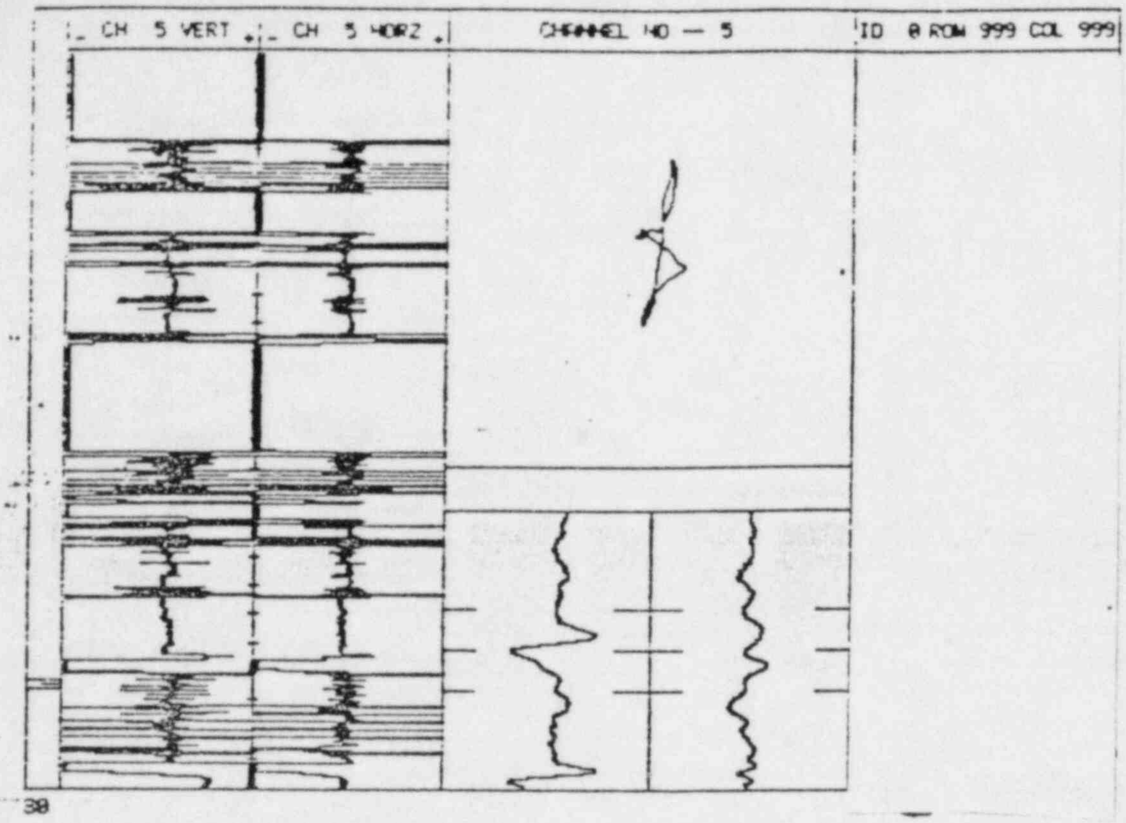

FIGURE 12 - 40% TW, Parent Tube Free Span (Flaw D)

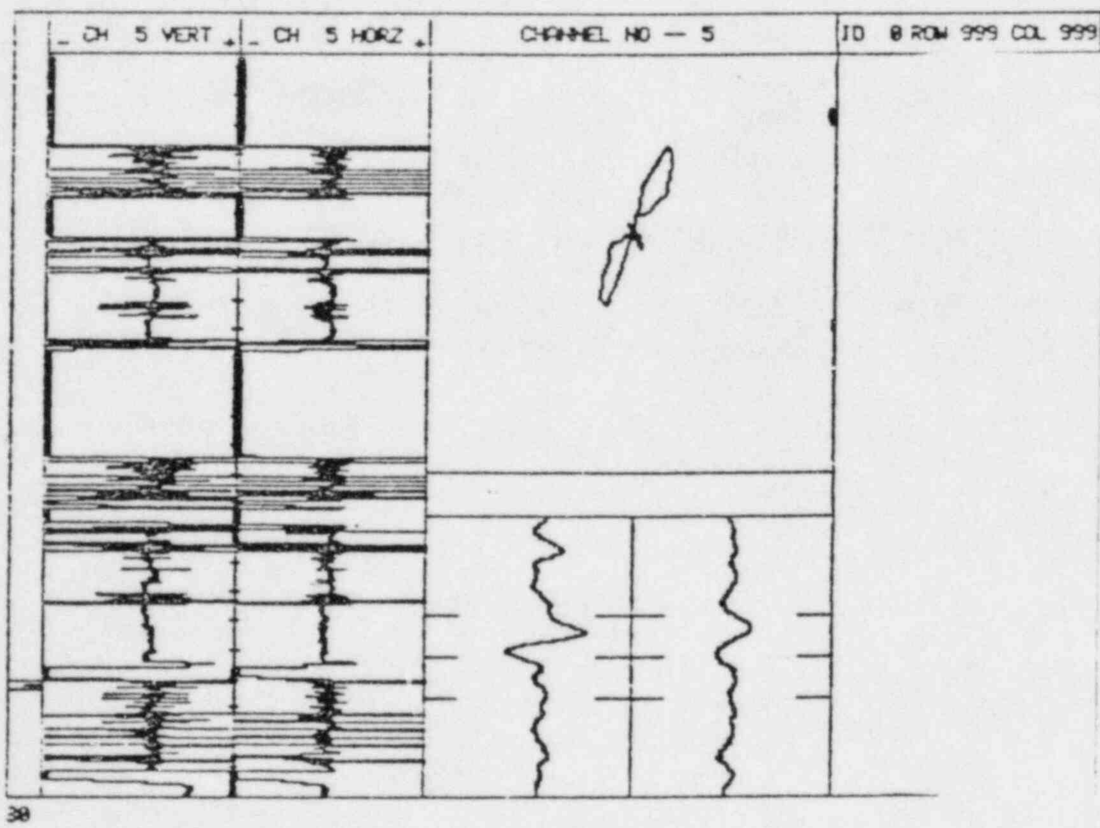

FIGURE 13 - 20% TW, Parent Tube Free Span (Flaw C)

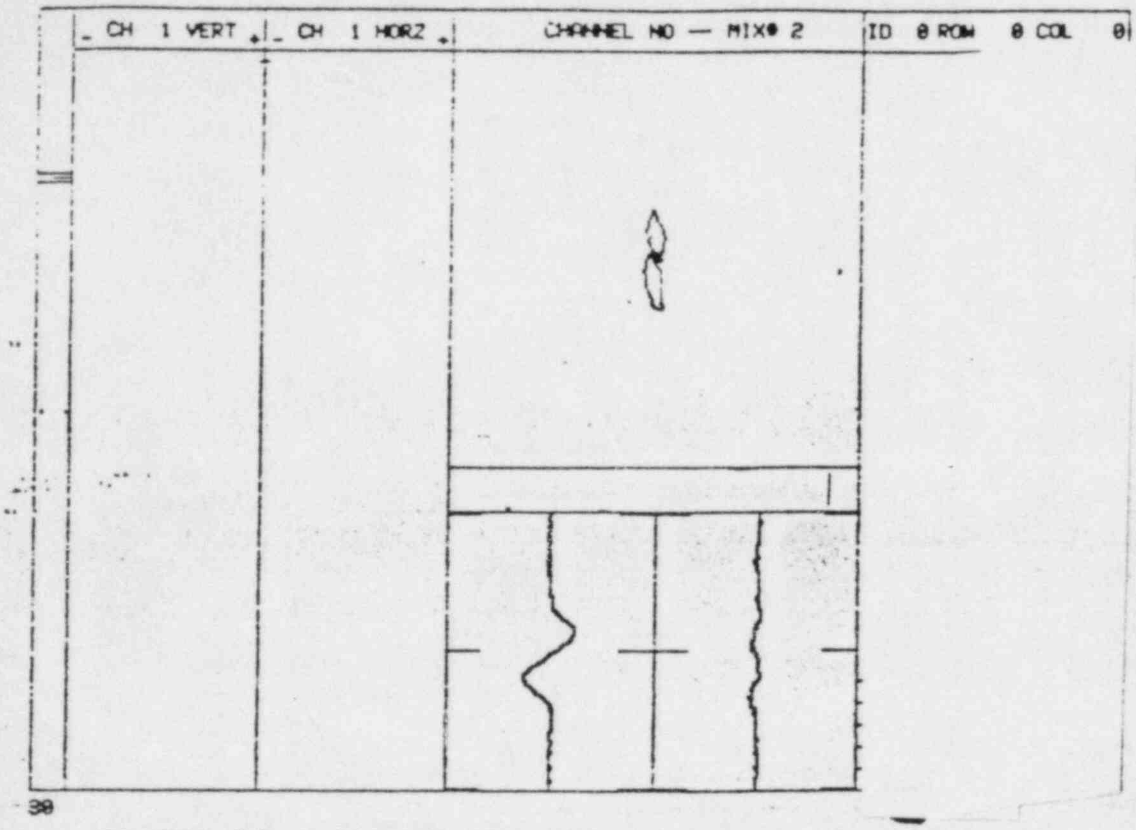

FIGURE 14 - 40% TW, Parent Tube Free Span (Flaw D)

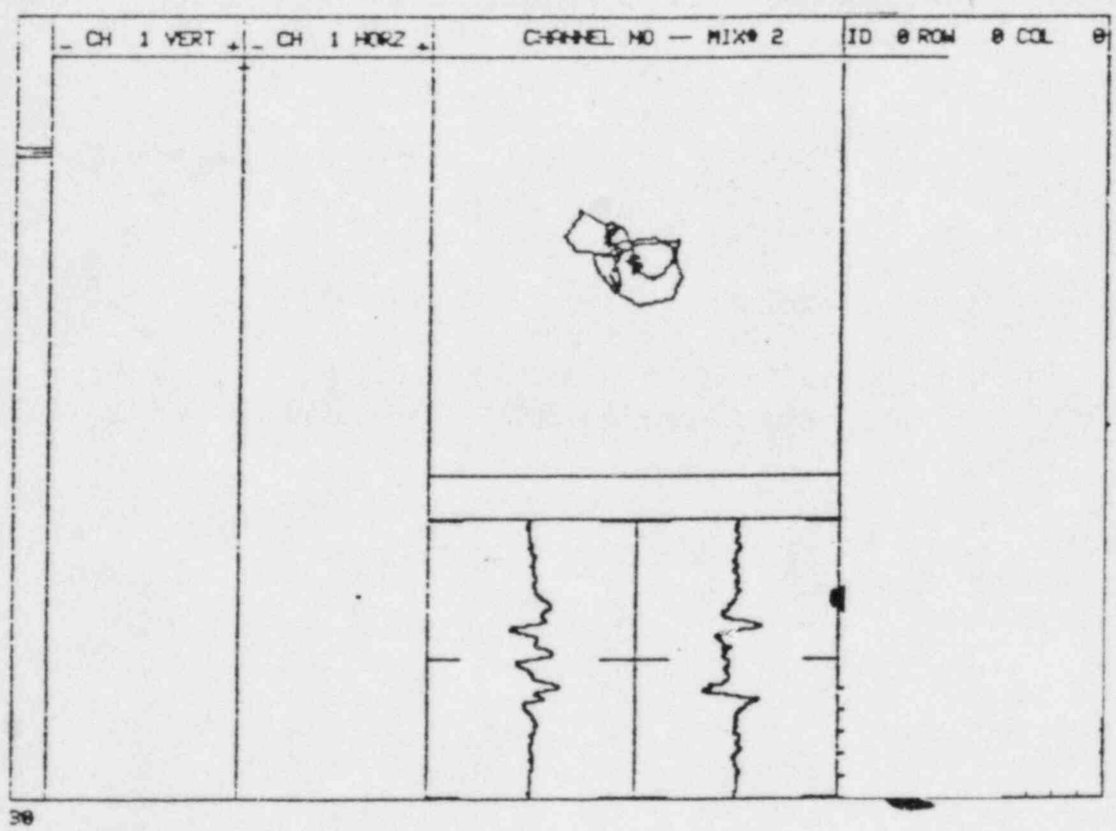

FIGURE 15 - Composite of 40% TW, Parent Tube in Center of Expansion (Flaw M)

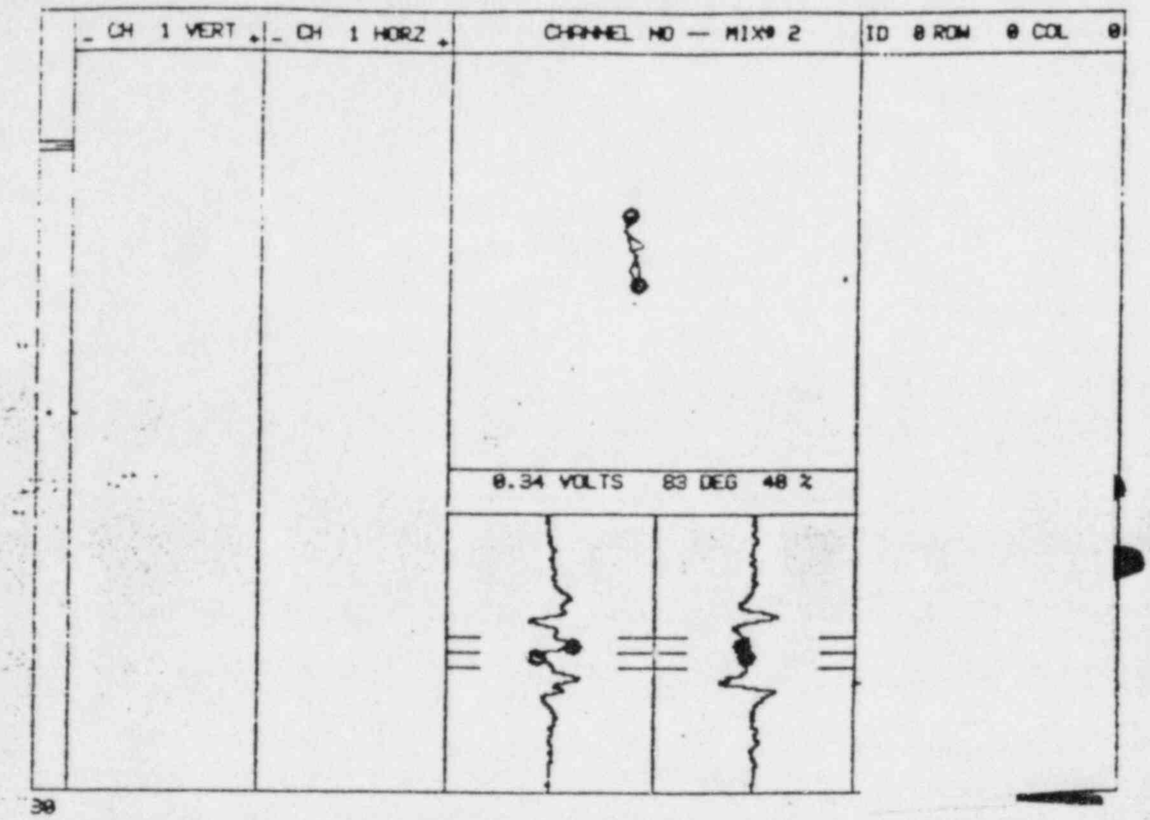

FIGURE 16 - 40% TW, Parent Tube in Center of Expansion Showing Flaw M Only

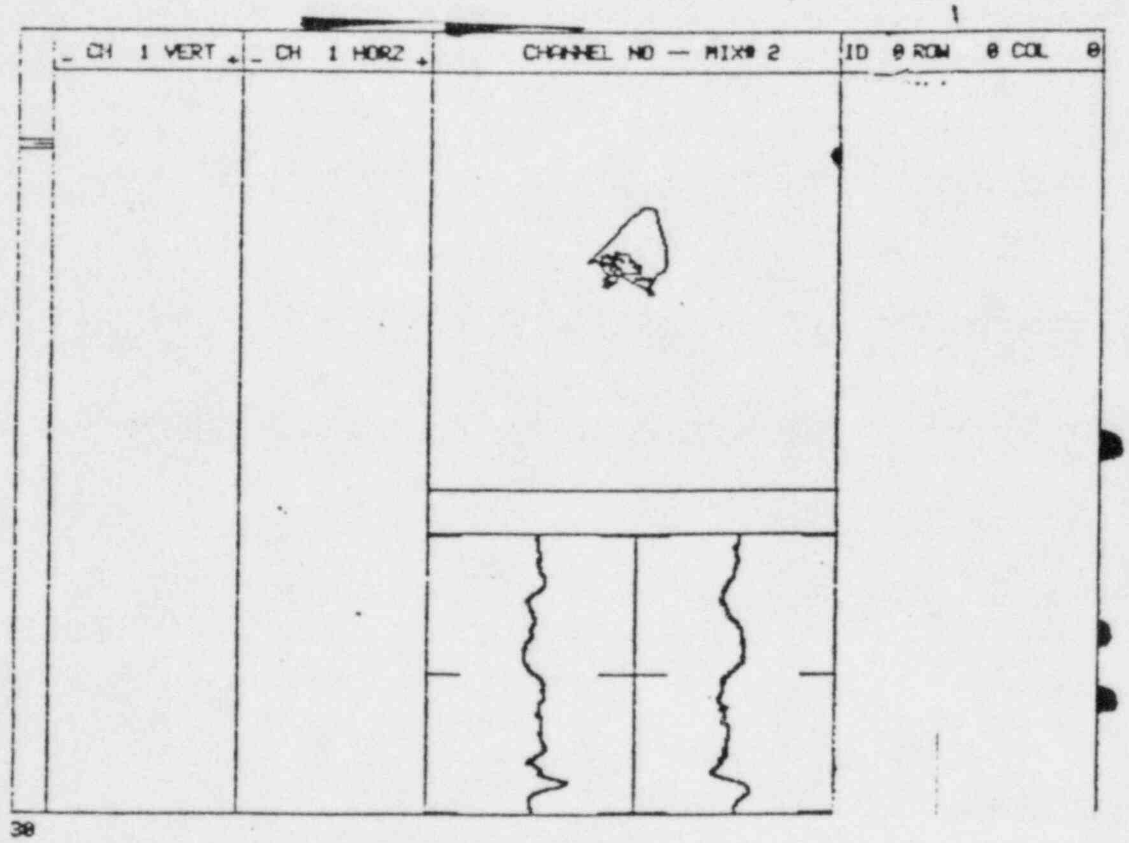

FIGURE 17 - Residual Clean Expansion

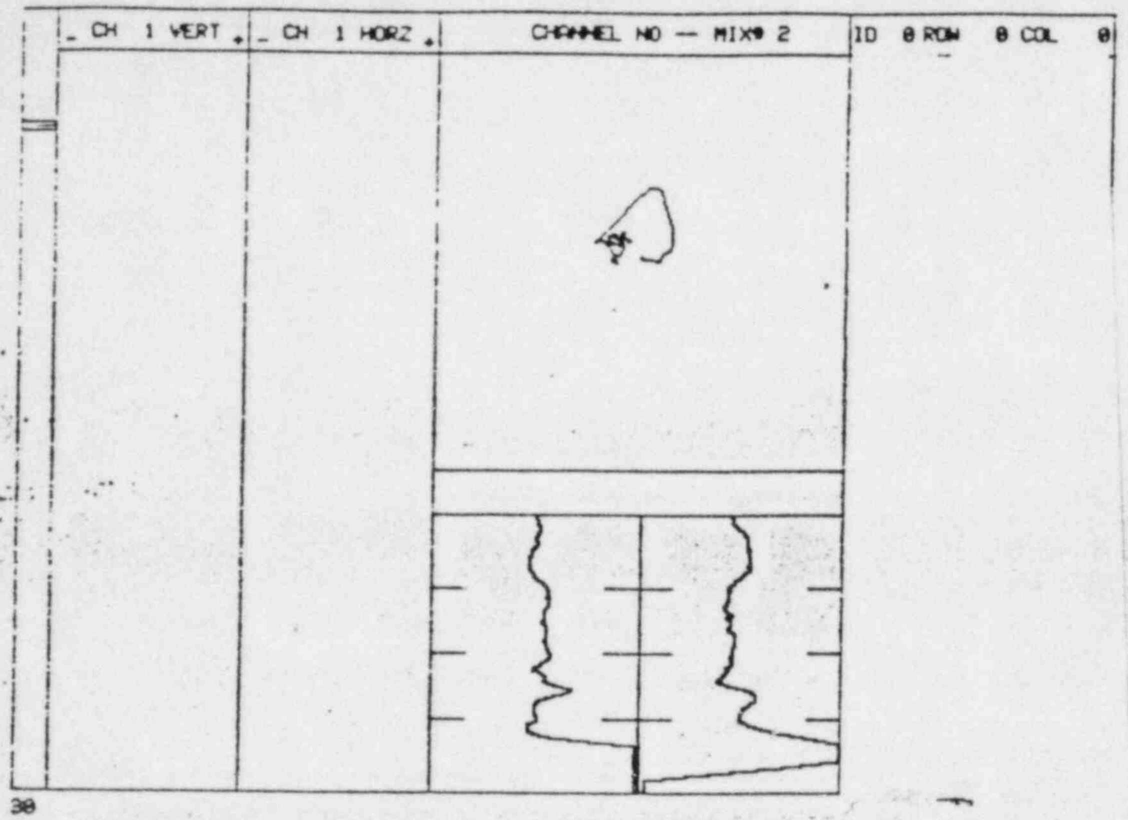

FIGURE 18 - Residual First Transition at Expansion Shown in Figure 17

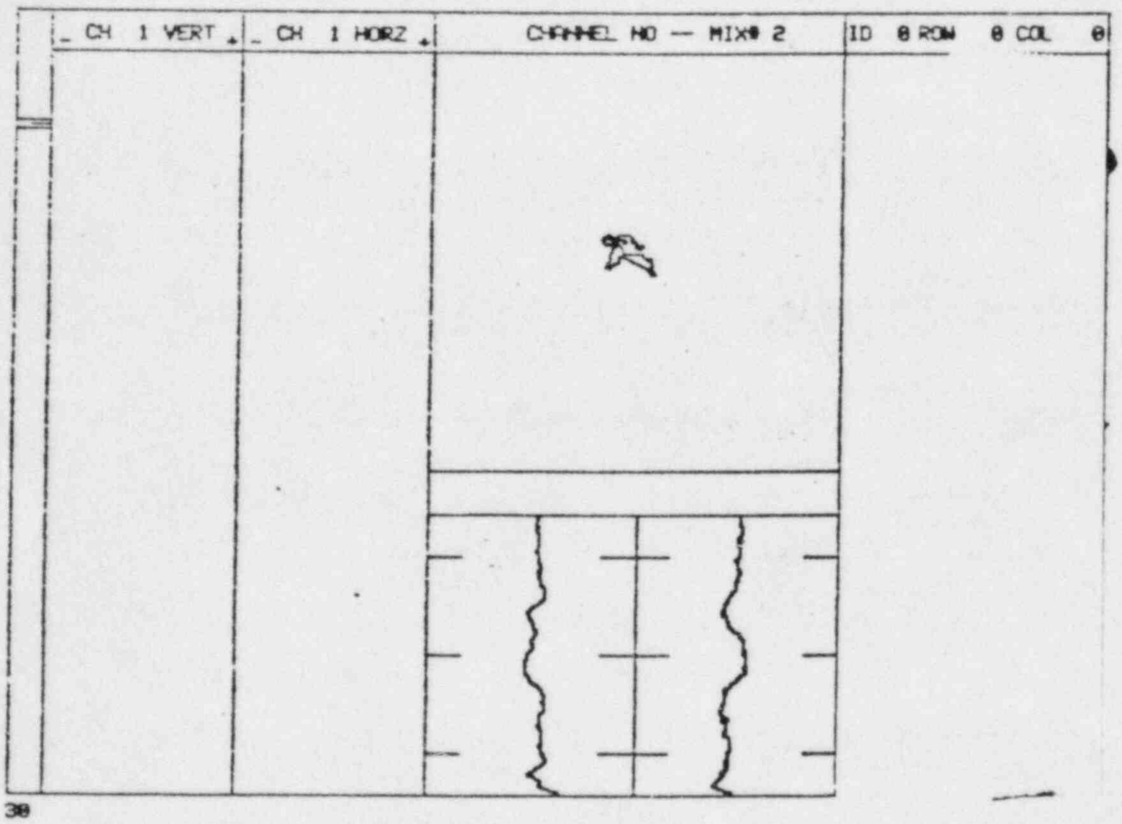

FIGURE 19 - Residual Second Transition of Expansion Shown in Figure 17

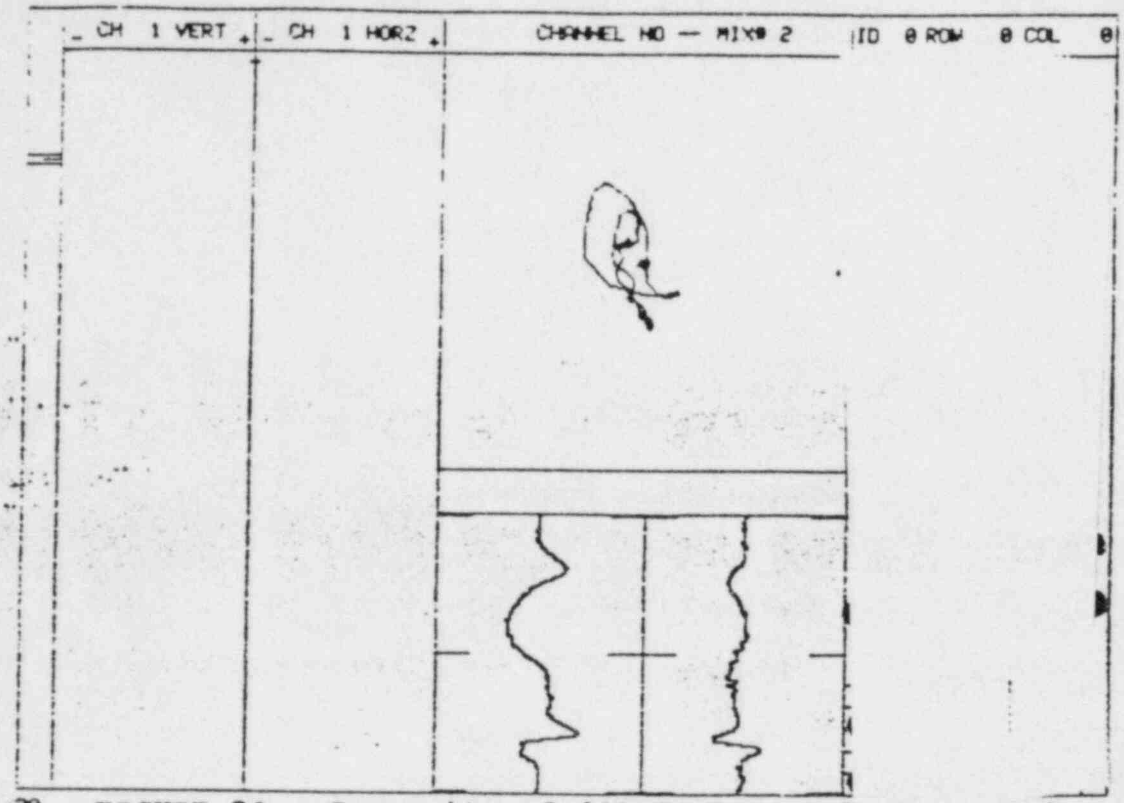

FIGURE 20 - Composite of 40% TW Parent Tube Flaw at First Transition (Flaw A) and 40% TW Sleeve Flaw at Second Transition (Flaw B) - Expansion Suppression Mix

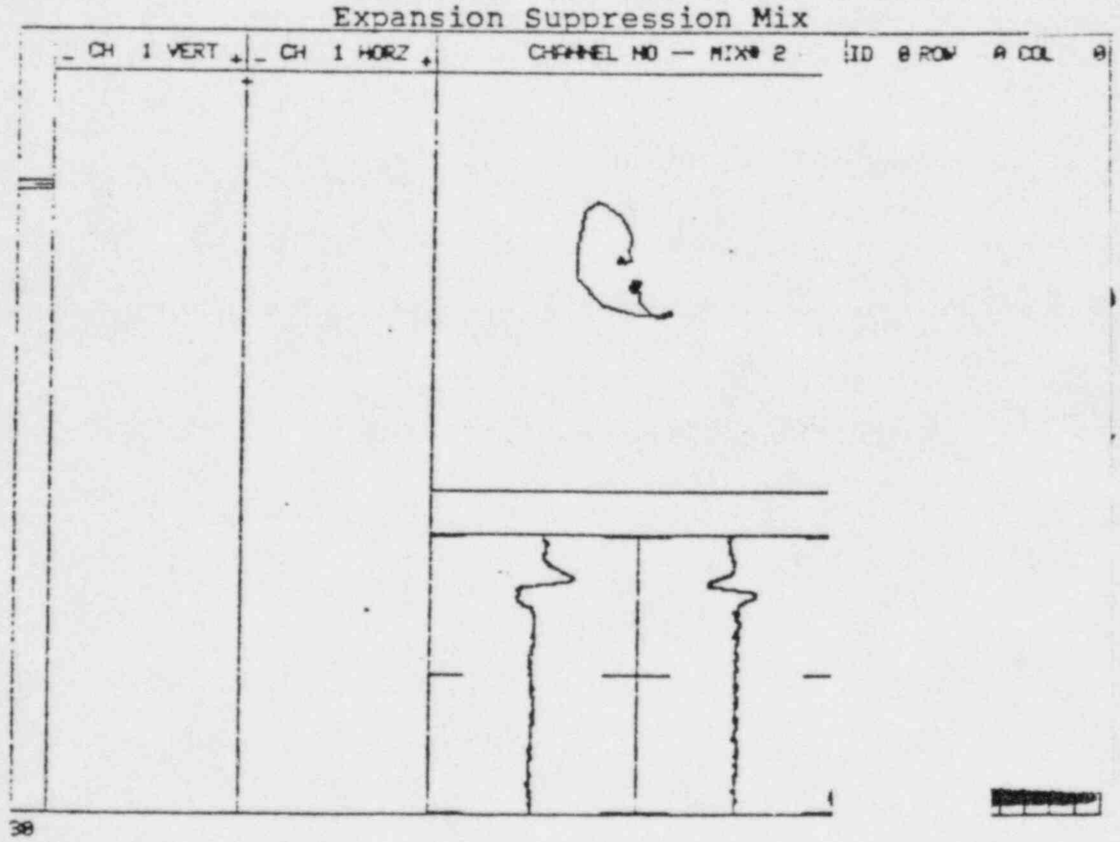

FIGURE 21 - 40% TW Parent Tube Flaw at First Transition Shown in Figure 20. Compare to Figure 18.

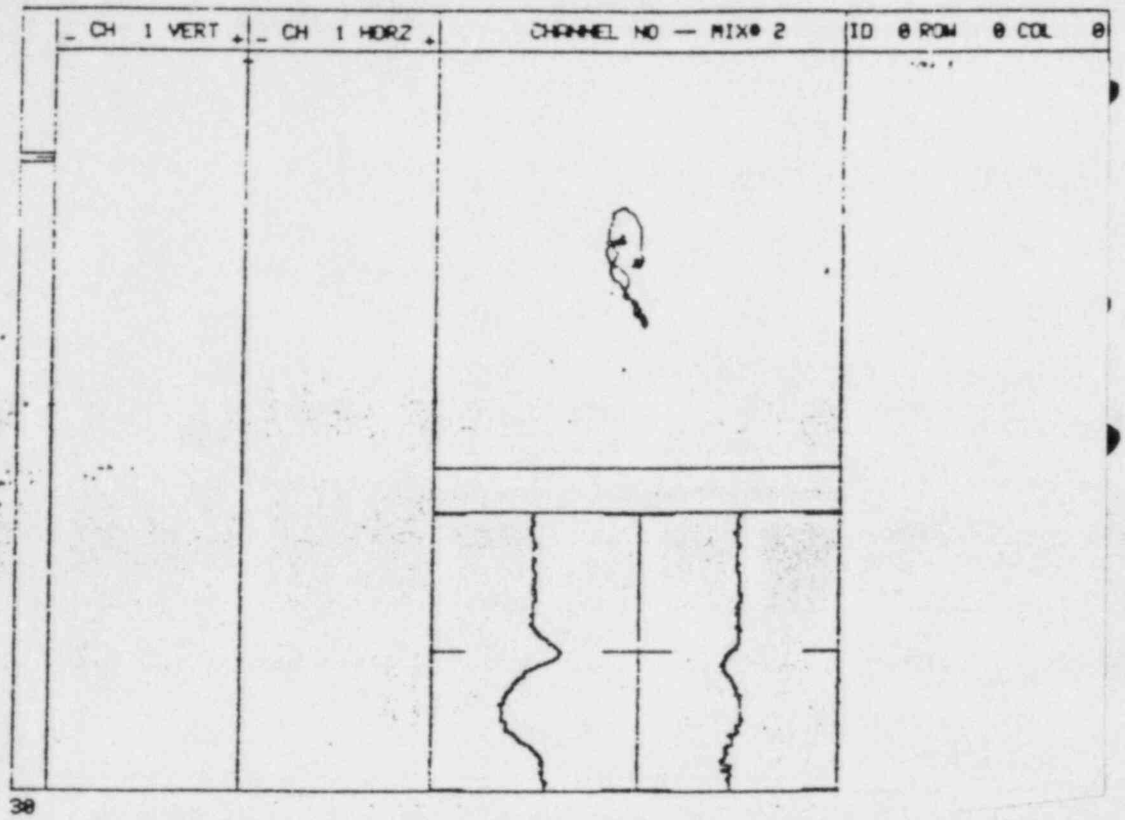

FIGURE 22 - 40% TW Sleeve Flaw at Second Transition Shown in Figure 20. Compare to Figure 19.

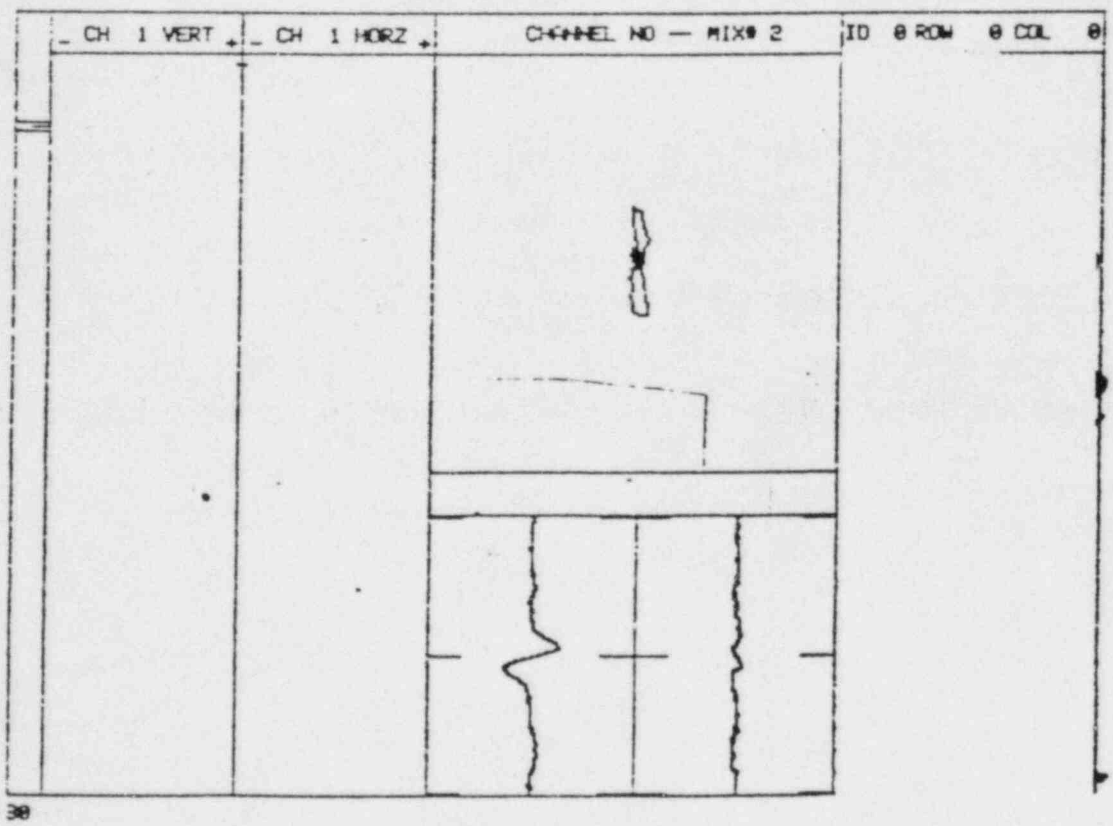

FIGURE 23 - 40% TW Sleeve Free Span (Flaw I)

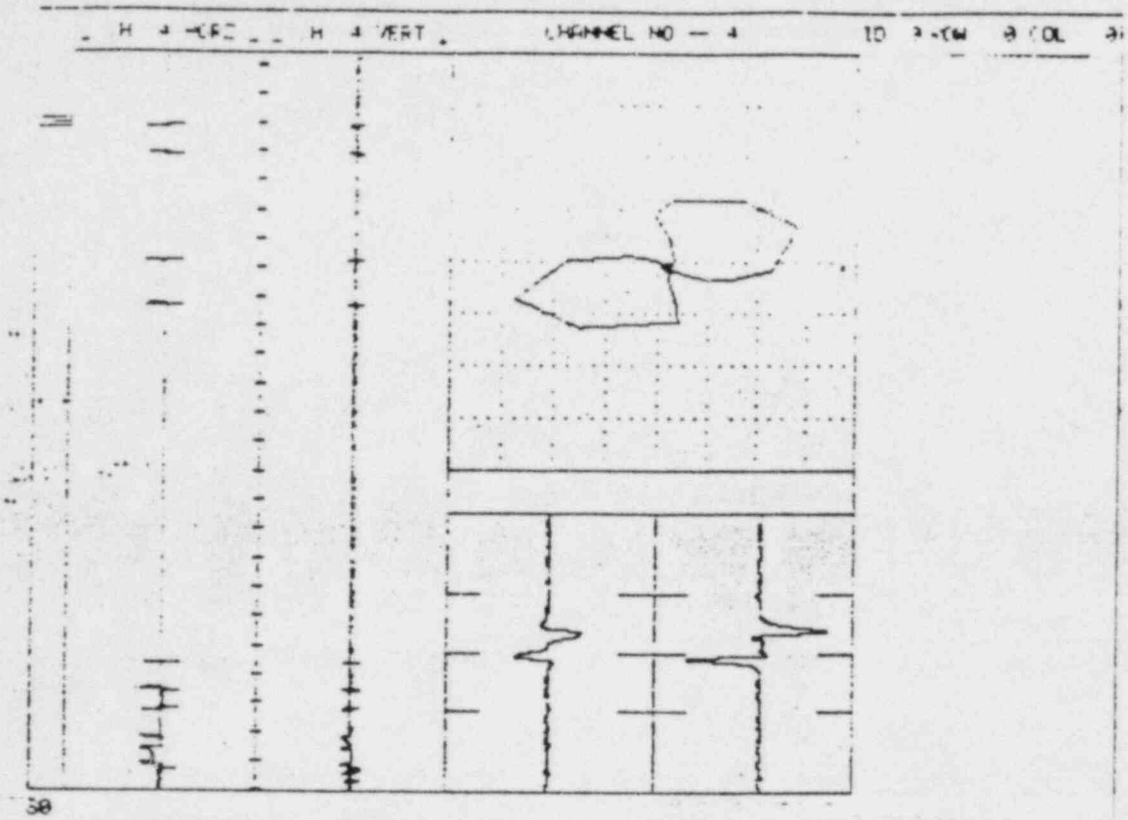

FIGURE 24 - TSP Sample Over Clean Section of Sleeved Tube

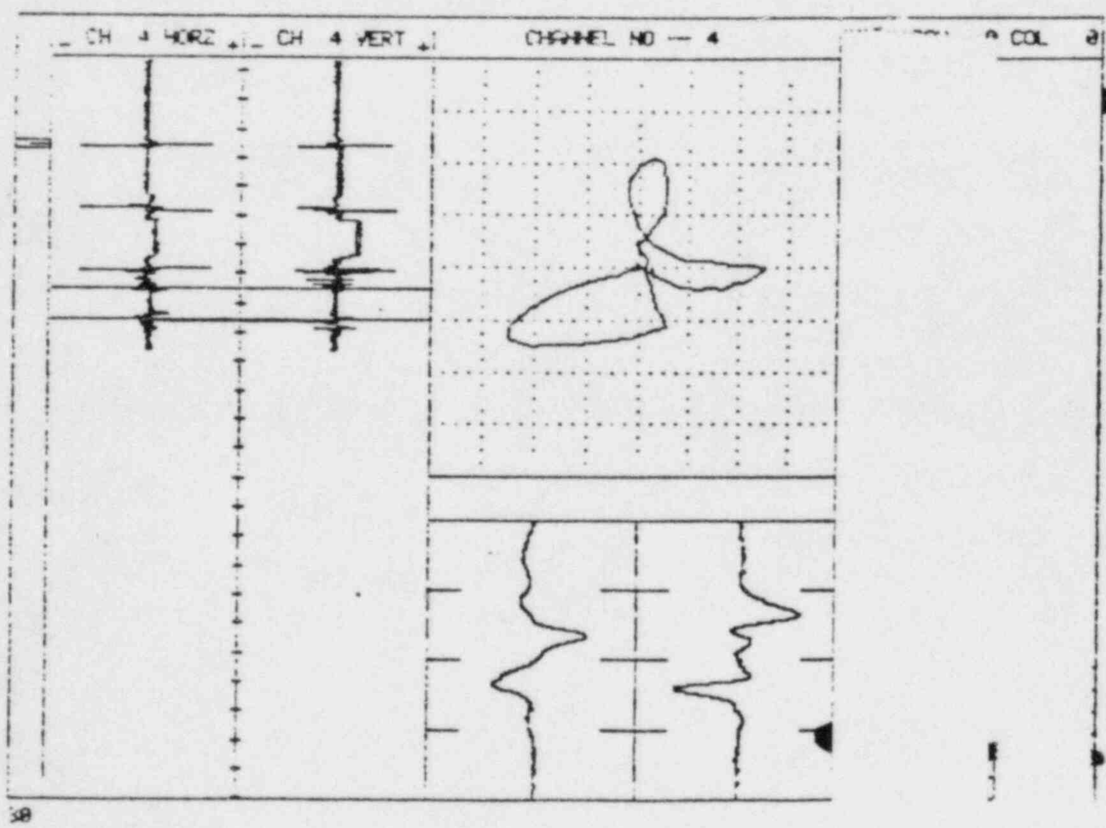

FIGURE 25 - TSP Sample Placed at Edge of 20% TW Parent Tube Free Span (Flaw C)

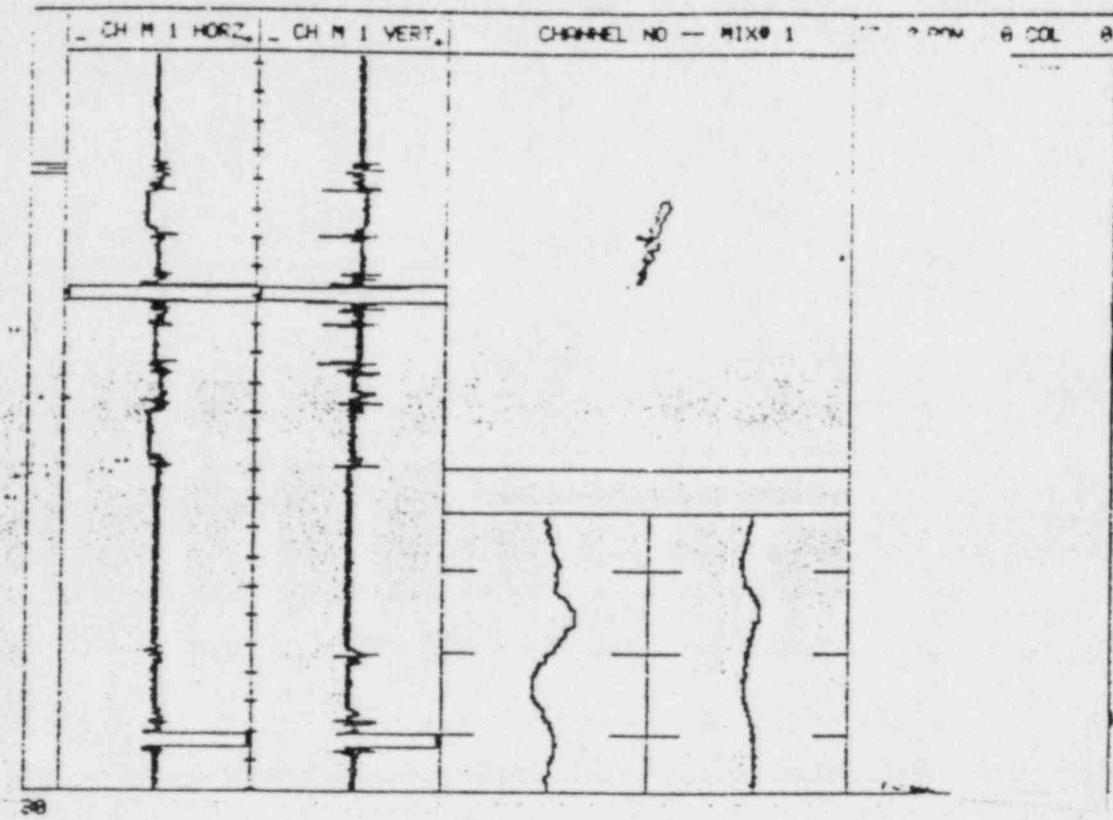

FIGURE 26 - Same as Figure 25. But Using