

# JOINT DISCUSSION OF PAPERS BY J. D. ROSS AND R. W. LEEP, AND W. N. BECK

MR. EDWIN M. MILLER.<sup>1</sup>—In the light of your experiences on bonded materials what is your opinion on whether it is feasible to check metal-to-metal contact such as one tube expanded into another for heat exchange purposes?

MR. GLENN E. FULMER.<sup>2</sup>—Will the ultrasonic test described differentiate between a metallurgical bond and intimate contact? That is, a weak mechanical bond that has no air space present?

MR. W. N. BECK (*author*).—We are liable to get into “hot water” as soon as we start talking about the difference between a metallurgical bond, and a physical bond. If you study the cross section of bonded layers, you can observe the presence of various degrees and types of metallurgical bond.

If you have two surfaces in intimate contact, a percentage of ultrasonic energy can be transmitted through the metal that is being tested.

If the metals are not united, the surface of discontinuity will reflect and will not transmit the energy to the adjacent surface.

Now, with respect to that question, I will try to answer it this way. If you have an intimate contact, a jigsaw type of bond layer, where your metal surfaces

are actually hanging on to each other, you will observe a percentage of transmission through it. However, it is equidistant from actually a good metallurgical bond in that you can discriminate the situation ultrasonically. My experience has been that you can tell basically the difference in the bond; whether or not it is a metallurgical bond.

MR. J. D. ROSS (*author*).—In my opinion you cannot determine the quality of a bond if you are using longitudinal waves. If you can use a shear wave, you may get an idea of the strength of the bond.

In longitudinal vibration the molecules are vibrating on the order of several molecular diameters so that if they are close enough together, they can transmit this mechanical vibration and you will get transmission across the surface. The amount of energy transmitted depends on how close the two surfaces are.

If the surfaces are close enough that ultrasonic energy is transmitted, then I believe that you will get an appreciable heat transfer.

In the case of fuel elements, we are concerned with what happens when it heats up. If you have a bond that is not metallurgically sound, then when it is heated up, this space may actually increase and form a barrier, so that its heat transmission will be reduced.

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