Overview and Purpose

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Overview and Purpose

Abstract
Our purpose in today's session is to discuss procedures for developing accept/reject criteria for NDE methods of inspection. Many of the methods we will describe this morning are not very familiar to members of the audience, so we have deliberately set the session at a fairly leisurely pace so you can assimilate these concepts as they are presented this morning. We would like the session to be relatively informal so we can ask questions and have a fairly extensive discussion period. Following the talks this morning, and after you have had a chance to assimilate some of the details, there will be a poster session immediately after lunch where we're really asking the question, "Are the measurements that are being made in the various labs and institutions in the country really the appropriate measurements to fit within the accept/reject framework you will have heard described this morning?" Then, finally, after the posters are completed, there will be a general discussion whereby we will all assemble again to ask the question, "Are the right measurements being made; if not, what other measurements should be made?" and general questions of that nature.

Keywords
Nondestructive Evaluation

Disciplines
Materials Science and Engineering
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Since it is partially a pictorial session this morning, I thought it might be worthwhile, before getting into some detailed talks, to very briefly acquaint you with some of the concepts involved in the development of accept/reject criteria.

There are at least three components involved in the development of accept/reject decisions. There is the nondestructive measurement, which is the area that most of you are very familiar with. Secondly, one needs to understand the fracture condition; how does fracture occur from the defect that you have been measuring? There is also a need to obtain information about the typical populations of defects that occur within the materials. Once one has acquired information on these three aspects of the problem, then one is allowed to make an accept/reject decision. It turns out that, by necessity, we end up with a probabilistic form of analysis. There are error functions associated with each of the above aspects, which require that the problem is probabilistic in character. Further, one can develop probabilistic accept/reject criteria from one of several data bases. Empirical data can be used which must include data on the three aspects that I described earlier. One can also use physical models for the measurements (such as the scattering from defects) and for the failure modes (such as fracture mechanics of the defects). Optimal, one would like to combine physical models of each aspect of the problem with empirical data to achieve the best possible accept/reject decision making.

Let me describe, very quickly, before we get into the first talk, roughly the sort of thing that needs to be done in order to develop an accept/reject decision. The case in point is one which is of great interest to most of you, i.e., the case in which we have isolated non-interacting defects in the material. We will be inspecting that material in some fashion and trying to estimate its failure probability. It turns out that, firstly, one tries to estimate defect dimensions from the inspection process. Secondly, one tries to estimate from the defect dimensions what the fracture condition will be, that is, what is the time-to-failure for a particular stress. Thirdly, one needs to know (or have some knowledge of) the a priori distribution of defects in the component. This means that one needs to know the probability of a defect of a certain type occurring within the volume of the component that is being fabricated. These three pieces of information need to be appropriately combined to form the accept/reject decision base.

There is another further thought that must be mentioned here. One can apply dollars to the rejection probability and dollars to failure probability. When one starts to apply dollars in that fashion, one can get a total expected cost which includes the cost of the inspection and includes the cost of a failure. This curve will generally show a cost minimum. It is this minimum cost, of course, which specifies the inspection level that should be chosen for your inspection if dollars are ultimately the important parameter involved.

The different talks today will emphasize different aspects of the problem. Some will emphasize, almost exclusively, the use of empirical data. Others will emphasize, almost exclusively, the physical models and others will try to combine those two in the best fashion that is presently available.