

FRACTURE MECHANICS OF METALS, COMPOSITES, WELDS, AND BOLTED JOINTS

Application of LEFM, EPFM,
and FMDM Theory

Bahram Farahmand, Ph.D.

Boeing Technical Fellow

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failure. An overview of different **non-destructive** inspection techniques is presented in section 1.6.2

1.6.2 **Non Destructive** Inspection (NDI)

Non-Destructive Inspection (NDI) can be defined as the use of **non-intrusive** methods to determine the integrity of a material or structure. Many **non-intrusive** methods have been developed to evaluate materials for property determination, to verify quality of workmanship, and to screen a component for the existence of flaws. A flaw, in this sense, can be considered as any nonconformity that exceeds an established size criteria. Improper NDI inspection methods for flaw detection, or lack of interval inspections on fracture critical hardware can lead to premature failure of structure and loss of life.

Flaw detection is by far the most important aspect of NDI in regards to safe-life assessment of fracture critical parts. Fracture mechanics analysis assumes the existence of a maximum flaw size in the part that grows in a stable manner during its service life. NDI provides the assurance that a flaw larger than the identified maximum size does not exist in the part. From a safety perspective, the initial assumed crack lengths provided by the NDI methods are larger than any pre-existing flaw that could be present in the structure after inspection. However, the degree of conservatism as a result of the larger initial crack size assumption (used to evaluate the life) must be realistic enough not to impact the structural weight or cause unnecessary rejection of parts.

There are numerous NDI methods utilized for flaw detection in structural components [40]. Although many specialized methods are developed for specific materials and configuration, most techniques are variations on a few general methods which use visual enhancement of defects or measure some form of energy transmission through materials and its interaction with defects. The most prevalent of the NDI techniques commonly used in the detection of flaws in aerospace and aircraft components are: liquid penetrant, magnetic particle, eddy current, ultrasonic, and radiography. The purpose of this section is to briefly describe the different NDI methods, to explain in simple language the physical phenomenon of **non-destructive** inspection, it's application, and to discuss the variables affecting them.