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16. Abstract This report presents the theoretical and experimental results of a four year research program on the fatigue crack propagation and ductile fracture in pipelines and relatively thin-walled cylindrical containers. The objectives of the program were (a) to identify the possible modes of fracture failure in pipelines and pressurized cylinders containing a circumferential flaw, (b) to review the field and to develop the appropriate theoretical models for various phases of the fatigue and fracture in pipelines, and to carry out the necessary analytical investigations in order to develop the tools needed for the application of these models, and (c) to design and perform an experimental research program in order to test the validity and limitations of the theoretical models. The theoretical part of the program deals with the development of analytical techniques for an accurate calculation of stress intensity factors in pipes and flat plates containing a through or a part-through crack, and with the development of an elastic-plastic model for studying ductile fracture in pipelines. The experimental study was carried out on single edge notched and surface cracked X70 steel plate specimens and on circumferentially cracked standard X60 pipes. Baseline fatigue crack propagation data was collected from single edge notched specimens. The fatigue crack propagation rates in surface cracked plates and pipes were obtained by using the periodic crack front marking technique. After the fatigue tests, all three types of specimens were subjected to ductile fracture by gradually increasing the applied load. The results show that correctly calculated stress intensity factors could be highly effective as a predictive tool in fatigue crack propagation studies. Also, the pipe experiments generally confirm the validity of the theoretical ductile fracture instability model.

17. Key Words	18. Distribution Statement
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