

Macaw's Pipeline Defects

THE AIM of this book is to illustrate the range of defects that may be encountered in high-pressure steel pipelines and pipeline coatings. It gives advice on the probable causes and significance of the defects, and comments on appropriate remedial actions. This book, however, is not intended as a complete 'Do-it-yourself' manual for the diagnosis and analysis of defects, and use of this manual will not make the user an instant expert. Many of the defects require analysis and diagnosis by a qualified expert using specialist analytical techniques.

The defects included in this book encompass all aspects of high-pressure steel pipeline manufacture, construction and operation.

The section on manufacture includes defects in steel plate, seamless pipe, and seam welds produced by electrical-resistance welding (ERW) and submerged-arc welding (SAW). Girth welds are dealt with in the section on construction, along with poor construction practices such as lack of cover, electrical shorts, poor pipe support, etc.

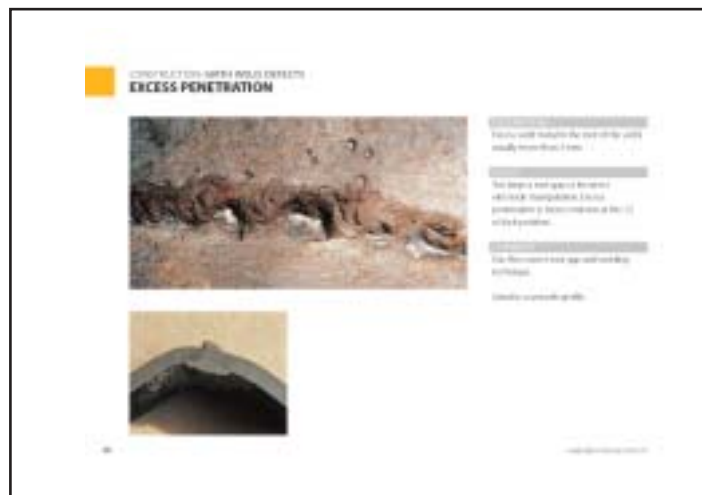
The section dealing with operational defects encompasses internal corrosion, external corrosion, erosion, fatigue, third-party damage, denting, and buckling.

Faults in the external corrosion control system are dealt with in separate sections. Coating defects are shown for the common types of mill-applied pipe coating and field-applied girth weld coatings. Common problems with cathodic protection schemes are also illustrated.

The final section of the book shows examples of the interaction between fault conditions to create a new integrity risk to the pipeline; for example shielding of the cathodic protection by a disbonded coating to create the conditions for stress-corrosion cracking.

Each section in this book has been compiled and edited by experience engineers with many years of practical experience in pipeline engineering, metallurgy, welding, coatings, and corrosion. This volume will therefore provide a unique and useful pictorial reference for engineers working in the pipeline industry.

Macaw's Pipeline Defects is fully illustrated throughout with photographs of actual defects and descriptive text alongside (*see the sample pages below*). All photographs and information contained in this document are, however, intended for guidance only.



Manufacturing defects

The first section deals with defects that occur during steelmaking, rolling of the plate for pipe manufacture and the manufacturing process itself. In principle, all critical defects of this kind should be eliminated in the proof test carried out in the pipe mill.

Construction defects

The second section considers defects that may be introduced into the pipeline during the construction process. Critical defects of this kind should be detected in the post-construction hydrostatic pressure test.

Operational defects

The third section of the book deals with defects that initiate and grow after the pipeline has been commissioned. These defects may initiate from a pre-existing fault within the pipe, or they may initiate from an area of the pipe surface that is free of any manufacturing or construction faults.

Operational faults represent the largest problem for the pipeline operator who must assess which defects are likely to develop, the rate at which they will develop and the consequences for pipeline safety.

All of these issues are dealt with in the operational risk assessment for the pipeline and the findings of this risk assessment will decide the frequency and type of periodic proof tests or inspections designed to prevent operational failures.



Coating and CP defects

The fourth section deals with defects in the external pipe coating and the cathodic protection system. These faults create the conditions in which external corrosion can develop.

Defect interaction

The final section provides examples of how defects interact to generate new or modified risks to pipeline integrity.

The authors

Dr Colin Argent (Editor) has worked in the pipeline industry for over 30 years in activities encompassing production, transmission and distribution. His experience is mainly in corrosion prevention by design or preventative maintenance and in the formulation of cost-effective corrosion management strategies for ageing pipeline systems. Colin started Macaw Engineering in 1996 with three colleagues to provide **materials and corrosion and welding** consultancy services to the pipeline industry. The firm has worked in many countries on projects ranging from new-build to life-extension, and risk assessment to technical training.

The objective in producing the book was to capture the experience and expertise of the senior consultants associated with Macaw Engineering, and to present this knowledge in an easily-accessible format. Having established the picture-based format, the main problem in compiling the book was to find good-quality pictures of the defects. Approximately 7500 pictures were collected, sorted, and mostly rejected during the compilation.

Peter G. Morgan (Associate Editor) is currently managing partner at Lithgow Associates. Peter joined TCI in 1987 as technical director, and was tasked with expanding the company's international base of clients and launching the company's consultancy services. Considerable success was gained in this field with prestigious projects undertaken in Brunei, Thailand, Hong Kong, and numerous locations in the Middle East.

Peter's background was gained in marine engineering, serving on Esso tankers in the Merchant Navy. He then worked in Germany in the marine shipbuilding/repair, oil, and gas industries. On his return to the UK, he quickly established himself in the-then newly-emerging coatings inspection industry. He formed, and was made secretary of, the first-ever committee tasked with the review of coatings used in the North Sea oil and gas industry. The committee's report was supported by the Department of Energy and, indeed, elements of the report have been incorporated in all major oil and gas company specifications and philosophies ever since.

In 1983 Peter was selected to become one of the four original UK team to be trained and form the trainer/lecturer nucleus of the NACE International Coating Certification Programme (now called CIP). He has taught all over the world. Peter established the consulting group as one of the foremost independent corrosion consultancy groups within the UK. The group has specialized in litigation and arbitration, and has undertaken some significant projects. Recent examples are a \$US300 million action arbitration in the International Court in Paris, and a \$multi-million litigation for the UK Government, together with smaller projects in overseas cases in Germany, Hong Kong, and France. Peter has been a retained consultant for BP, Shell International, Elf, Occidental USA, Brunei Shell, and many others.