C E O C O R

**COMMITTEE ON THE STUDY OF PIPE
CORROSION AND PROTECTION
SECTOR C MATERIALS**

CRITERIA FOR THE SELECTION OF METALLIC PIPELINES COATINGS

GUIDELINES

May 2005 Edition

INTRODUCTION

These guidelines deal with coatings (internal and external) for non-alloyed or low-alloyed steel, stainless steel, copper and cast iron pipe coatings, in other words, the widely used metals for water and gas pipeline systems.

Metal corrosion occurrences can be controlled by using two techniques, which are generally jointly used: the passive protection and the active protection or cathodic protection.

The passive protection consists in an electrolytic separation between the metal and the pipeline environment, through applying appropriate coatings.

The pipeline coating plays an important role in the anticorrosion protection system and its effectiveness is essential for the piping system durability. Due to the difficulty of their inspection, mainly for buried or immersed pipelines in deep waters, it is essential that the use of coatings provides the same durability properties as the one expected for the piping system (40 years or more).

On buried or immersed, electrically continuous metallic pipelines (welded or shunted joints), cathodic protection is realized with an appropriate electric current circulation between an artificial anode and the pipeline, which constitutes the cathode of the system. When the direction and the applied current intensity assure a sufficient lowering of the electrochemical potential of the metal, the material is located in the immunity field at the metal-electrolyte interface, where corrosion phenomena reduce to industrially negligible values.

Cathodic protection is usually applied on the external surfaces of buried or immersed non alloyed or low alloyed steel pipelines (welded joints or metallic connections); in special circumstances, it can also be applied at the internal surfaces of these pipelines.

The cathodic protection of externally coated and buried stainless steel pipelines is only applied in particular cases.

On buried cast iron pipes, due to the electrical discontinuity of the joints assembly, cathodic protection is only exceptionally applied.

This technique no more applies for copper pipelines.

In order to obtain an excellent durability of a pipeline, the selection of the coating, the application and its control after the application are fundamental. Therefore these guidelines, prepared by a group of European experts, are to be considered as a useful supplement to National, European and International standards, and a precious help for the designers and the end users. Easy to employ, it can be considered as an important working tool for all who may be interested.

The chapters in the guideline cancel and replace the following former recommendations:

Chapter 1: Criteria for the selection of steel pipes coatings, April 1992 Ed.

Chapter 2: Criteria for the selection of non- and low alloy steel pipelines accessories coatings, March1994 Ed.

Chapter 3: Criteria for the selection of pipelines external coatings of stainless steel tubes and accessories, May 1998 Ed.

Chapter 4: Criteria for the selection of external coatings of copper pipe systems, April 2001 Ed. and March 2003 Ed.

Chapter 5: Coating selection criteria for cast iron pipes, April 2001 Ed. and March 2003 Ed.

The members of the Working Groups who contributed to the elaboration of this document are:

M. Arpaia, I	(chapter 1)
E. Bini, I	(chapter 1)
D. Copin, F	(chapters 1, 2, 3, 4, 5)
E. Di Caprio, I	(chapter 3)
G.P. Guidetti, I	(chapters 1, 2, 4, 5)
M. Langenfeld, F	(chapter 5)
J. Mailliard, F	(chapters 1, 2, 3)
G.C. Mei, I	(chapter 4)
L. Rigosi, I	(chapter 3)
M. Romagnoli, I,	(chapters 1, 2, 3, 4, 5)
G. Rouleau, F	(chapters 1, 2, 3)
H.E. Wolff, D	(chapter 1).

Acknowledgments:

I would like to thank my Working Group's colleagues for their precious help in the realization of these guidelines and my Sector C colleagues for their revision and critical comments during plenary meetings, chaired by B. Elzenga (first part of the document) and by S. Rigal (second part of the document).

Special thanks go to D. Copin, G.P. Guidetti and M. Langenfeld for the final text revision; D.H. Deacon for the English translation of chapter 1 (a version of this chapter in Italian is also available); C. Triquet for the German and English translation of chapter 4; M. Langenfeld for the English and German translation of chapter 5; G. NOUAIL for the editorial setting and last checking, and up-dating some European standards or drafts indicated in the edition of March 2003.

The Leader
of Working Group "Coatings"
M. Romagnoli

CONTENTS AND SUBJECT INDEX

OBJECTIVE

This guideline is intended for an usage by metallic pipelines users, designers or piping operators, to allow the selection of the correct coatings (type of use, cost, ease of application, ease of use) for pipes, fittings and accessories to afford protection against mechanical and/or corrosive action :

- from external sources (soil, atmosphere, water..)
- from the transported fluid (water, gas…).

METALLIC PIPELINES DESIGN AND CONSTRUCTION

In order to obtain the expected durability it is necessary to work out previously, while designing and realizing the work, the most suitable precaution against metallic pipelines corrosion.

The main factors to consider as regards the coatings follow.

External coating

The external coating must be chosen in the light of the hereafter reported factors:

- characteristics of the pipes;
- geographical and physical location;
- environment of the pipe;
- accessibility of the structure;
- proximity to other structures;
- operating temperature;
- ambient temperature and mechanical stresses during the application of the coating, transport, storage, installation and hydraulic testing;
- durability of the structure and cost of maintenance;
- any system of active protection;
- economic conditions.

The following specific factors are to be considered:

Underground pipes:

- nature of the ground: mechanical, physico-chemical and biological characteristics;
- mechanical stresses transmitted by the ground: dynamic and static loads and stresses from backfilling, penetration of roots;
- possible formation of electrochemical cells, presence of stray currents from d.c. or traction current installation, proximity of cathodic protection installation or cathodically protected structure, proximity of HV power transmission lines;

Underwater pipes, whether or not in underwater excavation:

- type of water: fresh, salt;
- mechanical stresses: shallow or at great depth, special laying condition or particular situation;

Overhead pipes:

- type of atmosphere: rural, mountainous, urban, marine, industrial;
- situation: overhead, in gallery, in tunnel, ventilated or not, humid atmosphere or not, etc.;
- mechanical stresses during installation;

Pipes coming out of the ground, or within the tidal range:

- nature of the ground, water and atmosphere;
- mechanical stresses;

Hot water or waste water pipes, when passing through walls:

- type of wall construction and others additional materials.

The table next page shows a summary of the stresses and test methods concerning the behaviour of the coating for underground pipes.

Internal coating

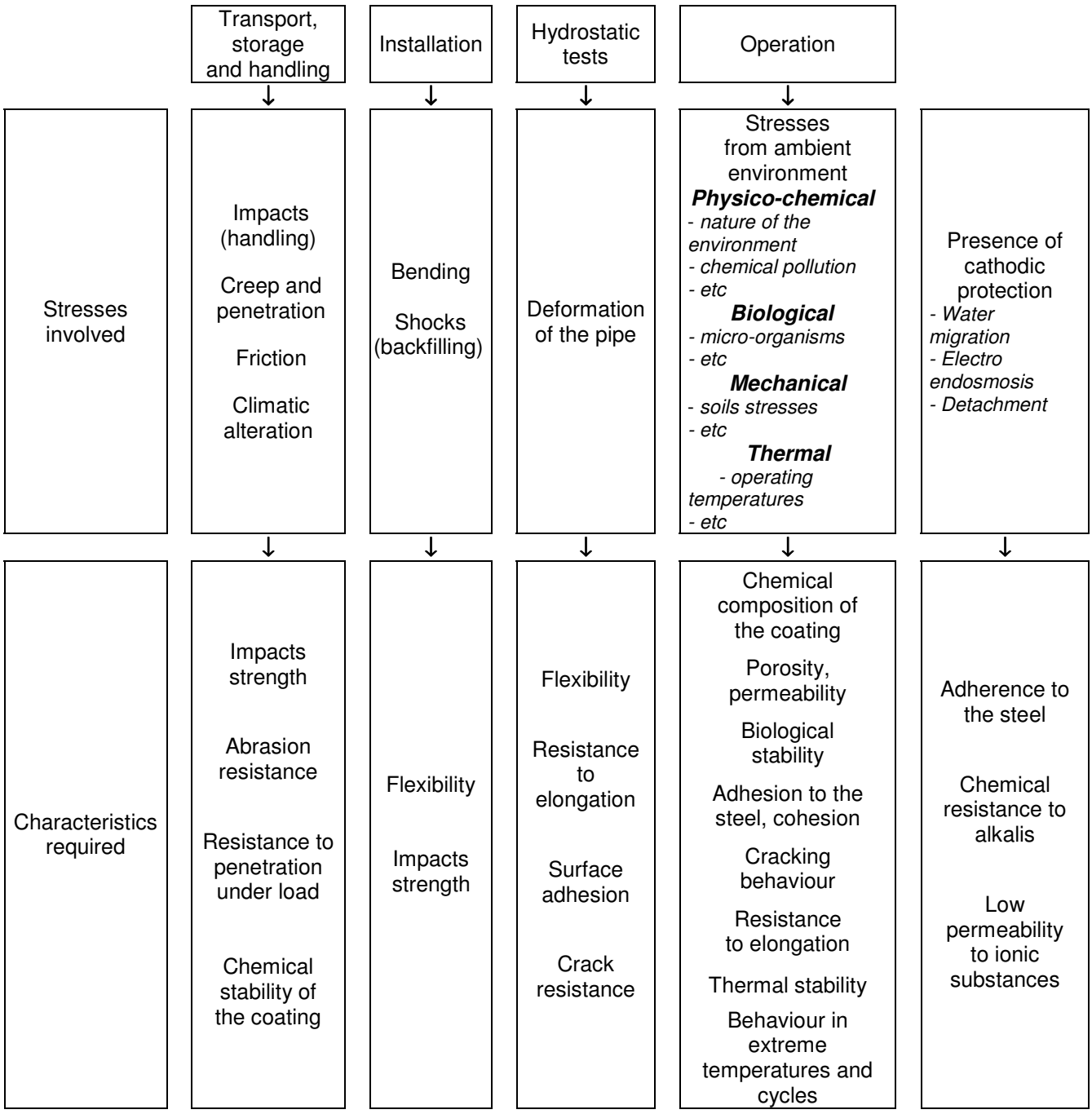
The coating must be chosen in relation to:

- the type of fluid to be carried: water, gas, oil, etc.;
- the characteristics of the fluid: chemical, physical, bacteriological composition;
- operating temperature and pressure;
- operating mode: temporary working or not, partially filled pipes or not, etc.

As regards the mentioned fluids, account must be taken above all of:

- water: tendency or not to form a protective metal oxide-calcium deposit;
- gas: dehydration-, desulphurization-, etc, treatments: presence of residual water, carbon dioxide, hydrogen sulphide and other sulphur-containing components and solid impurities;
- oil: presence or not of salt water, carbon dioxide, hydrogen sulphide, etc.

Summary table of the stresses and tests
concerning the behaviour of the coating for underground pipes



Note: Stresses experienced by a coating and their transposition into typical test methods to evaluate the behaviour of the coating.