



National Standards Authority of Ireland

IRISH STANDARD

I.S. CEN/TR 15235:2005

ICS 25.160.40

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WELDING - METHODS FOR ASSESSING IMPERFECTIONS IN METALLIC STRUCTURES

*This Irish Standard was
published under the
authority of the National
Standards Authority of
Ireland and comes into
effect on:
December 7, 2005*

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Údarás um Chaighdeán Náisiúnta na hÉireann

TECHNICAL REPORT
RAPPORT TECHNIQUE
TECHNISCHER BERICHT

CEN/TR 15235

October 2005

ICS 25.160.40

English Version

**Welding - Methods for assessing imperfections in metallic
structures**

Soudage - Méthodes d'évaluation des défauts dans les
constructions métalliques

Schweißen - Verfahren zur Beurteilung von
Unregelmäßigkeiten bei metallischen Bauteilen

This Technical Report was approved by CEN on 22 September 2005. It has been drawn up by the Technical Committee CEN/TC 121.

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Contents	Page
Foreword	3
Introduction	4
1 Scope	5
2 Terms and definitions	5
3 Symbols and abbreviations	5
4 ECA principles	6
5 Safety considerations	6
6 Existing ECA-procedures	9
Bibliography	13

Foreword

This CEN Technical Report (CEN/TR 15235:2005) has been prepared by Technical Committee CEN/TC 121 "Welding", the secretariat of which is held by DIN.

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Introduction

European provisions for assessing imperfections in metallic structures are needed to meet the requirements of industry. The technology is being applied by many industries for materials selection, design and fabrication and in-service assessment using existing methods. Engineering Critical Assessment (ECA) methods for the assessment of imperfections have received further support by the EC directive 97/23/EC concerning pressure equipment (PED) which permits such methods as an alternative to conventional methods.

The present Technical Report gives guidance to the application of BS 7910 and the European SINTAP Report. Some further documents are also mentioned.

Experience from the application should, in a few years, provide enhanced technology in the subject and eventually permit standardisation at the European level.

Conventional design procedures involve application of mathematical models such as the theory of elasticity. Actions are described by characteristics such as stress and strain. Resistance described by characteristics such as yield stress and ultimate limit stress. The designer has to assure that the resistance of the structure is adequate, using adequate safety factors, partial coefficients, etc. The mathematical models presuppose a homogenous material.

Many failure modes involve cracks. Failure may originate from a crack and/or failure may propagate (slow or fast) as a crack. Application of the conventional theory of elasticity to a structure with a crack leads to a singularity at the crack tip because the stresses approach infinity. To this should be added that a closer study of the fracture processes shows that in-homogeneities such as grain structure and even the atomic structure may influence the mode of fracture. Conventional design procedures can, for these reasons, not be applied in situations where an analysis of the significance of a crack-like imperfection is necessary and they cannot be applied for an analysis of the propagation of fatigue cracks, creep cracks, stress corrosion cracks, etc.

Alternative methods termed fracture mechanics have been developed in order to model the behaviour of structures containing cracks. Fracture mechanics interpret crack driving force and materials resistance by an alternative set of parameters such as stress intensity factor, crack tip opening displacement, etc.

Engineering critical assessments use a combination of conventional design procedures and fracture mechanics calculations, depending on the nature of the imperfection and the likely type of failure. General corrosion results for example in a reduction in cross section and may be analysed by conventional design procedures whereas propagation of fatigue cracks has to be analysed by fracture mechanics methods.

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