WES 2815 : 2014

WES

Test method for brittle crack arrest toughness, K_{ca}

WES 2815 : 2014

Translated and Published

by

The Japan Welding Engineering Society

Printed in Japan

In the event of any doubt arising,
the original standard in Japanese is to be final authority.

WES 2815：2014

Japanese Text

Investigated by The Japan Welding Engineering Society

Established：2014-01-01

Draft Committee: FTE Committee (Chief: HAGIHARA Yukito) of JWES Iron and Steel Division / JWES ATE Committee (Chief: AIHARA Shuji)

Under the Direction of JWES Standard Committee (Chairman：OMATA Kazuo)

This English translation is published by: The Japan

Welding Engineering Society

4-20, Kanda Sakuma-cho, Chiyoda-ku, Tokyo, Japan 101-0025

Member List of Iron and Steel Division, Technical Committee, FTE Committee

Post	Name	Organization
Advisory Member	MIYATA Takashi	Nagoya University
Technical Committee Chairman	AIHARA Shuji	The University of Tokyo
FTE Chief	HAGIHARA Yukito	Formerly with Sophia University
FTE-WG-R Leader	MINAMI Fumiyoshi	Osaka University
FTE-WG-C&I Leader	TAGAWA Tetsuya	Nagoya University
Secretary (Neutral Member)	YOSHINARI Hitoshi	National Maritime Research Institute
Neutral Member	OHATA Mitsuru	Osaka University
Neutral Member	TOYODA Masao	Japan Science and Technology Agency
Neutral Member	TOYOSADA Masahiro	Kyushu University
Neutral Member	NAKAGOMI Tadao	Shinshu University
Neutral Member	SHIBANUMA Kazuki	The University of Tokyo
Neutral Member	NAKAI Hiroaki	The University of Tokyo
Neutral Member	AOKI Mitsuru	The Japan Welding Engineering Society
Neutral Member	KATSUTA Junichi	Nagasaki University
Neutral Member	KITADA Hiroshige	Nippon Kaiji Kyokai
Neutral Member	YAMAMOTO Norio	Nippon Kaiji Kyokai
Neutral Member	MIMURA Hiroshi	Formerly with Yokohama National University
Member	YAMASHITA Yoichi	IHI Corporation
Member	YAMADA Takehisa	IHI Corporation
Member	YAMASHITA Maki	Osaka Gas Co., Ltd.
Member	NISHIKAWA Hiroyasu	Kawasaki Heavy Industries, Ltd.
Member	KIUCHI Akira	Kobelco Research Institute
Member	TAHARA Takayasu	T & T Technology
Member	MITSUYA Masaki	Tokyo Gas Co., Ltd.
Member	ITATANI Masao	Toshiba Corporation Power Systems Company
Member	HIRAI Shuichi	Toyo Kanetsu K. K.
Member	UNO Yoshiaki	JGC Corporation
Member	MURAI Ryosuke	Mitsubishi Heavy Industries, Ltd.
Member	YAGI Nobuyori	Mitsubishi Heavy Industries, Ltd.
Member	ICHIMIYA Mitsuru	Yokogawa Bridge Corporation
Member (Steel Producer)	IMAMURA Hiroki	Kobe Steel, Ltd.
Member (Steel Producer)	IGI Satoshi	JFE Steel Corporation
Member (Steel Producer)	SHIMANUKI Hiroshi	Nippon Steel & Sumitomo Metal Corporation
Member (Steel Producer)	KOEDA Hideo	The Japan Steel Works, Ltd.
Chief Secretary, Headquarter Secretary Committee	IKI Hiroshi	Nippon Steel & Sumitomo Metal Corporation
Vice-Chief Secretary, Headquarter Secretary Committee	SHIWAKU Toyoaki	Kobe Steel, Ltd.
Secretary, Headquarter Secretary Committee	NISHIMURA Kimihiro	JFE Steel Corporation
Secretariat	SHIRAKURA Toshiya	The Japan Welding Engineering Society
Secretariat	MORITA Tsutomu	The Japan Welding Engineering Society
Secretariat	TANAKA Makoto	The Japan Welding Engineering Society

Member List of Iron and Steel Division, Technical Committee, ATE Committee

Post	Name	Organization
Chief Member	AIHARA Shuji	The University of Tokyo
Neutral Member	HAGIHARA Yukito	Formerly with Sophia University
Neutral Member	TERAMOTO Tokuo	University of Tsukuba
Neutral Member	YOSHINARI Hitoshi	National Maritime Research Institute
Neutral Member	TAGAWA Tetsuya	Nagoya University
Neutral Member	FUKUI Tsutomu	Nippon Kaiji Kyokai
Neutral Member	SUGIMOTO Kei	Nippon Kaiji Kyokai
Neutral Member	SHIBANUMA Kazuki	The University of Tokyo
Neutral Member	NAKAI Hiroaki	The University of Tokyo
Neutral Member	KAWATA Itsuki	The University of Tokyo
Neutral Member	AOKI Mitsuru	The Japan Welding Engineering Society
Neutral Member	MIMURA Hiroshi	Formerly with Yokohama National University
Secretary (Steel Producer)	INOUE Takehiro	Nippon Steel & Sumitomo Metal Corporation
Member (Steel Producer)	IMAMURA Hiroki	Kobe Steel, Ltd.
Member (Steel Producer)	KANEKO Masahito	Kobe Steel, Ltd.
Member (Steel Producer)	TAJIKA Hisakazu	JFE Steel Corporation
Member (Steel Producer)	HASE Kazukuni	JFE Steel Corporation
Member (Steel Producer)	HANDA Tsunehisa	JFE Steel Corporation
Member (Steel Producer)	OHKUBO Takeshi	Nippon Steel & Sumitomo Metal Corporation
Member (Steel Producer)	KAWABATA Tomoya	Nippon Steel & Sumitomo Metal Corporation
Member (Steel Producer)	SHIMADA Yusuke	Nippon Steel & Sumitomo Metal Corporation
Chief Secretary, Headquarter Secretary Committee	IKI Hiroshi	Nippon Steel & Sumitomo Metal Corporation
Vice-Chief Secretary, Headquarter Secretary Committee	SHIWAKU Toyoaki	Kobe Steel, Ltd.
Secretary, Headquarter Secretary Committee	NISHIMURA Kimihiro	JFE Steel Corporation
Secretariat	SHIRAKURA Toshiya	The Japan Welding Engineering Society
Secretariat	MORITA Tsutomu	The Japan Welding Engineering Society
Secretariat	TANAKA Makoto	The Japan Welding Engineering Society

Contents

Test method for brittle crack arrest toughness, K_{ca}

Introduction This standard specifies the test method to evaluate the brittle crack arrest toughness of steel using fracture mechanics parameter.

1. Scope This standard is applied to ferrite steel base metals exhibiting ductile to brittle transition behavior. Applicable materials include steel plates and steel pipes. Steel pipes are prepared to be a flat shape in an appropriate manner. It is intended for materials with a tensile strength of 950 MPa or less and a test specimen thickness of 200 mm or less. The range of arrest temperatures is between −196°C and 100°C.

Setting a temperature gradient in the width direction of a test specimen, and applying uniform stress to the test specimen, strike the test specimen to initiate a brittle crack from the mechanical notch at the side of the test specimen and causes crack arrest (temperature gradient type arrest testing). Using the stress intensity factor, calculate the arrest toughness, K_{ca}, from the applied stress and the arrest crack length. This value is the arrest toughness at the temperature of the point of crack arrest (arrest temperature). To obtain K_{ca} at a specific temperature such as the design temperature of a structure, the method specified in **annex A** can be used.

To determine the dynamic behavior of crack propagation and the dynamic strain of a test specimen, the method specified in **annex B** can be used.

As a method for initiating a brittle crack, a secondary loading mechanism can also be used (see **annex C** "Double tension type arrest test"). The arrest characteristics of a test specimen can also be evaluated by connecting a crack starter plate and the test plate in the width direction through welding to enable a brittle crack initiated from the mechanical notch at the side of the test specimen to propagate in the crack starter plate, and by observing the propagation behavior of the crack immediately after entering the test plate (see **annex D** "Duplex type arrest test").

2. Normative references The following standards contain provisions, which, through references in this standard, constitute provisions of this standard. Their latest versions shall apply.

JIS G 0202 Glossary of Terms Used in Iron and Steel (Testing)

JIS Z 3001 Welding Terms

3. Terms and definitions Major terms and definitions used in this standard are in conformity with **JIS G 0202** and **JIS Z 3001-1**, **2**, **3**, and **4**, as well as the following:

(1) Brittle fracture In general, fracture generated in a low stress and low deformation state is called brittle fracture. This standard specifies the test method of ferritic steel exhibiting ductile to brittle transition, and hence it limits brittle fracture to that caused by cleavage fracture.

(2) Brittle crack Crack propagating due to brittle fracture is called a brittle crack. The crack propagation velocity is approximately 200 - 300 m/s or more.

(3) Arrest It means the phenomenon that a brittle crack propagating at a high velocity stops.