



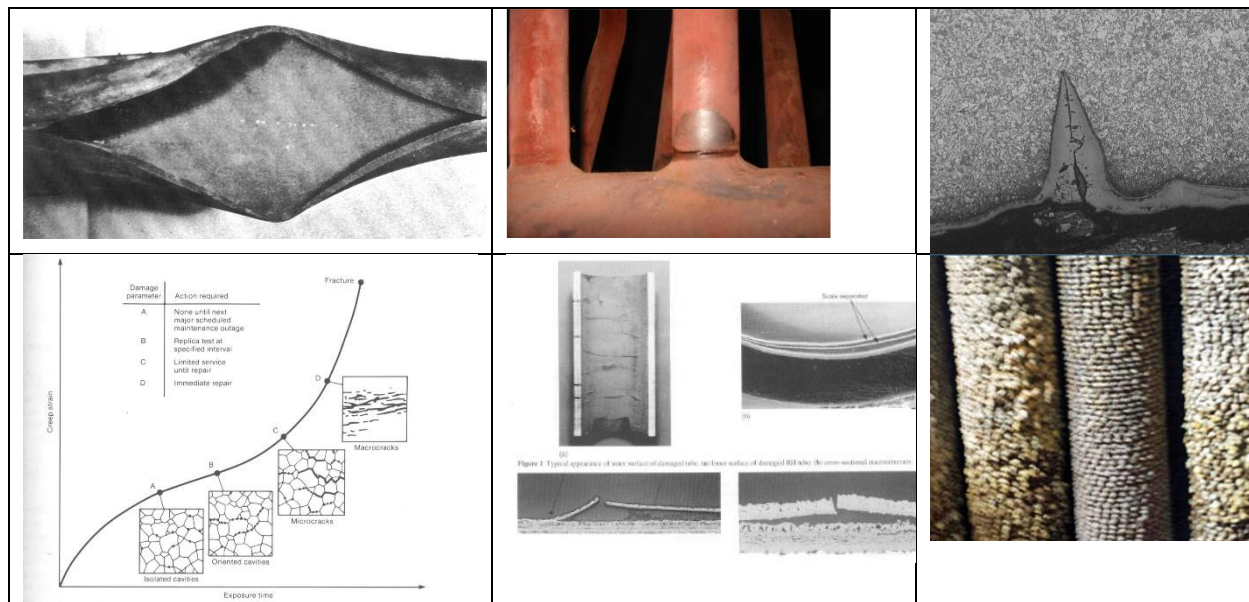
3-Day Online Training Course (Presented from London)

Dates: 15-17 February 2022

# Boiler Tube Damage, Failure & Life Assessment

*Materials, Damage Mechanisms, Inspection, Root Cause Failure Analysis, Life Assessment and Risk Based Management*

Acronym: ‘**BTF**’ (*Boiler Tube Failures*)



This 3-days course will run for 3.5 hours each day with 30 minutes optional Discussion Session at the end of each day. At this point attendees can put their videos and microphones on and speak to the Course Presenter or to each other to exchange their experience. This way the course can be as close to the in-person event as possible!

**The Course would emphasise the current and latest understanding, supported by notes and references for further reading and will be accompanied by Worked Examples.**



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[www.etd-consulting.com](http://www.etd-consulting.com) BS EN ISO 9001: 2015 Certified VAT No: 733600853

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**All times shown below are London times.**

You will be sent the Zoom link a few days before the start of the course. Please join at 0745h to introduce yourself and to make sure that you don't miss the start in case of any last-minute connection problems. Please write to [enquiries@etd-consulting.com](mailto:enquiries@etd-consulting.com) in case of problems.

BTF  
COURSE

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**DAY 1** (0800-1130h)

**Materials of Construction & Damage Mechanisms**

**Module 1: Boiler Tube Materials**

(0800 – 0945h)

Various materials in use will be reviewed and their pros and cons discussed. Materials for the new generation of higher efficiency plant (such as T23, T91, T92, 12Cr steels) will also be discussed and their welding and oxidation issues elaborated.

- Furnace Wall Tube Materials (C, C-Mn Steel and low alloy steels for the new generation of higher efficiency plant), their use and characteristics will be discussed.
- Reheater and Superheater Tube Materials (CrMoV, High Cr and Stainless Steels) will be discussed and reviewed.

**Break = 0945 – 1000h**

**Module 2: Damage Mechanisms**

(1000 – 1130h)

Understanding the life influencing damage mechanisms and possible remedial actions are a key element for a successful tube life assessment and extension. A detailed review will be made of the damage mechanisms, and how to recognise them. Following tube damage and failure mechanisms will be discussed.

- Creep (both short and long term failures)
- Fatigue (especially important in the plants subjected to cyclic operation)
- Corrosion (steam side and flue side)
- Flow Assisted Corrosion (FAC) in HRSGs
- Erosion
- Above mechanisms in combination

**Optional DISCUSSION SESSION 1130 to 1200h**

## DAY 2 (0800-1130h)

Please join at 0745h to make sure that you don't miss the start in case of any last-minute connection problems. Please write to [enquiries@etd-consulting.com](mailto:enquiries@etd-consulting.com) in case of problems.

### **Root Cause Failure Analysis, and Case Histories of Tube Failures in Boilers / HRSGs**

#### Module 3: Root Cause Failure Analysis

(0800 – 0945h)

This module will discuss the principles of root cause analysis (RCA) as applied to boiler tube failure investigation. This will discuss the typical scope of work during the RCA, the tasks involved and their purpose. The discussion will lead into the detailed case studies of actual tube failure examples in Module 4.

#### Break = 0945 – 1000h

#### Module 4: Case Histories

(1000 – 1130h)

This module will show various cases of tube failures and how root cause failure analysis (RCA) of these was carried out:

- Furnace wall tubes
- Superheater / Reheater tubes
- Economiser tubes
- HRSG tube failures due to Flow Assisted Corrosion (FAC)

Optional DISCUSSION SESSION 1130 to 1200h

**DAY 3** (0800-1130h)

Please join at 0745h to make sure that you don't miss the start in case of any last-minute connection problems. Please write to [enquiries@etd-consulting.com](mailto:enquiries@etd-consulting.com) in case of problems.

**Tube Inspection, Life Assessment and Risk Based Management****Module 5: Tube Inspection**

(0800 – 0945h)

This module will discuss tube inspection for wall thinning, pitting corrosion, bore oxide thickness, flue deposits, hardness testing and replication.

- Tube inspection (borescopy, UT etc.)
- Bore oxide thickness measurement
- Preferential thinning
- Portable hardness testing and what does it tell us
- Measurement of corrosion pits
- Tube replacement (under what circumstances and with what materials)

**Module 6: Tube Life Assessment and Risk Based Management**

(1000 – 1130h)

This module will show a number of cases of how tube safe remaining life is calculated for various type of damage mechanisms such as creep, corrosion, oxidation etc. This module will also cover risk based tube failure management and how to reduce tube failures in a power plant boiler/ HRSG.

- Tube life due to creep
- Tube life calculation from oxide thickness measurement
- Safe remaining tube life due to thinning from corrosion.
- Risk based management of boiler tube cracking and failures (steps needed to reduce and manage failures in a power plant / HRSG boiler).

[Optional DISCUSSION SESSION 1130 to 1200h](#)

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## ABOUT THE COURSE PRESENTER

**Dr David Robertson, Lead Metallurgist, ETD Consulting, UK**



Dr Robertson has over twenty years of experience of materials used in the power, petrochemical and other industries. Since 2004, Dr Robertson has been working for ETD Consulting on projects related to high-temperature plant integrity and life assessment, materials and welding issues, and root cause failure analysis. Through his work, Dr. Robertson has gained extensive experience of the materials used and damage/ failure mechanisms in high-temperature plants. He also has considerable experience in examination and interpretation of metallographic replicas and microstructures in order to assess metallurgical damage and degradation (creep cavitation, spheroidisation, corrosion etc).

Boiler and HRSG tube failure analysis and integrity/ life assessment is one of Dr Robertson's speciality and he has worked in this area for about 15 years or so.

Dr Robertson is internationally known in his field and has special experience with T91 steel tubes being used in modern higher performance supercritical power plants. He is also very familiar with the issue of various alloys used for boiler and HRSG tubes and their occasional replacement with different tube materials. Dr. Robertson gained his qualifications in metallurgy at Imperial College, London.

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## ABOUT THE ORGANISER

**European Technology Development Ltd. (ETD), UK**

ETD is a UK based engineering and consulting company specialising in life assessment/ extension, maintenance, materials and engineering issues in all types of power generating and process plant. In addition to its *main business of technical consulting, plant inspection and their condition and life assessment*, ETD regularly organises training courses in power, petrochemical, oil, gas and other industrial sectors as a part of its programme on *technology transfer to industry worldwide*. In the recent past ETD has organised various international workshops/ courses/ conferences in the UK, a number of other European countries (Germany, France, Portugal), Middle East, Far East, South East Asia, Canada and the USA. The issues involved in these courses covered lifing and failure analysis; HRSG design, maintenance and inspection; plant life assessment/ extension; high temperature plant materials behaviour; plant component safety and durability; performance of in-service welds and weld repairs; power plant cycling - technical and cost issues; boiler and turbine maintenance; petrochemical and refining plant issues; and, power plant benchmarking for performance, and risk based maintenance and inspection (RBMI).

*For further information,*

Please visit: [www.etd-consulting.com](http://www.etd-consulting.com) Or, write to: [enquiries@etd-consulting.com](mailto:enquiries@etd-consulting.com)

**REGISTRATION FORM (Please email)**

Online Training Course

**Boiler Tube Damage, Failure & Life Assessment**  
(BTF Course)

**Dates: 15 – 17 February 2022**

**Registration Fee:** Covers delivery of the course & provision of presentations in pdf format (all fees shown are in GB Pounds). Please put 'x' in the relevant box and show the total payment.

Reduced Fee (Until 17 Jan. 2022)	Full Fee (From 18 Jan. 2022)
£350	£400
Please show here (no. of attendees <input type="text"/> x £ <input type="text"/> ): <b>Total Amount Payable = £</b> <input type="text"/>	

**How to Pay:** When paying please quote reference 'BTF Course' and the ETD invoice number (if this was issued):

**1) By bank to bank transfer to:** European Technology Development Ltd.  
(ETD bank account details will be provided on registration)

**2) Credit Cards:** Payment information will be provided on registration.

*When registering, please state here how you paid or intend to pay:*

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All Registration & Payment enquiries to: [enquiries@etd-consulting.com](mailto:enquiries@etd-consulting.com)

**Attendee(s) Details**

Your **title** and **name:**

Company:

Job Title (optional):

Address:

Phone:

E-mail:

**Address for Registration:**

Please email the required information/ completed form to: [enquiries@etd-consulting.com](mailto:enquiries@etd-consulting.com)