

# **SUPERALLOYS**

## **FOR HEAVY-DUTY and AIRCRAFT-TYPE GAS TURBINES**

**DR. DONALD H. BOONE**  
**BWD TURBINES LIMITED, INC.**  
2412 Cascade Drive  
Walnut Creek, CA 94598-4300  
P 925.938.4780  
F 925.938.3068  
boone@bwdturbines.com

**PROF. GERHARD E. FUCHS**  
**Materials Science & Engineering**  
**University of Florida**  
116 Rhines Hall, PO Box 116400  
Gainesville, FL 32611-6400  
P 352.846.3317  
F 352.392.7219  
gfuch@mse.ufl.edu

The increasing demand for, and the favorable response to, our recent course offerings in Europe, Asia, Canada, and now in Gainesville, FL has have lead to the next scheduled presentation of the short course, **SUPERALLOYS FOR HEAVY DUTY and AIRCRAFT TYPE INDUSTRIAL GAS TURBINES**. It is planned again for the excellent University of Florida Materials Science facilities, Gainesville, FL, 3-6 May, 2010. Because of the popularity and size limitations of the course, it is not too early to make your plans and reservations.



**SUPERALLOYS** is a 4-day course providing a basic level of knowledge on the metallurgy, manufacturing, mechanical, and surface behavior of these critical gas turbine hot-section alloys and components. The course emphasizes the history, development and present understanding of these alloys and their processing into useful components. Also, turbine degradation modes and their effects upon operational life and subsequent reparability options are then presented in detail. An in-depth coverage of coating protection, selection, and application techniques will be made as these technologies are so vital to subsequent repair and refurbishments strategies. Specifically, the repair and rejuvenation cycle and processes including stripping and recoating, NDI techniques, welding, brazing, HIPing and re-heat treatment, and property rejuvenation are presented. Of particular importance is the information on component degradation, remaining life assessment, and repair workscoping.

This course, is designed to provide a basis for the engineering, supervisory and purchasing decisions concerning gas turbine equipment operation, and component repair, refurbishment, refitting, and replacement where superalloys are involved. It has been given both publically, and "in-house" to OEM's, utilities, cogeneration/I.P.P's, airlines, component designers and manufacturers, as well as various users and repair groups. A recent Darmstadt University course had 30+ students from all over the world. This course has been presented over 80 times, and has become the standard training course of the entire gas turbine industry.

The complete set of over 1,500 pages of notes with an additional appendix of critical and hard to obtain information is provided on CD to each student. A hard copy for class use can be ordered as well. In case specific and/or additional information is required, contact Dr. Donald H. Boone at the address shown above. Please visit our Web Site [www.bwdturbines.com](http://www.bwdturbines.com). Your interest and "spreading the word" will be highly appreciated.

# SUPERALLOYS

## FOR HEAVY-DUTY and AIRCRAFT-TYPE GAS TURBINES

**Dr. DONALD H. BOONE and  
Prof. GERHARD E. FUCHS**

**3-6 May, 2010 University of Florida, Materials Science & Engineering Department  
(Rhines Hall), Gainesville, FL.**

### MONDAY, 3 May

08:30	WELCOME & INTRODUCTION	Boone & Fuchs
09:00	Superalloys in Turbine Design	Boone
09:30	BREAK	
09:45	Superalloys for Gas Turbines	
10:30	What Makes Superalloys Strong?	Fuchs
11:45	Processing of Superalloys	Fuchs
12:30	LUNCH	
01:30	Processing of Superalloys	Fuchs
02:00	Principles of Nickel Base Alloys	Fuchs
03:00	BREAK	
03:15	Principles of Cobalt Base Alloys	Fuchs
03:45	Principles of Ni-Fe Base Alloys	Fuchs
04:30	Metallurgy of the Casting Process	Fuchs
05:30	CLOSE	
06:00	Cocktail Hour and Reception	

### TUESDAY, 4 May

08:30	Directionally Solidified and Monocrystal Castings	Fuchs
09:30	What's New, What's Happening	Fuchs
10:00	BREAK	
10:15	The Stability of Superalloys	Fuchs
10:45	Surface Attack; Oxidation and Hot Corrosion Principles	Fuchs & Boone
11:30	Degradation of Coatings under Service Conditions.	Boone
12:30	LUNCH	
01:30	Protective Coatings, Introduction	Boone
02:30	BREAK	
02:45	Diffusion Aluminide Coatings	Boone
04:30	Modified Aluminide Coatings	Boone
05:30	CLOSE	

### WEDNESDAY, 5 May

08:30	Vapor Phase Aluminides	Boone
09:30	BREAK	
09:45	Overlay Coating Processing	Boone
10:45	Thermal Spray Coating Processing	Boone
11:30	Thermal Barrier Coatings	Fuchs & Boone
12:30	LUNCH	
01:30	Overlay Coating Compositions	Boone
02:30	BREAK	
02:45	Coating Mechanical Property Considerations	Boone & Fuchs
03:30	Coating Ranking and Selection Considerations	Boone
04:30	Repair & Rejuvenation, Introduction & Considerations	Boone
05:30	CLOSE	

### THURSDAY, 6 May

08:30	R&R Cleaning, Stripping	Boone
09:30	NDI Techniques	Boone
10:00	BREAK	
10:15	Braze Repair Techniques; Recent Advances & limitations	Boone
11:15	Weld Repair Techniques; Recent Advances & Limitations	Boone
12:30	LUNCH	
01:30	Component R&R Summary	Fuchs
02:00	Component Life Assessment, Philosophy & Procedures incl. Case Studies	Boone
03:30	Course Recap, Discussion	Fuchs & Boone
04:30	CLOSE	

# **SUPERALLOYS**

## **FOR HEAVY-DUTY and AIRCRAFT-TYPE**

### **GAS TURBINES**

**Donald H. Boone and  
Gerhard E. Fuchs**

**BWD Turbines Limited, Inc.  
2412 Cascade Drive  
Walnut Creek, CA 94598-4300**

**P (925) 938 4780  
F (925) 938 3068  
boone@bwdturbines.com**

This 4-Day course presents a basic level of knowledge of the metallurgy, manufacture, mechanical and surface behavior of these critical turbine hot section alloys. Most importantly, the course also provides strong coverage of coating protection and the technologies vital to repair and refurbishment such as coating stripping and re-coating, welding, brazing, HIPing and re-heat treatment. Thus, a sound working knowledge for the decisions concerning repair, refurbishment, retrofitting and replacement is provided.

Please register the following students for the "Superalloys" 4-Day Course to be given at the University of Florida, Materials Science & Engineering's excellent technical facilities in Gainesville, FL. Housing will be at the University of Florida Hilton Hotel and Conference Center, Monday through Thursday, 3-6 May, 2010. Transportation between the hotel and short course venue will be provided. The specific course location along with more specific travel and hotel information will be supplied with reservation confirmation.

NAME: \_\_\_\_\_ TITLE: \_\_\_\_\_ Phone  
Fax  
e mail

COMPANY: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

CITY: \_\_\_\_\_

STATE/ZIP/COUNTRY: \_\_\_\_\_

- 4-Day fee including CD notes is \$1,900.00/student; a \$100 discount available until 1 March. 10% Group discounts for 3 or more students are also available.
- Hard copy of the ~1500 pages of notes, available at check in when pre ordered, \$125.00
- Enclosed is a check or P.O.# in the amount of \$\_\_\_\_\_ (made payable to BWD Turbines Ltd. Inc.) (\$1,000.00 non-refundable deposit required for each registrant). Balance due at start of course.
- VISA, MC and AmEX charge cards accepted.
- Bank wire transfer information available

Please return registration form to:

**Donald H. Boone  
BWD Turbines Limited, Inc.  
2412 Cascade Drive  
Walnut Creek, CA 94598-4300**

# SUPERALLOYS

FOR HEAVY-DUTY and AIRCRAFT-TYPE  
GAS TURBINES

## COURSE INSTRUCTORS

### Donald H. Boone, Ph.D.

Industrial Consultant and President of BWD Turbines Limited and Boone & Associates, Inc. His expertise and experience includes the areas of protective coatings and their processing, and the effects



of structure on performance for protection and for resulting mechanical properties. In addition, BWD Turbines is involved in the development and installation of coating manufacturing, and repair and rejuvenation facilities including automated welding and advanced brazing techniques. Dr. Boone was previously associated with Pratt and Whitney Aircraft's Advanced Materials Research & Development Lab, Temescal Coatings Div., Lawrence Berkeley Labs of the Univ. Of California, and the Dept. Of Mechanical Engineering Naval Postgraduate School. There he worked on the development, evaluation and processing of high temperature materials and coatings used in modern aircraft and industrial gas turbines. He is a member of several committees active in the area of gas turbine materials application and manufacturing including the

Manufacturing, Materials and Metallurgy Committee of IGTI. Dr. Boone has authored over 200 technical publications and holds a number of patents in the high temperature alloy and coatings field.

### Gerhard E. Fuchs, Ph.D.

After receiving his Ph.D. in Materials Science from R.P.I in 1986, Dr. Fuchs worked in the aerospace and nuclear power generation industries for 12 years and taught part time at Union College and R.P.I. In 1998, Dr. Fuchs joined the Materials Science and Engineering Faculty at the University of Florida, where his research has focused on the inter-relationship of processing, microstructure and properties of intermetallic alloys, Ni-base alloys and superalloys. Dr. Fuchs continues to work closely with industry, laboratories and other academic institutions and has developed a new graduate-level course on "High Temperature Alloys" and has updated courses on "Advanced Phase Diagrams", "Metallurgical Engineering" and "Process Metallurgy". Dr. Fuchs is active several professional societies, serving on several committees, including the High Temperature Alloys Committee (TMS), Seven Springs International Symposium Committee (TMS) and International Materials Review Editorial Board (ASM) and is also the faculty representative for the TMS/ASM Student Chapter at the University of Florida. Dr. Fuchs has also authored more than 50 technical publications and edited two books in the field high temperature alloys.

