

ACE/ATRIUM-10 ***Critical Power Correlation***

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Topics

- > Introduction
- > What has changed compared to SPCB correlation?
- > Formal methods of development
- > Theoretical model for correlation
- > Applicability
 - ◆ Range of applicability
 - ◆
 - ◆
- > Conclusions

Introduction

Why a New Correlation?

Overview Comparison of ACE/ATRIUM-10 to SPCB

Correlation Component	SPCB	ACE/ATRIUM-10
Correlation Form		
Rod peaking function		
Input Conditions		
Calculated Result		

ACE/ATRIUM-10 will be used in the same applications as SPCB, including

Correlation Form ***What is different?***



Differences in Rod Centered Peaking Function



Formal Methods of Correlation Development

Methods for Correlation Development Critical Power Correlation

- > The correlation development followed the formal process described in EMF-2022(P) “Correlation Development Guideline” including:**
 - ◆ A correlation development plan**
 - ◆ Correlation theoretical model development**
 - ◆ Data qualification**
 - ◆ Partitioning of the data into defining and validating data sets**
 - ◆ Correlation fitting and assessment of curve fit**
 - ◆ Correlation validation with independent data set**

Methods for Correlation Development Additive Constants



Topical Report Structured on Development Process

- > **Introduction (Section 1)**
- > **Summary (Section 2)**
- > **Definition of correlation (Section 3)**
- > **Correlation evaluation and behavior (Section 4)**
- > **Correlation validation (Section 5)**
- > **Critical power test data (Section 6)**
- > **Appendices**
 - ◆ **Derivation of theoretical form (Appendix A)**
 - ◆ **Rod centered peaking function examples (Appendix B)**
 - ◆ **List of symbols (Appendix C)**

Theoretical Model for Correlation

Theoretical Model

Theoretical Model

Theoretical Model

Theoretical Model

Where is the correlation equation?



Correlation Implementation

- > A single point of implementation – a reusable computer code library – is used for implementing correlation in all production codes**
- > A single point of implementation provides**
 - ◆ Consistent means for checking correlation input**
 - ◆ Consistent treatment of nodalization**
 - ◆ Consistent treatment of fluid properties**
 - ◆ Single consistent treatment of correlation bounds**
 - ◆ Elimination of subtle differences between code implementations of the critical power correlation**

Range of applicability is appropriate

Range of Applicability Pressure



Range of Applicability Mass Flow Rate (Upper Limit)



Range of Applicability Mass Flow Rate (Upper Limit)



Range of Applicability Mass Flow Rate (Lower Limit)



Range of Applicability Mass Flow Rate (Lower Limit)

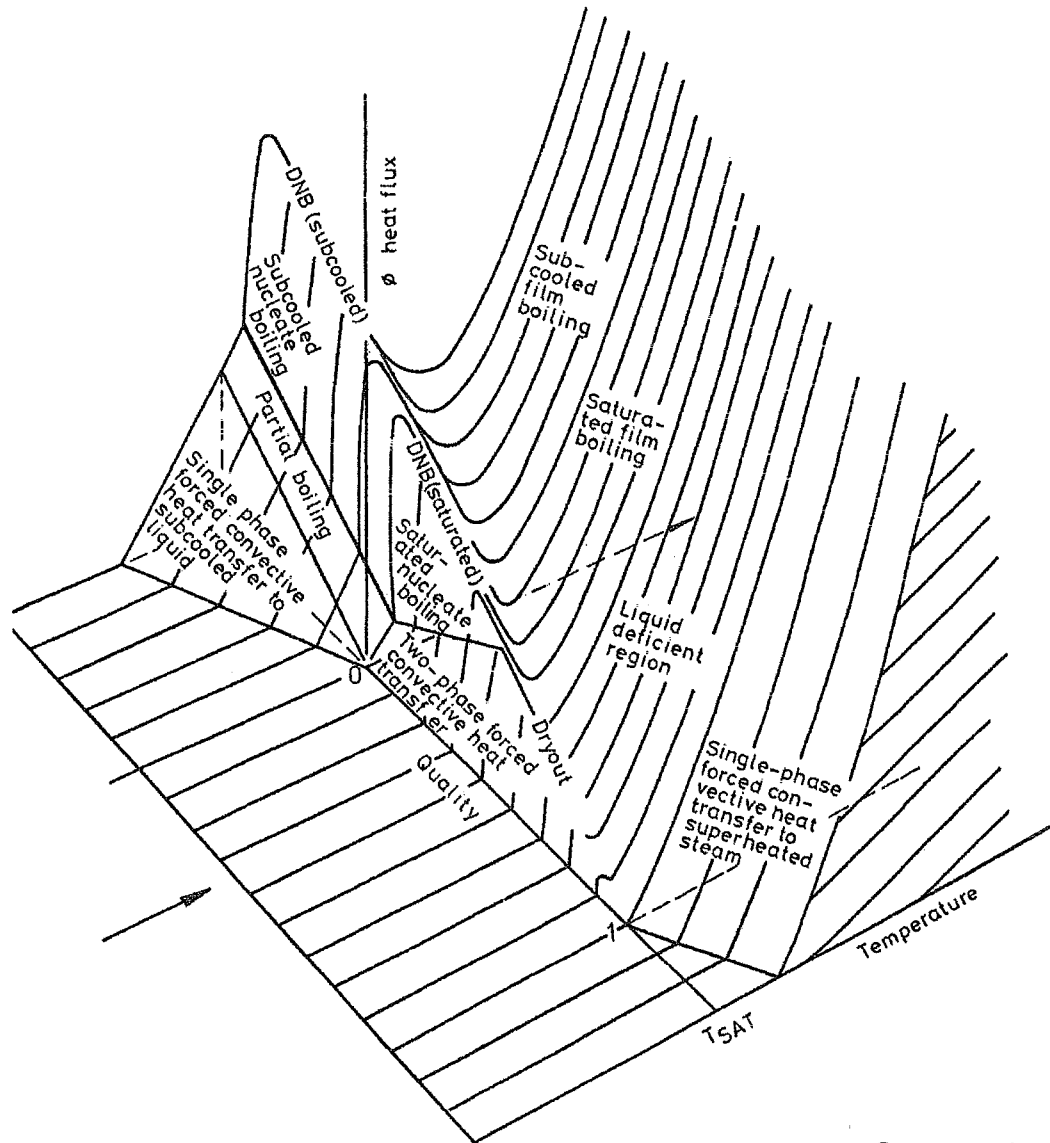
Range of Applicability Inlet Subcooling (Upper Limit)

Range of Applicability Inlet Subcooling (Lower Limit)





3D Boiling Map

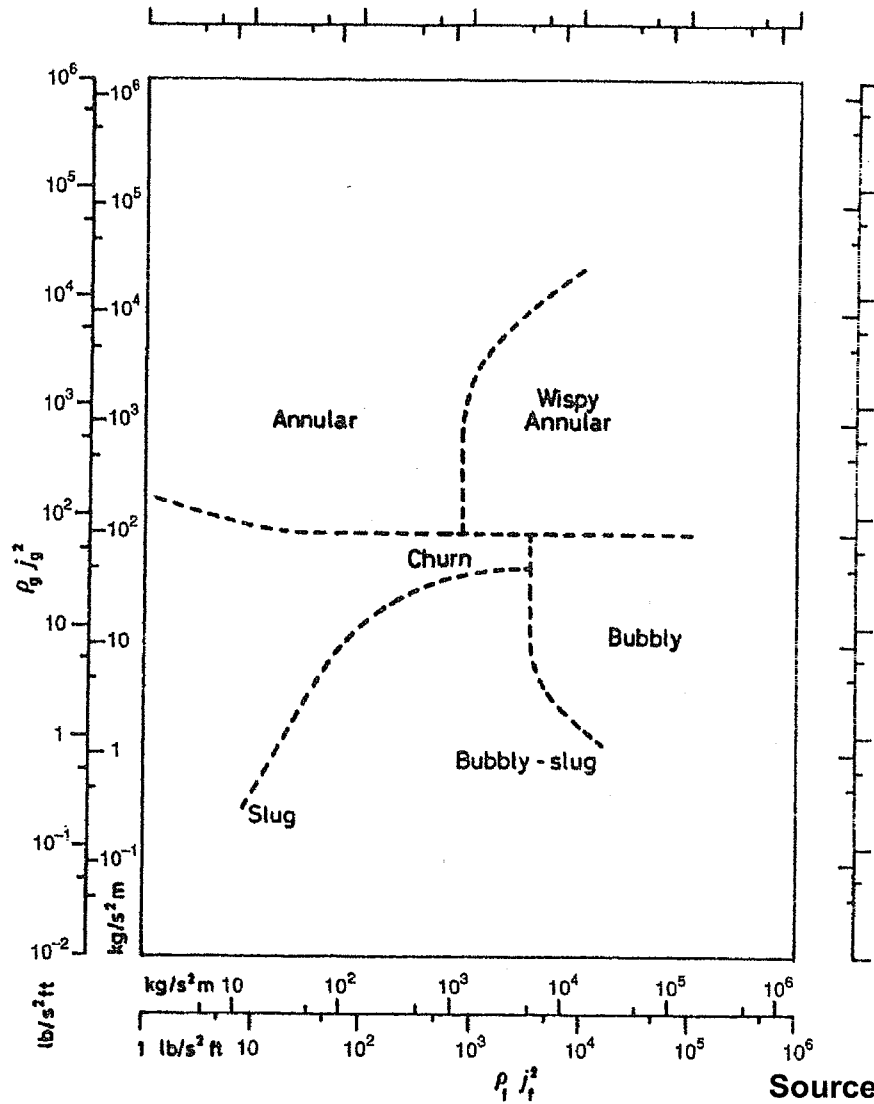


Source: Collier and Thome, Convective Boiling and Condensation, 3rd Edition, Page 174.





JFlow Regime Map



Source: Collier and Thome, Convective Boiling and Condensation, 3rd Edition, Page 19.



Correlation Applies to Transients

Transient Applications

Transient Applications

Conclusions

> **The ACE/ATRIUM-10 correlation can be approved because:**

- ◆ **The range of applicability is both sufficient and adequate**
- ◆ **The correlation applies to all conditions that might be encountered within the range of applicability**