Three-Dimensional Flow Analysis Inside Consortium Impeller at Design and Off-Design Conditions

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Three-dimensional flow fields inside the Consortium impeller were analyzed with a Navier-Stokes code. The numerical results at the design and off-design conditions are compared with the experimental data.

THREE-DIMENSIONAL FLOW ANALYSIS INSIDE CONSORTIUM IMPELLER AT DESIGN AND OFF-DESIGN CONDITIONS

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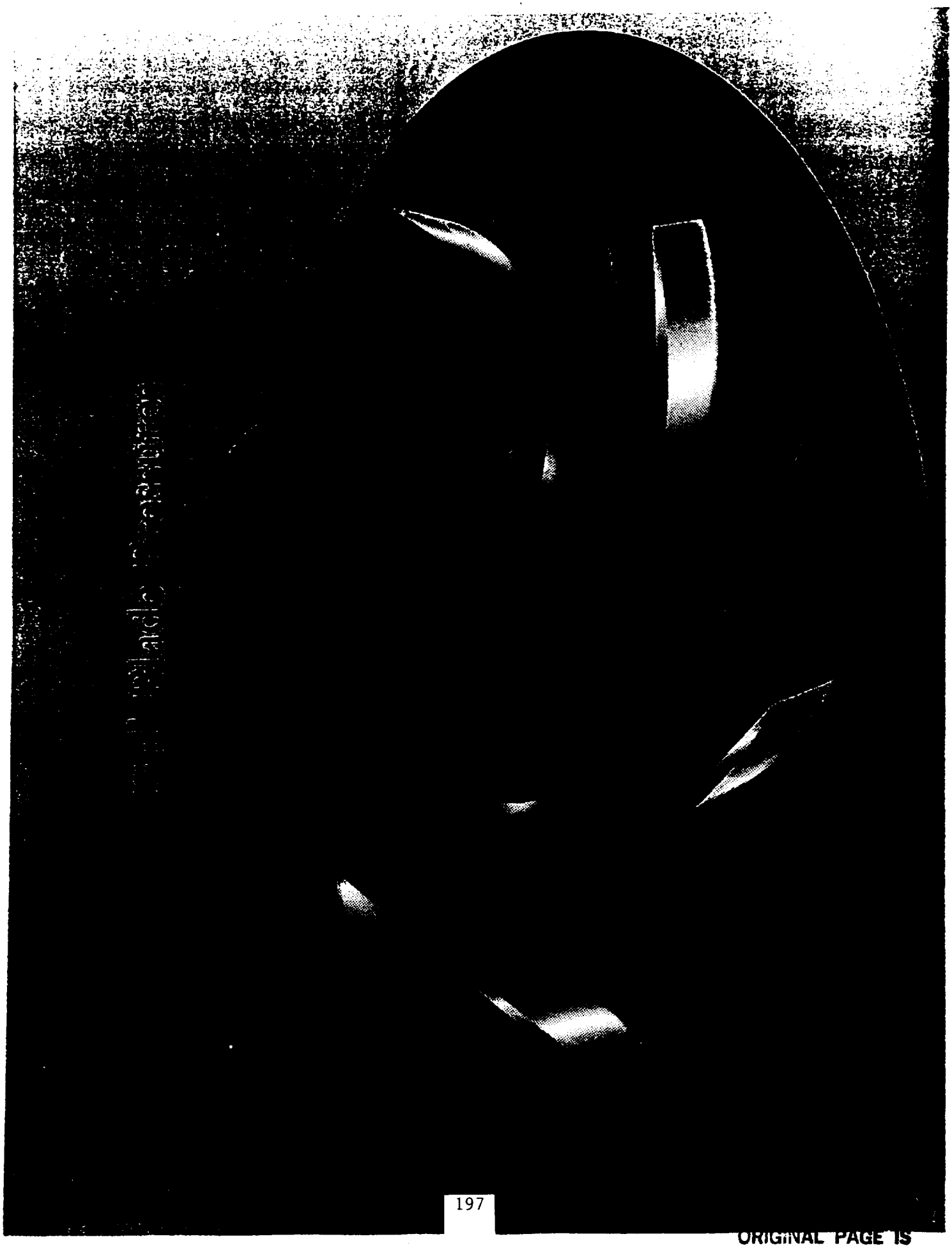


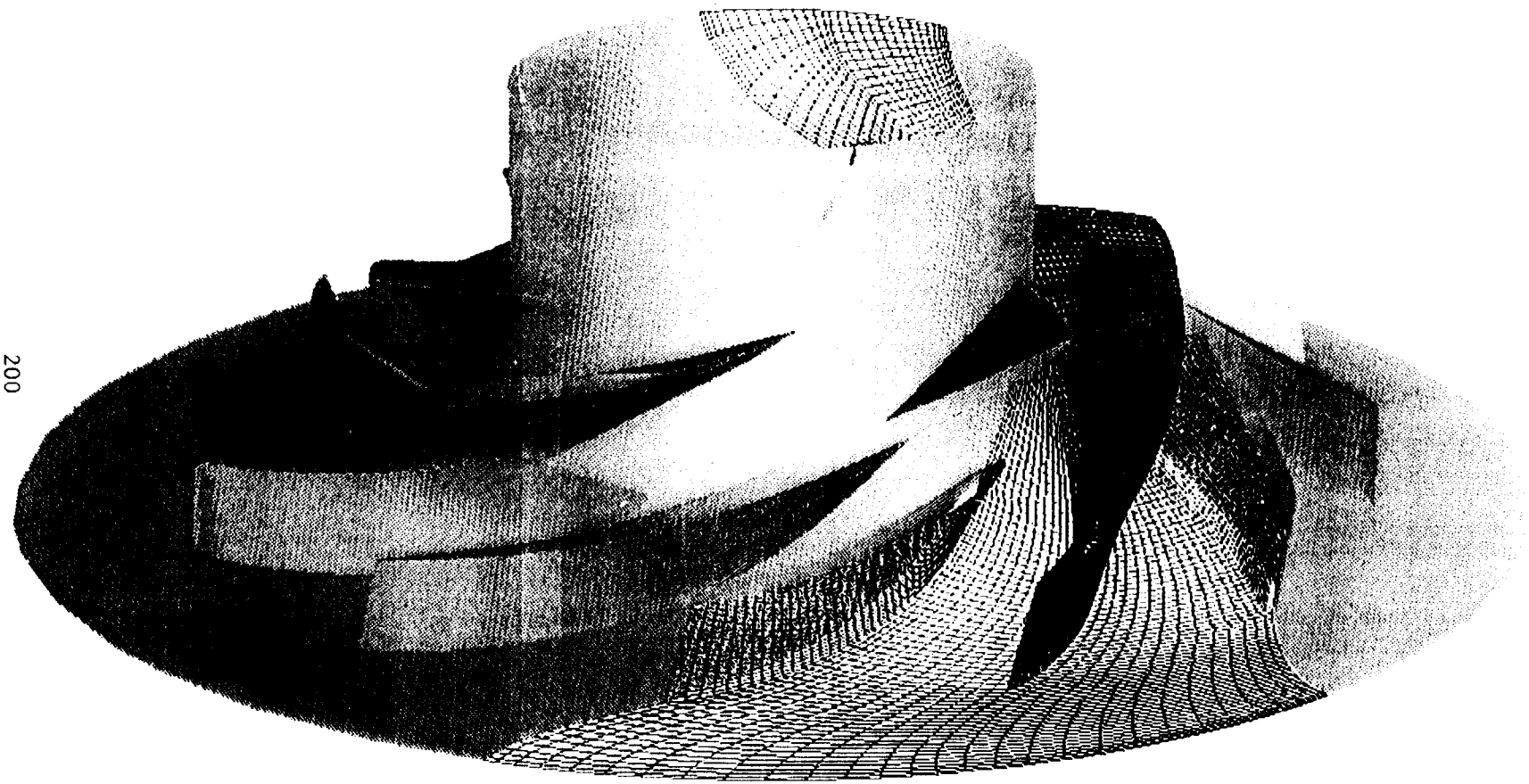
Objective

- o Design and Off-Design Performance
- o Numerical Optimization of Splitter

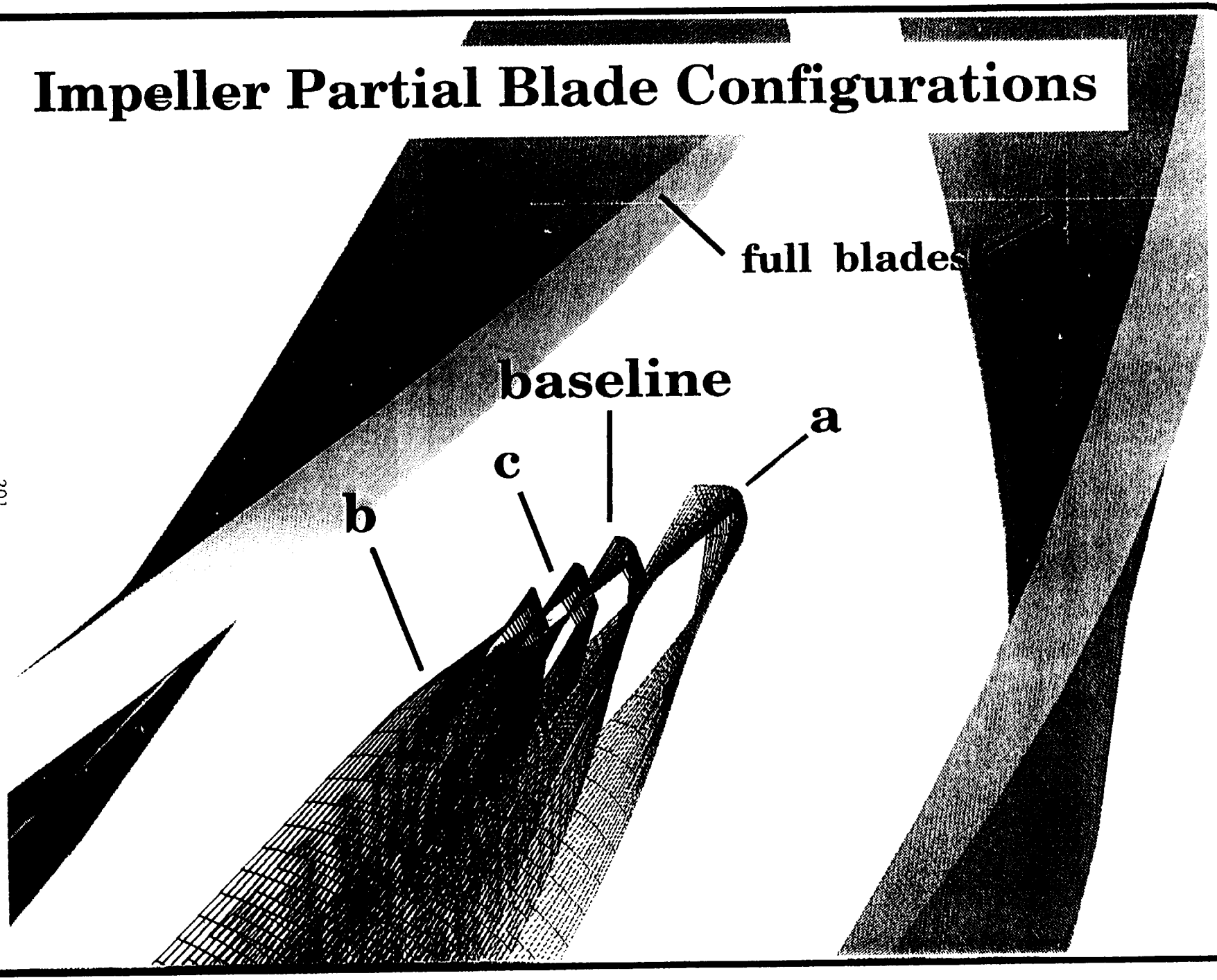
Computational grid

- o I-GRIDS
- o 40x24x123, 30x24x123, and 12x12x80

Computational Grid



Impeller Partial Blade Configurations

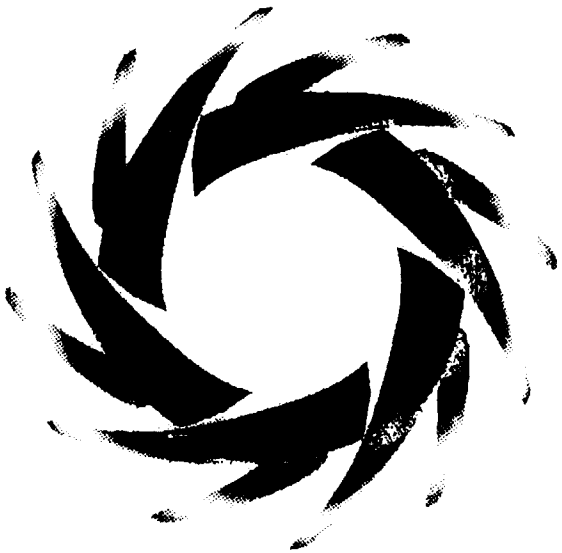


Flow Cases Studied

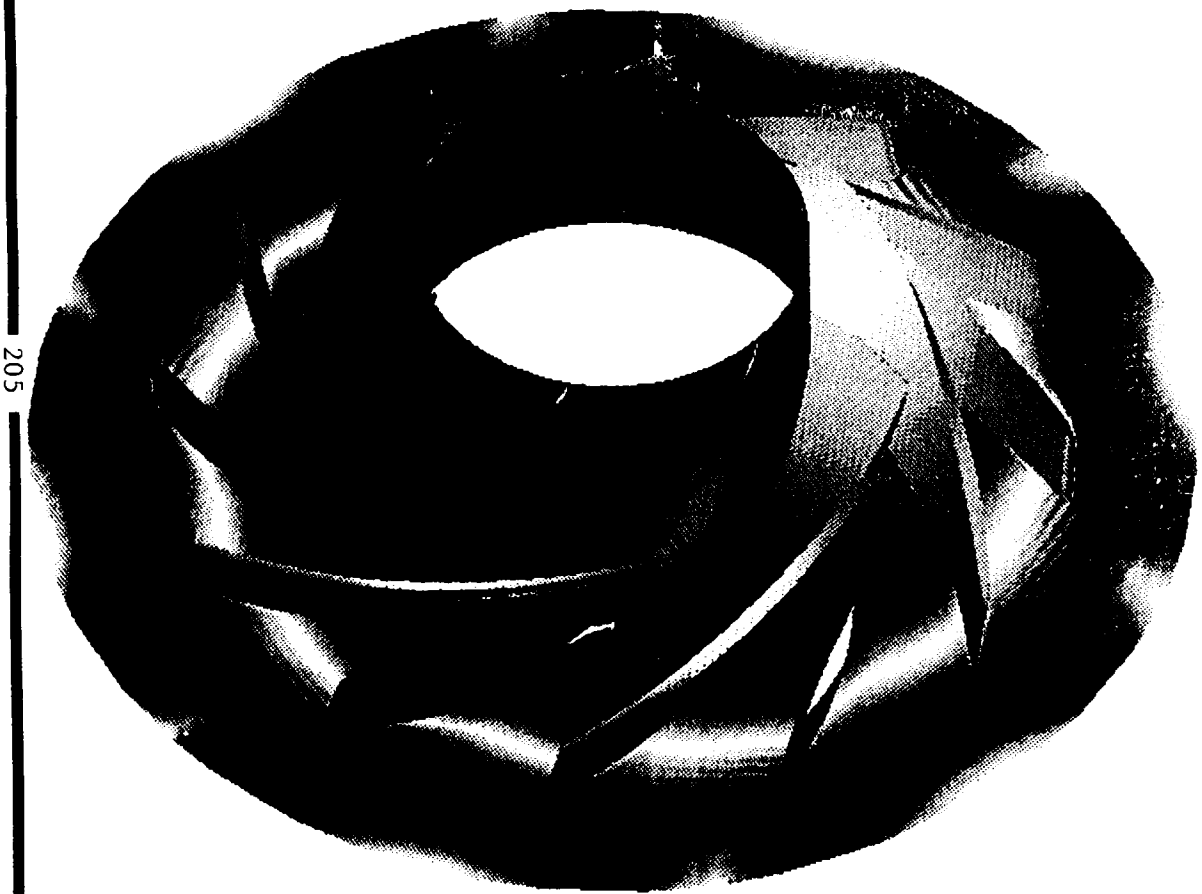
- Baseline
  - Design Flow
  - 120 % Design Flow
  - 88 % Design Flow
- Optimization of Splitter
  - Baseline
  - Cases A, B, C

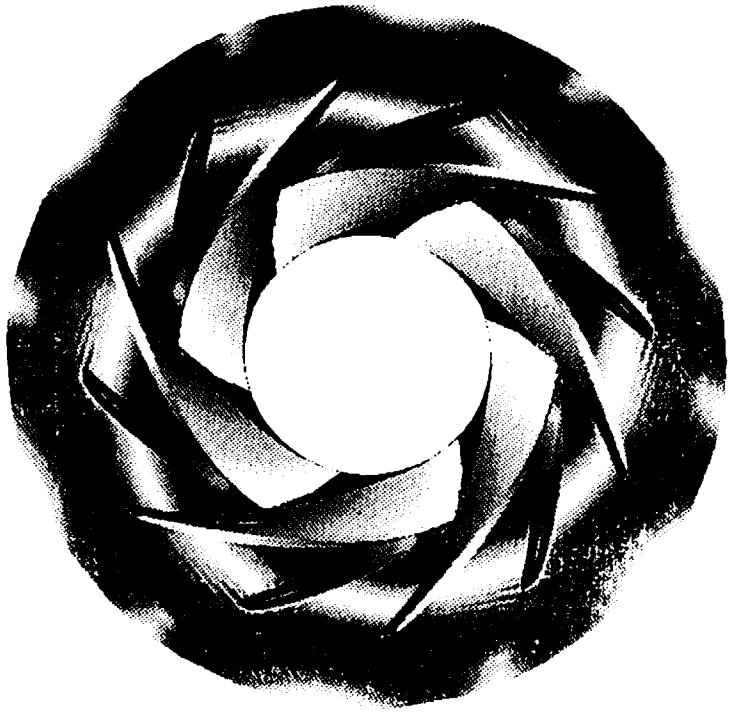
- **Baseline**
  - **Design Flow**
  - **120 % Design Flow**
  - **88 % Design Flow**

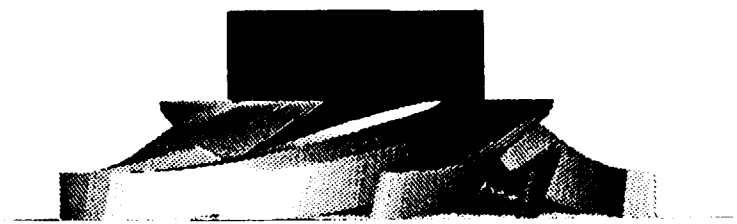
Blade Surface Pressure Contour



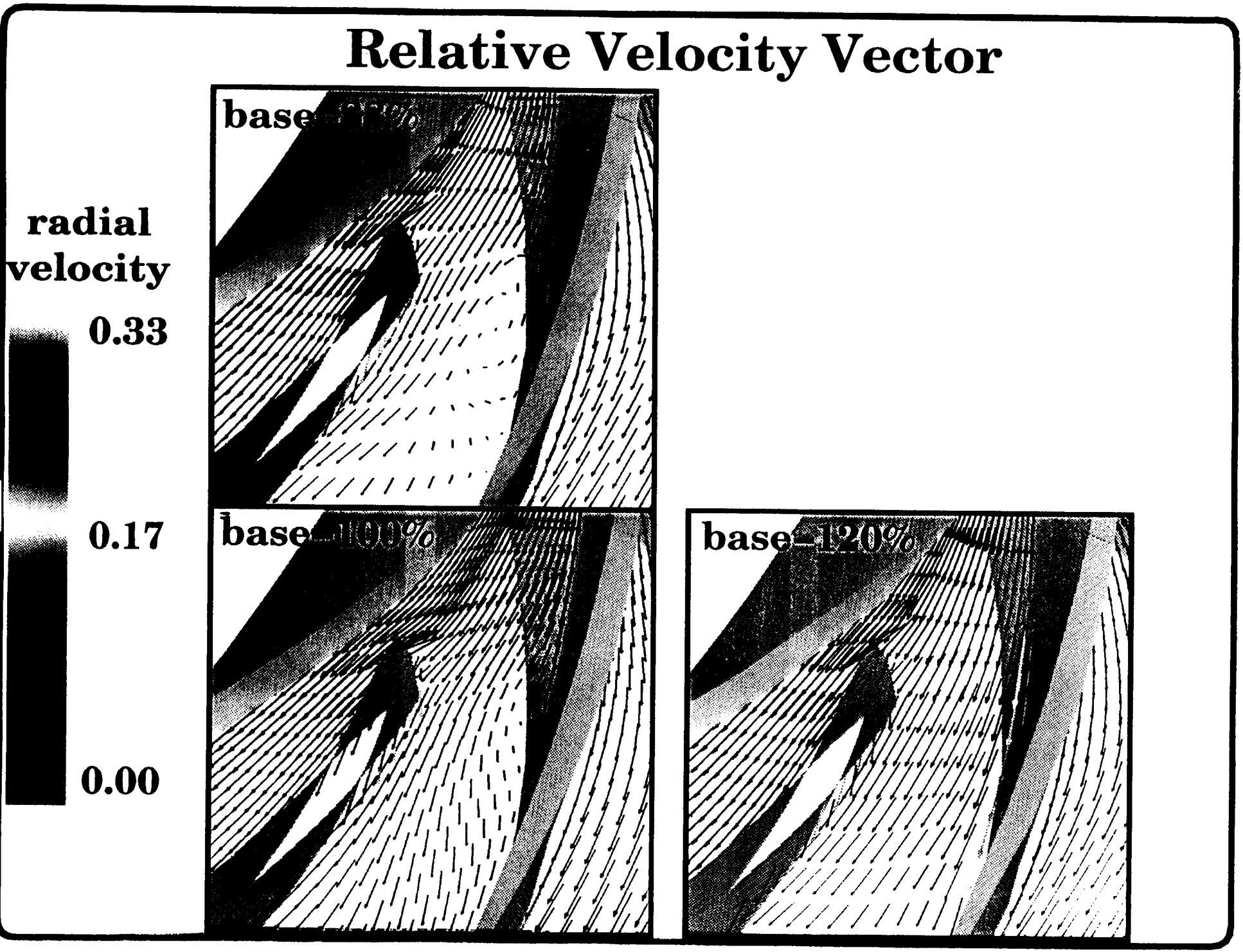
Hub Surface Pressure Contour



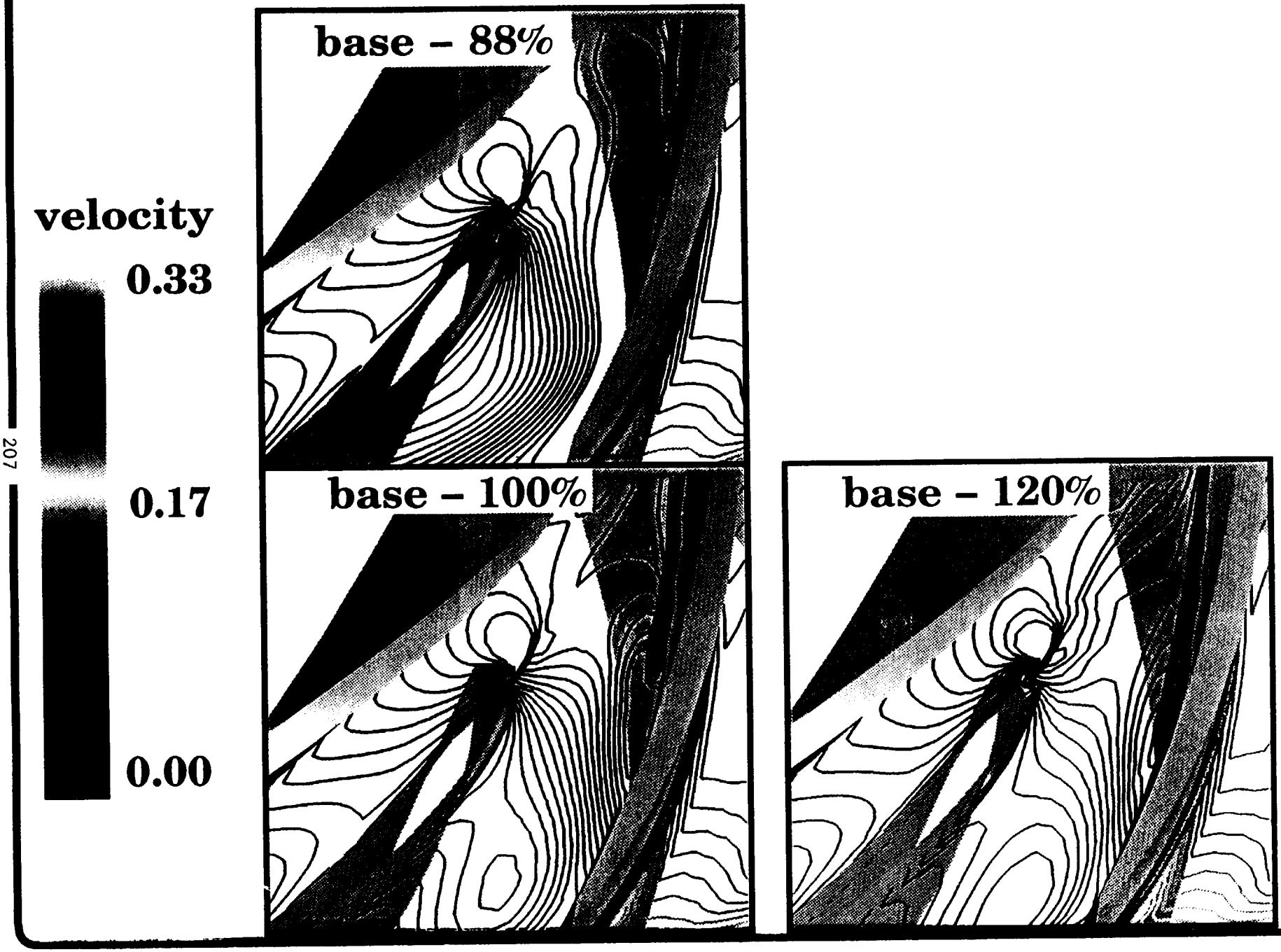




Relative Velocity Vector

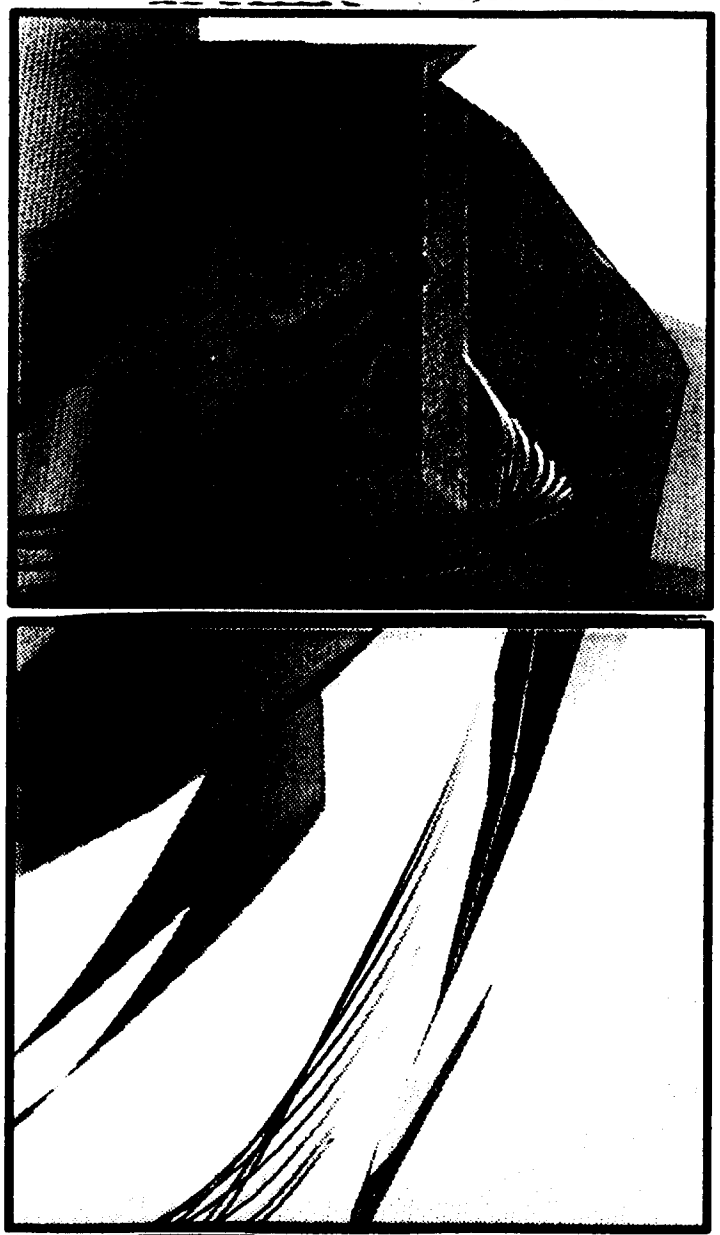


Nondimensional Radial Velocity

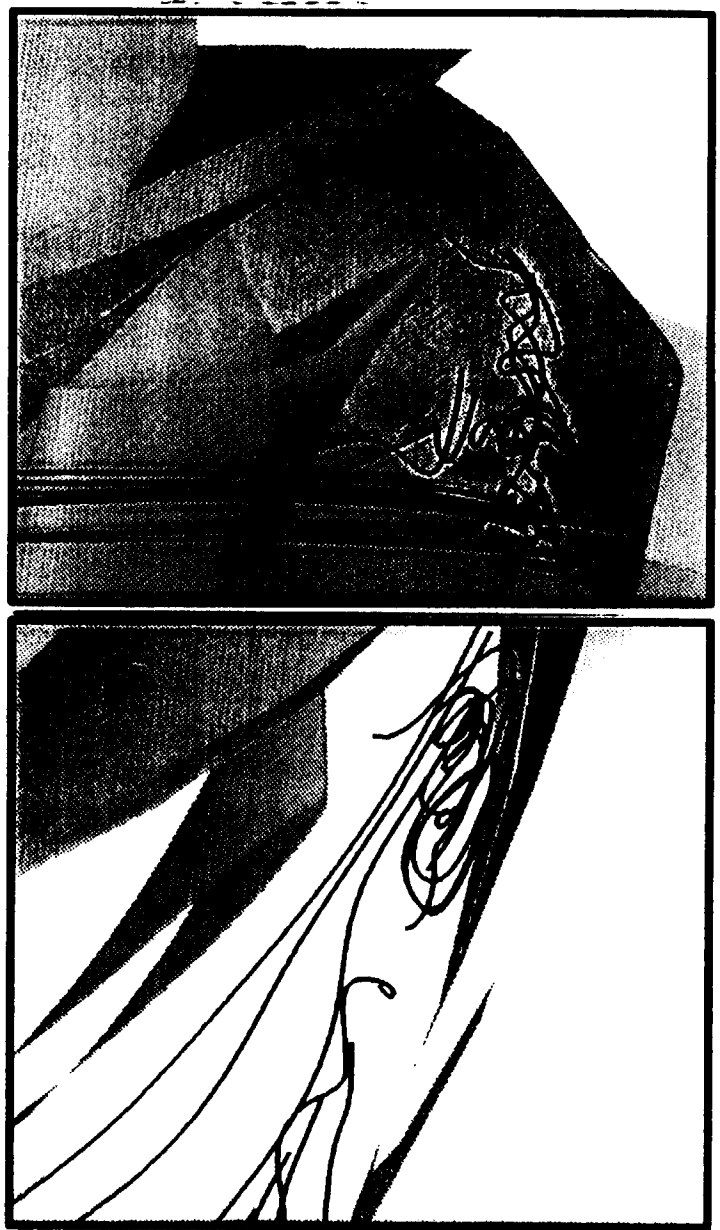


Particle Trace

baseline–coarse

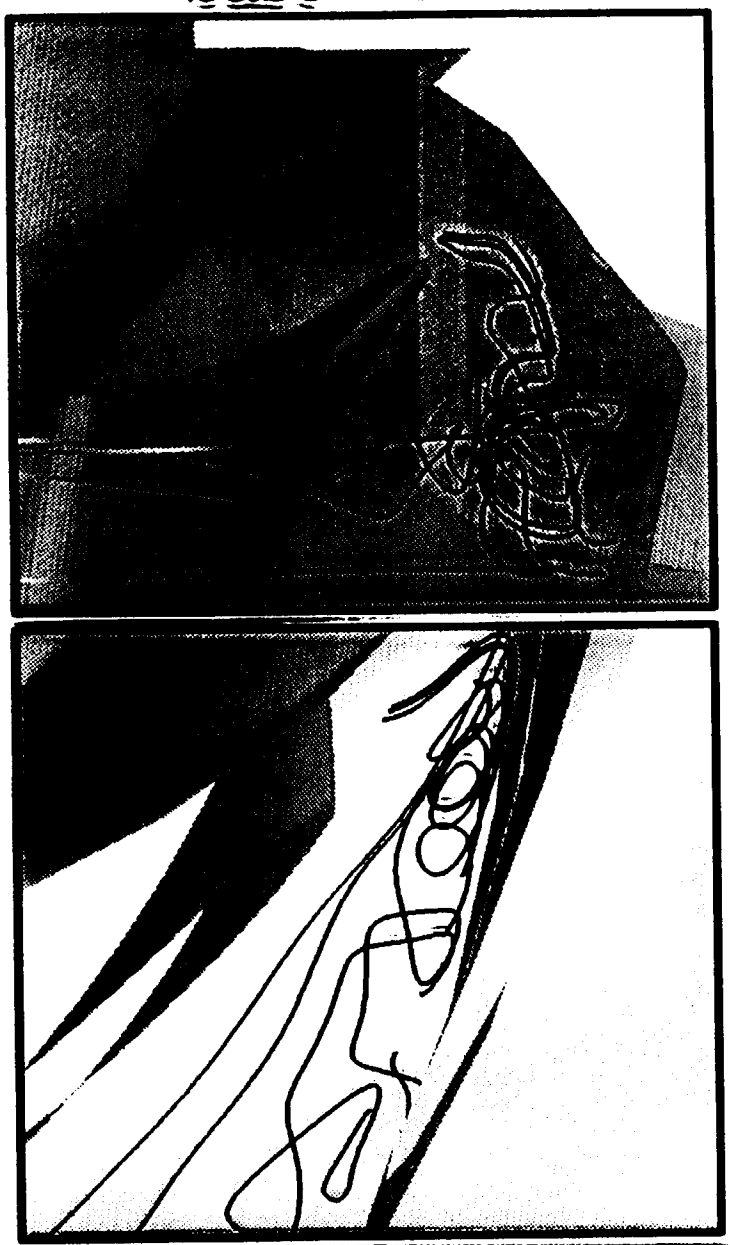


baseline–dense

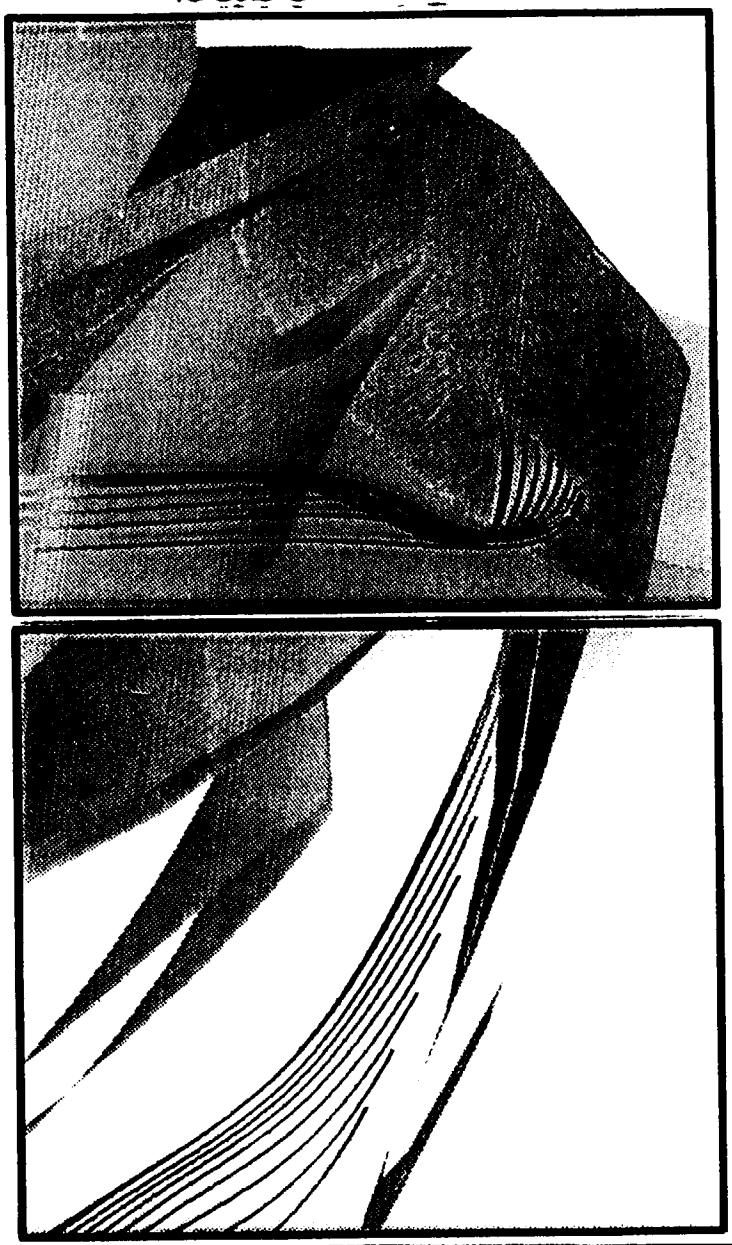


Particle Trace

base – 88%



base – 120%



Flow Split

88 % Flow : .46/.54

100 % Flow : .49/.51

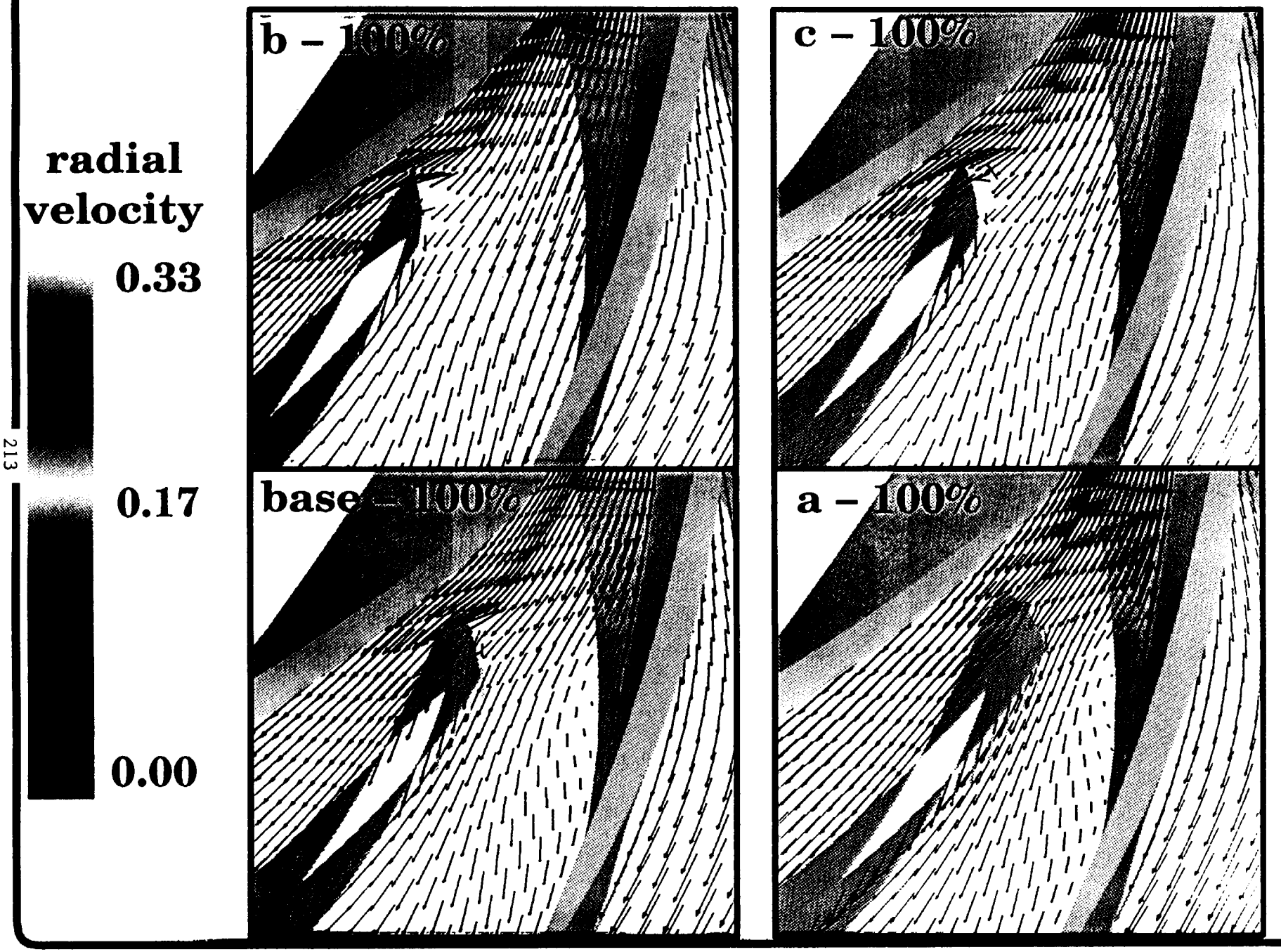
120 % Flow : .52/.48

Observation

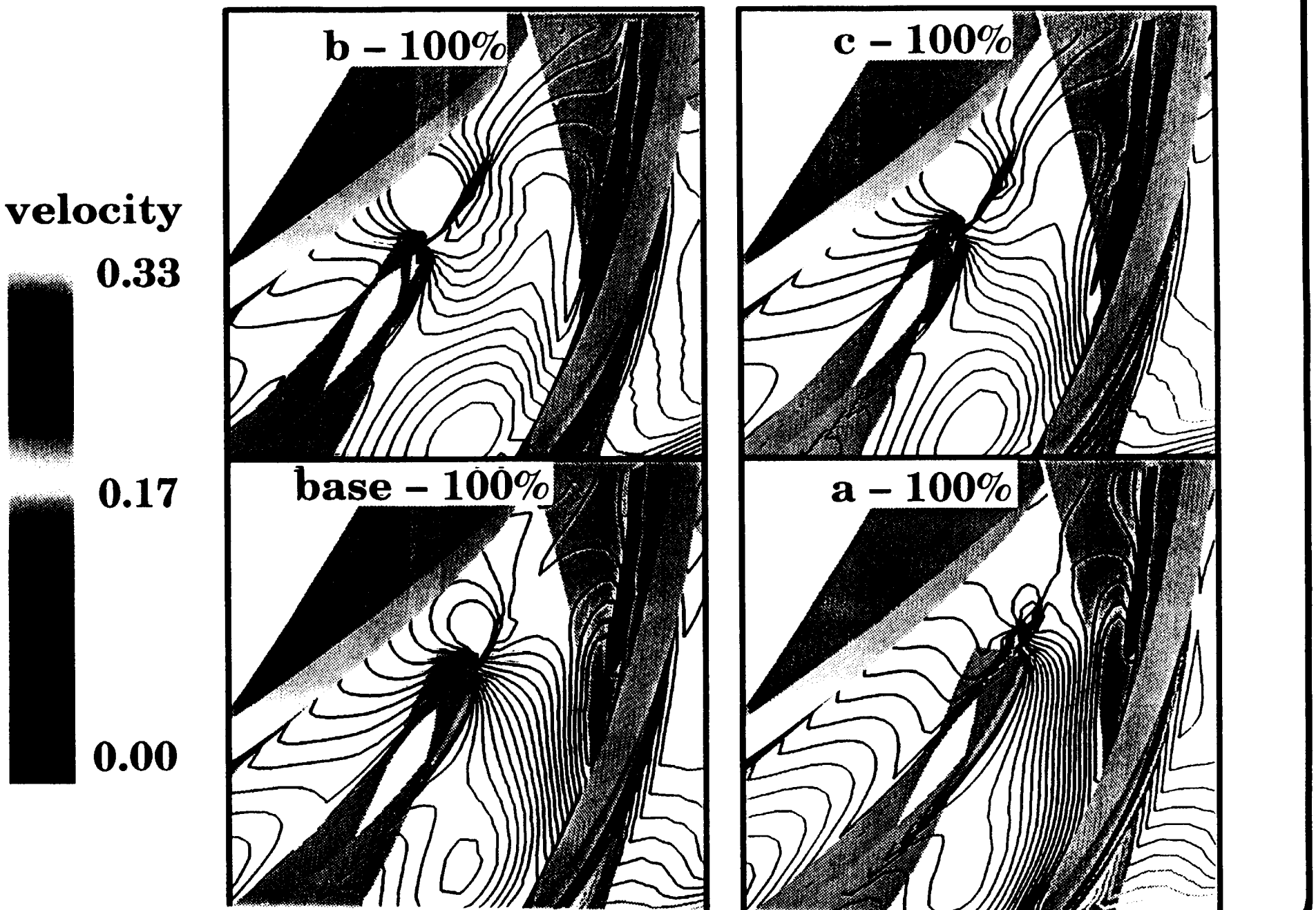
- o Small Flow Separation at Design Flow rate
- o Large Flow Separation at 88 % Flow rate
- o No Flow Separation at 120 % Flow rate

- **Optimization of Splitter**
  - **Baseline**
  - **Cases A, B, C**

Relative Velocity Vector



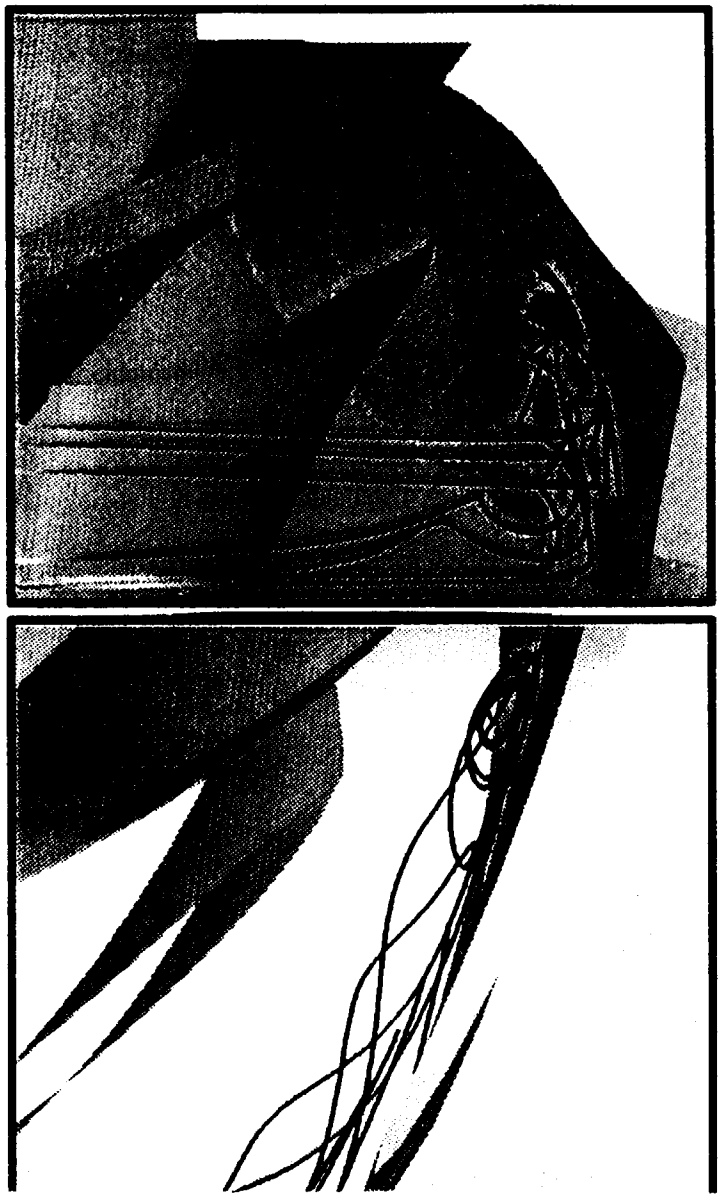
Nondimensional Radial Velocity



Particle Trace

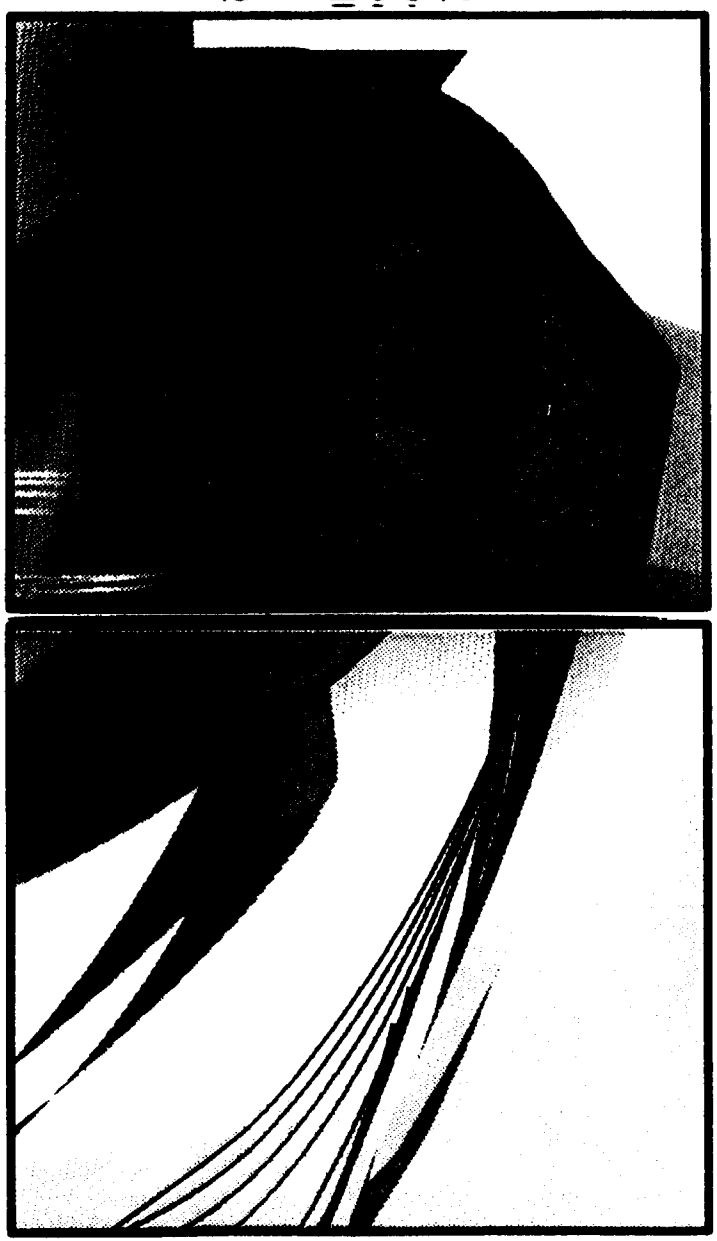
base – 100%

a – 100%

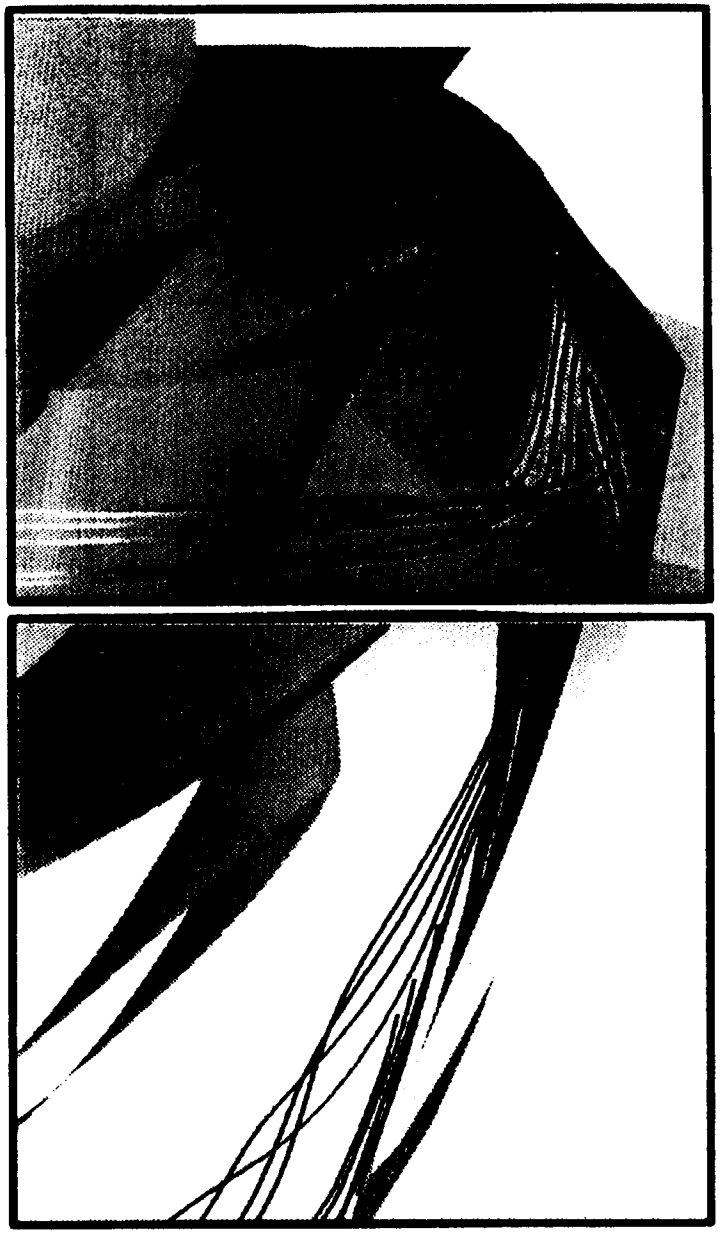


Particle Trace

b – 100%



c – 100%



Observation

- o Small Flow Separation for Baseline Design
- o Large Flow Separation for Design A
- o No Flow Separation For Design B
- o Design C is a Good Compromise