

**PACKAGE ID** - 000722SUN0000 FORCE2

**KWIC TITLE** - A Multidimensional Eulerian Model for  
Simulating Gas-Solids Flow

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**LIMITATION CODE** -UNL                   **AUDIENCE CODE** - UNL

**COMPLETION DATE** - 01/01/1991   **PUBLICATION DATE** - 05/01/1991

**DESCRIPTION** - FORCE2 is a fundamentally based three-dimensional numerical model for simulating fluid-bed hydrodynamics for a wide range of fluid beds, from laboratory to plant scale. It is based upon the 'two-fluid' modeling approach and includes surface permeabilities, volume porosities, and distributed resistances.

**PACKAGE CONTENTS** - Media Directory; Software Abstract;  
DOE/MC/24193-3503; DOE/MC/24193-3502; DOE/MC/24193-3504; Media  
Includes Source Code, Sample Problem Input;

**SOURCE CODE INCLUDED?** - Yes

**MEDIA QUANTITY** - 1 3.5 Diskette

**METHOD OF SOLUTION** - FORCE2 can perform either a transient or a steady simulation. In the transient mode, the implicit multifield technique due to Rivard is used to predict the hydrodynamics. The solution is controlled by the timestep, iteration, and mass convergence parameters specified. In the steady mode, a modified SIMPLER solution algorithm (Patankar and Schnipke) is used. This method is based on solving the momentum equations with a fixed pressure field and then correcting the velocities and pressures so that conservation of mass is satisfied. For each macro solution step, iterative solutions of the momentum equations, pressure correction equations, and continuity equations are carried out using a matrix solution procedure.

**COMPUTER** - SUN

**OPERATING SYSTEMS** - UNIX

**PROGRAMMING LANGUAGES** - FORTRAN 77

**SOFTWARE LIMITATIONS** - Problem size is limited by internal code dimensions. other limitations include: use of incompressible flow

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**SOFTWARE LIMITATIONS - (CONT)** only for the steady simulation, Newtonian fluids, solids only for one of the two phase, and forced convection or diffusion dominated flows.

**SOURCE CODE AVAILABLE (Y/N)** - Y

**UNIQUE FEATURES** - Transient or steady-state simulation; two-dimensional or three-dimensional parabolic or elliptical flows; distributed resistance modeling to simulate obstructions, such as porous plates and tube bundles in the flow field; general geometry specification using either complete blockage of control volumes (cells) or blockage of control volume surfaces; flow areas and volumes modified with surface permeabilities and volume porosities to account for obstructions in the flow field; Rivards implicit multifield solution method for transient simulations (1977); a modified SIMPLER solution algorithm (Patankar, 1980, Schnipke, 1986) for the steady simulation; simultaneous solution of the pressure field with the SIMPLER algorithm.

**RELATED SOFTWARE** - The FORCE2 Post-processor is system dependent and uses proprietary GKS graphics software. It is not included in the FORCE2 package.

**OTHER PROG/OPER SYS INFO** - Easily portable to other systems. The MAKE.FILE refers to a 'MAIN.F' file that is not in the source directory. Screening could not be completed.

**HARDWARE REQS** - A UNIX workstation with at least 6 Mybytes RAM and 20 Mbytes of disk space is needed to run FORCE2.

**TIME REQUIREMENTS** - A problem with 500 computational nodes will require 30 minutes of CPU time for each second of real time simulation.

**REFERENCES** - S.W. Burge, FORCE2: A Multidimensional Flow Program for Gas-Solids Flows, User's Guide, DOE/MC/24193-3503, May 1991; S.W. Burge, FORCE2: A Multidimensional Flow Program for Gas-Solids Flows, Theory Guide, DOE/MC/24193-3504, May 1991; S.W. Burge, Initial Validation of FORCE2, DOE/MC/24193-3502, June 1991.

**ABSTRACT STATUS** - Submitted June 20, 1994. Released AS-IS October 26, 1994

**SUBJECT CLASS CODE** - H

**KEYWORDS** -

COMPUTER PROGRAM DOCUMENTATION  
F CODES  
TWO-PHASE FLOW  
FLUIDIZED-BED COMBUSTION  
FLUIDIZED-BED COMBUSTORS  
FINITE DIFFERENCE METHOD

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SOFTWARE ABSTRACT

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TRANSIENTS  
FLUID FLOW  
HYDRODYNAMICS  
GAS FLOW  
SOLIDS

**EDB SUBJECT CATEGORIES** -  
990200 014000 420400

**SPONSOR** - DOE/FE

**PACKAGE TYPE** - AS - IS