

**PACKAGE ID** - 000650IBMPC00 PIPE

**KWIC TITLE** - Heat Transfer and Friction-Factor Methods  
Turbulent Flow Inside Pipes 3d Rough

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

**COMPLETION DATE** - 02/01/1992   **PUBLICATION DATE** - 02/01/1992

**DESCRIPTION** - Three-dimensional roughened internally enhanced tubes have been shown to be one of the most energy efficient for turbulent, forced convection applications. However, there is only one prediction method presented in the open literature and that is restricted to three-dimensional sand-grain roughness. Other roughness types are being proposed: hemispherical sectors, truncated cones, and full and truncated pyramids. There are no validated heat-transfer and friction-factor prediction methods for these different roughness shapes that can be used in the transition and fully rough region. This program calculates the Nusselt number and friction factor values, for a broad range of three-dimensional roughness types such as hemispherical sectors, truncated cones, and full and truncated pyramids. Users of this program are heat-exchangers designers, enhanced tubing suppliers, and research organizations or academia who are developing or validating prediction methods.

**PACKAGE CONTENTS** - Media Directory; Software Abstract; ANL/ESD/TM-31;  
Media Includes Source Code, Executable Module;

**SOURCE CODE INCLUDED?** - Yes

**MEDIA QUANTITY** - 1 3.5 Diskette

**METHOD OF SOLUTION** - PIPE obtains solutions of a modified form of the momentum and energy equations using an implicit finite difference method. These modified forms on the momentum and energy equations contain contributions from the roughness elements and also form the unaltered portion of the pipe.

**COMPUTER** - IBM PC

**OPERATING SYSTEMS** - MS-DOS

**PROGRAMMING LANGUAGES** - MS-FORTRAN 77

**SOFTWARE LIMITATIONS** - Can not be used for all types of three-dimensional spiral-rib roughness configurations.

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**SOFTWARE LIMITATIONS - (CONT)**

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

**UNIQUE FEATURES** - Throughout the code, attempts were made to use variable names that were close facsimiles of the symbols in the mathematical development in the text. \$DECLARE and \$STRICT commands of Microsoft FORTRAN were used that force the compiler to obey strict FORTRAN 77 standards for easing portability. The input is interactive and output is self explanatory.

**RELATED SOFTWARE** - PIPE is used for cone and truncated cone shapes. Another version called PIPES is used for hemispherical sectors. The difference in the two programs is one subroutine.

**HARDWARE REQS** - PC computer

**TIME REQUIREMENTS** - About 10 seconds on 386 type machine.

**REFERENCES** - R.B Taylor and B.K. Hodge, 'Validated Heat-Transfer and Pressure-Drop Prediction Methods Based on the Discrete Element Method: Phase I, Three-Dimensional Roughness, ANL/ESD/TM-131, February 1992.

**ABSTRACT STATUS** - Submitted January 1994. Released screened March 2, 1994.

**SUBJECT CLASS CODE** - H

**KEYWORDS** -

COMPUTER PROGRAM DOCUMENTATION  
P CODES  
THREE-DIMENSIONAL CALCULATIONS  
HEAT TRANSFER  
TURBULENT FLOW  
TUBES  
FRICTION FACTOR  
HEAT EXCHANGERS

**EDB SUBJECT CATEGORIES** -

990200 420400

**SPONSOR** - DOE/CE

**PACKAGE TYPE** - SCREENED