RECOMP II USERS' PROGRAM NO. 1052

PROGRAM TITLE:	SUBROUTINE K(k)
PROGRAM CLASSIFICATION:	Subroutine
AUTHOR:	J. N. Brooks Baird-Atomic, Inc. Cambridge, Massachusetts
PURPOSE:	Subroutine K(k) obtains the complete elliptic integral of the first kind of the floating parameter k.
DATE:	9 December 1960

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B/A Subroutine K(k)

SUBROUTINE K(k)

Subroutine K(k) obtains the complete elliptic integral of the first kind, viz.

$$K = K(k) = F(\tfrac{1}{2}\pi, k) = \int_0^{\frac{1}{2}\pi} \frac{d\phi}{\sqrt{1 - k^2 \sin^2\phi}} = \int_0^1 \frac{dx}{\sqrt{(1-x^2)(1-k^2x^2)}} .$$

$$0 \leq k < 1 .$$

The approximation used is that given in Hastings, "Approximations for Digital Computers."[1]

$$K(k) \approx \sum_{i=0}^{4} a_i \eta^i + \left(\sum_{i=0}^{4} b_i \eta^i \right) \ln_e 1/\eta ,$$

$$\eta = 1-k^2$$

the cofficients given as follows:

$a_0 = 1.3862,9436,112$	$b_0 = .5$
$a_1 = .0966,6344,259$	$b_1 = .1249,8593,597$
$a_2 = .0359,0092,383$	$b_2 = .0688,0248,576$
$a_3 = .0374,2563,713$	$b_3 = .0332,8355,346$
$a_4 = .0145,1196,212$	$b_4 = .0044,1787,012$.

The maximum error ϵ as shown in the table (op. cit.) is

$$|\epsilon| \leq 1.5 \times 10^{-8} .$$

To obtain K'(k) make use of the following relationship:

$$K'(k) = K(k') = F(\tfrac{1}{2}\pi, k') \quad .$$

[1] Hastings, Cicil Jr., "Approximations for Digital Computers," Princeton University Press, Princeton, N.J., 1955. Page 172.

[2] For further information and relationships see:
Erdelyi, et al., "Higher Transcendental Functions," Bateman Manuscript Project, Calif. Institute of Technology, McGraw-Hill Book Co., Vol. 2 , Chapter XIII, 1953.

Relocation Matrix IV(-L.)

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