Warning: Subroutine MA26 performs functions which are adequately treated by routines in other standard subroutine libraries (for example, LAPACK). The use of this routine is not recommended, and it may be removed from future releases of this library.

1 SUMMARY

The routine solves the system of linear equations

$\mathbf{T}x=b$

where the matrix **T** is symmetric positive definite and tri-diagonal The matrix must be in the form of two arrays containing the diagonal and off-diagonal elements. After the first entry when the matrix factors are computed, the routine may be re-entered with a new R.H.S. and a solution obtained without re-factorization. If the matrix is found to be not positive-definite, an error return will be made and an error message generated.

ATTRIBUTES — Version: 1.0.0. **Types:** MA26A, MA26AD. **Calls:** None. **Original date:** May 1975 **Origin:** W.R. Owen, University of Queensland, Australia.

2 HOW TO USE THE PACKAGE

The single precision version

```
CALL MA26A(N,ALPHA,BETA,BX,IERR)
```

The double precision version

```
CALL MA26AD(N,ALPHA,BETA,BX,IERR)
```

N is an INTEGER variable, the size (dimension) of the matrix and length of the arrays ALPHA, BETA and BX.

Restriction N > 1.

ALPHA is a REAL (DOUBLE PRECISION in the D version) array to be set on entry to the diagonal

ALPHA(K) = $T_{k,k}$ 1 ≤ k ≤ N, 1 ≤ K ≤ N

(as produced by MC04B/BD). On return ALPHA will contain the diagonal matrix factors.

BETA is a REAL (DOUBLE PRECISION in the D version) array to be set by the user to the off- diagonal elements of the matrix such that

BETA(i) = $T_{i,i+1}$ 1 ≤ i ≤ (N-1) or BETA(j) = $T_{j,j-1}$ 2 ≤ j ≤ N

(as produced by MC04B/BD). On return BETA will contain the off-diagonal matrix factors. **NOTE:** BETA(1) need not be set by the user.

BX is a REAL (DOUBLE PRECISION in the D version) array to be set on entry to the right hand side of the equations, such that

BX(I) = b_i 1 ≤ I ≤ N, 1 ≤ i ≤ N.

On return BETA will contain the solution such that

BX(K) = x_k 1 ≤ K ≤ N, 1 ≤ k ≤ N

IERR is an INTEGER which on return will be

= 0 if a successful decomposition and solution has been computed;

= I if the decomposition failed at the Ith pivot.

3 COMMON

The routine uses a common area (MA26B/BD), which the user may reference.

The single precision version

```
COMMON/MA26B/LUEM,IOPT
```

The double precision version

```
COMMON/MA26BD/LUEM,IOPT
```

LUEM is an INTEGER may be set by the user to the logical unit number of the output device to which error messages are to be sent. It is set by default to 6. If set to zero, no messages will be generated.

IOPT is an INTEGER a switch to control processing and re-entry. If set to zero the matrix elements must be in arrays ALPH and BETA and a decomposition and solution will be attempted. If IOPT is non-zero the matrix factors must be in arrays ALPHA and BETA and a solution without decomposition will be computed for the right hand side in array BX.

4 OTHER ROUTINES

None required.

5 ERROR MESSAGES

Two circumstances will generate an error return as follows:

a) If N < 1, IERR is set to –1 and the message generated is of the form

```
ERROR IN MA26A    SIZE OF MATRIX =  n
```

where n is the value of the argument N on entry.

b) If the matrix is not positive definite, a zero or negative pivot will occur. IERR is set to the row number of this pivot and the message generated is of the form:

```
ERROR  IN  MA16A      PIVOT NUMBER  r  is  xxx
```

where r is the row number and xxx is the negative or zero value of the pivot from the rth row.

6 GENERAL INFORMATION

Use of common: : MA26B/BD used. See Section 3.

Workspace: : None required.

Input/output: : Violation of the argument restriction for N or loss of positive-definiteness results in an error message if LUEM in labelled common has not been set to zero. See Sections 3 and 5.

Restrictions: : There are restrictions on the value of N and the matrix must be tri-diagonal, symmetric and positive-definite.

7 METHOD

A standard Choleski decomposition is performed and the factors over-write the original matrix.

8 NOTE

The first location of BETA does not contain useful information on entry. This location is used by the routine but is set to 0.0 before returning.