

# NAG Library Routine Document

## D02NYF

**Note:** before using this routine, please read the Users' Note for your implementation to check the interpretation of ***bold italicised*** terms and other implementation-dependent details.

### 1 Purpose

D02NYF is a diagnostic routine which you may call either after any user-specified exit or after a mid-integration error exit from any of those integrators in sub-chapter D02M–N that use methods set up by calls to D02MVF, D02NVF or D02NWF.

### 2 Specification

```

SUBROUTINE D02NYF(NEQ, NEQMAX, HU, H, TCUR, TOLSF, RWORK, NST, NRE, NJE,
1              NQU, NQ, NITER, IMXER, ALGEQU, INFORM, IFAIL)

  INTEGER      NEQ, NEQMAX, NST, NRE, NJE, NQU, NQ, NITER, IMXER,
1              INFORM(23), IFAIL
  double precision HU, H, TCUR, TOLSF, RWORK(50+4*NEQ)
  LOGICAL      ALGEQU(NEQ)

```

### 3 Description

D02NYF permits you to inspect statistics produced by any integrator in this sub-chapter that has been set up a call to one of D02MVF, D02NVF or D02NWF. These statistics concern the integration only.

### 4 References

See the D02M–N sub-chapter Introduction.

### 5 Parameters

- |    |                                                                                                                                                                                                                                                                                                                     |               |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| 1: | NEQ – INTEGER                                                                                                                                                                                                                                                                                                       | <i>Input</i>  |
|    | <i>On entry:</i> the value used for the parameter NEQ when calling the integrator.                                                                                                                                                                                                                                  |               |
|    | <i>Constraint:</i> $NEQ \geq 1$ .                                                                                                                                                                                                                                                                                   |               |
| 2: | NEQMAX – INTEGER                                                                                                                                                                                                                                                                                                    | <i>Input</i>  |
|    | <i>On entry:</i> the value used for the parameter NEQMAX when calling the integrator.                                                                                                                                                                                                                               |               |
|    | <i>Constraint:</i> $NEQMAX \geq NEQ$ .                                                                                                                                                                                                                                                                              |               |
| 3: | HU – <b>double precision</b>                                                                                                                                                                                                                                                                                        | <i>Output</i> |
|    | <i>On exit:</i> the last successful step size.                                                                                                                                                                                                                                                                      |               |
| 4: | H – <b>double precision</b>                                                                                                                                                                                                                                                                                         | <i>Output</i> |
|    | <i>On exit:</i> the proposed next step size for continuing the integration.                                                                                                                                                                                                                                         |               |
| 5: | TCUR – <b>double precision</b>                                                                                                                                                                                                                                                                                      | <i>Output</i> |
|    | <i>On exit:</i> $t$ , the value of the independent variable which the integrator has actually reached. TCUR will always be at least as far as the output value of the argument $t$ in the direction of integration, but may be further (if overshooting and interpolation at TOUT was specified, e.g., see D02NBF). |               |

- 6: TOLSF – *double precision* *Output*  
*On exit:* a tolerance scale factor,  $\text{TOLSF} \geq 1.0$ , which is computed when a request for too much accuracy is detected by the integrator (indicated by a return with IFAIL = 3 or 14). If ITOL is left unaltered but RTOL and ATOL are uniformly scaled up by a factor of TOLSF the next call to the integrator is deemed likely to succeed.
- 7: RWORK( $50 + 4 \times \text{NEQ}$ ) – *double precision* array *Communication Array*  
*On entry:* contains information supplied by the integrator.
- 8: NST – INTEGER *Output*  
*On exit:* the number of steps taken in the integration so far.
- 9: NRE – INTEGER *Output*  
*On exit:* the number of function or residual evaluations (FCN (e.g., see D02NBF) or RESID (e.g., see D02NGF) calls) used in the integration so far.
- 10: NJE – INTEGER *Output*  
*On exit:* the number of Jacobian evaluations used in the integration so far. This equals the number of matrix *LU* decompositions.
- 11: NQU – INTEGER *Output*  
*On exit:* the order of the method last used (successfully) in the integration.
- 12: NQ – INTEGER *Output*  
*On exit:* the proposed order of the method for continuing the integration.
- 13: NITER – INTEGER *Output*  
*On exit:* the number of iterations performed in the integration so far by the nonlinear equation solver.
- 14: IMXER – INTEGER *Output*  
*On exit:* the index of the component of largest magnitude in the weighted local error vector ( $e_i/w_i$ ), for  $i = 1, 2, \dots, \text{NEQ}$ .
- 15: ALGEQU(NEQ) – LOGICAL array *Output*  
*On exit:*  $\text{ALGEQU}(i) = \text{.TRUE.}$  if the  $i$ th equation integrated was detected to be algebraic, otherwise  $\text{ALGEQU}(i) = \text{.FALSE.}$ . Note that when the integrators for explicit equations are being used, then  $\text{ALGEQU}(i) = \text{.FALSE.}$ , for  $i = 1, 2, \dots, \text{NEQ}$ .
- 16: INFORM(23) – INTEGER array *Communication Array*  
*On entry:* contains information supplied by the integrator.
- 17: IFAIL – INTEGER *Input/Output*  
*On entry:* IFAIL must be set to 0, -1 or 1. If you are unfamiliar with this parameter you should refer to Section 3.3 in the Essential Introduction for details.  
*On exit:* IFAIL = 0 unless the routine detects an error (see Section 6).  
 For environments where it might be inappropriate to halt program execution when an error is detected, the value -1 or 1 is recommended. If the output of error messages is undesirable, then the value 1 is recommended. Otherwise, if you are not familiar with this parameter, the recommended value is 0. **When the value -1 or 1 is used it is essential to test the value of IFAIL on exit.**

## 6 Error Indicators and Warnings

If on entry  $IFAIL = 0$  or  $-1$ , explanatory error messages are output on the current error message unit (as defined by  $X04AAF$ ).

Errors or warnings detected by the routine:

$IFAIL = 1$

On entry,  $NEQ < 1$ ,  
or  $NEQMAX < 1$ ,  
or  $NEQ > NEQMAX$ .

## 7 Accuracy

Not applicable.

## 8 Further Comments

Statistics for sparse matrix linear algebra calls (if appropriate) may be determined by a call to  $D02NXF$ .

## 9 Example

See Section 9 in  $D02NBF$ .

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