

NAG Toolbox

nag_specfun_bessel_k1_scaled (s18cd)

1 Purpose

nag_specfun_bessel_k1_scaled (s18cd) returns a value of the scaled modified Bessel function $e^x K_1(x)$ via the function name.

2 Syntax

```
[result, ifail] = nag_specfun_bessel_k1_scaled(x)
[result, ifail] = s18cd(x)
```

3 Description

nag_specfun_bessel_k1_scaled (s18cd) evaluates an approximation to $e^x K_1(x)$, where K_1 is a modified Bessel function of the second kind. The scaling factor e^x removes most of the variation in $K_1(x)$.

The function uses the same Chebyshev expansions as nag_specfun_bessel_k1_real (s18ad), which returns the unscaled value of $K_1(x)$.

4 References

Abramowitz M and Stegun I A (1972) *Handbook of Mathematical Functions* (3rd Edition) Dover Publications

5 Parameters

5.1 Compulsory Input Parameters

- 1: **x** – REAL (KIND=nag_wp)
The argument x of the function.
Constraint: $x > 0.0$.

5.2 Optional Input Parameters

None.

5.3 Output Parameters

- 1: **result**
The result of the function.
- 2: **ifail** – INTEGER
ifail = 0 unless the function detects an error (see Section 5).

6 Error Indicators and Warnings

Errors or warnings detected by the function:

ifail = 1

On entry, $x \leq 0.0$: K_1 is undefined. On softfailure nag_specfun_bessel_k1_scaled (s18cd) returns zero.

ifail = 2

On entry, x is too close to zero, as determined by the value of the safe-range parameter nag_machine_real_safe (x02am): there is a danger of causing overflow. On softfailure, nag_specfun_bessel_k1_scaled (s18cd) returns the reciprocal of the safe-range parameter.

ifail = -99

An unexpected error has been triggered by this routine. Please contact NAG.

ifail = -399

Your licence key may have expired or may not have been installed correctly.

ifail = -999

Dynamic memory allocation failed.

7 Accuracy

Relative errors in the argument are attenuated when propagated into the function value. When the accuracy of the argument is essentially limited by the *machine precision*, the accuracy of the function value will be similarly limited by at most a small multiple of the *machine precision*.

8 Further Comments

None.

9 Example

This example reads values of the argument x from a file, evaluates the function at each value of x and prints the results.

9.1 Program Text

```
function s18cd_example

fprintf('s18cd example results\n\n');

x = [0.4 0.6 1.4 2.5 10 1000];
n = size(x,2);
result = x;

for j=1:n
    [result(j), ifail] = s18cd(x(j));
end

disp('      x      e^xK_1(x)');
fprintf('%12.3e%12.3e\n',[x; result]);
```

9.2 Program Results

s18cd example results

x	$e^{xK_1(x)}$
4.000e-01	3.259e+00
6.000e-01	2.374e+00
1.400e+00	1.301e+00
2.500e+00	9.002e-01
1.000e+01	4.108e-01
1.000e+03	3.965e-02
