

## NAG Library Chapter Contents

### F06 – Linear Algebra Support Routines

F06 Chapter Introduction – a description of the Chapter and an overview of the algorithms available

Routine Name	Mark of Introduction	Purpose
F06AAF (DROTG)	12	DROTG nagf_blas_drotg Generate real plane rotation
F06BAF	12	nagf_blas_drotgc Generate real plane rotation, storing tangent
F06BCF	12	nagf_blas_dcsg Recover cosine and sine from given real tangent
F06BEF	12	nagf_blas_drotj Generate real Jacobi plane rotation
F06BHF	12	nagf_blas_drot2 Apply real similarity rotation to 2 by 2 symmetric matrix
F06BLF	12	nagf_blas_ddiv Compute quotient of two real scalars, with overflow flag
F06BMF	12	nagf_blas_dnrm Compute Euclidean norm from scaled form
F06BNF	12	nagf_blas_dpsth Compute square root of $(a^2 + b^2)$ , real $a$ and $b$
F06BPF	12	nagf_blas_deig2 Compute eigenvalue of 2 by 2 real symmetric matrix
F06CAF	12	nagf_blas_zrotgc Generate complex plane rotation, storing tangent, real cosine
F06CBF	12	nagf_blas_zrotgs Generate complex plane rotation, storing tangent, real sine
F06CCF	12	nagf_blas_zcsg Recover cosine and sine from given complex tangent, real cosine
F06CDF	12	nagf_blas_zcsgs Recover cosine and sine from given complex tangent, real sine
F06CHF	12	nagf_blas_zrot2 Apply complex similarity rotation to 2 by 2 Hermitian matrix
F06CLF	12	nagf_blas_zdiv Compute quotient of two complex scalars, with overflow flag
F06DBF	12	nagf_blas_iloadd Broadcast scalar into integer vector
F06DFE	12	nagf_blas_icopy Copy integer vector
F06EAF (DDOT)	12	DDOT nagf_blas_ddot Dot product of two real vectors
F06ECF (DAXPY)	12	DAXPY nagf_blas_daxpy Add scalar times real vector to real vector
F06EDF (DSCAL)	12	DSCAL nagf_blas_dscal Multiply real vector by scalar
F06EFF (DCOPY)	12	DCOPY nagf_blas_dcopy Copy real vector

F06EGF (DSWAP)	12	DSWAP nagf_blas_dswap Swap two real vectors
F06EJF (DNRM2)	12	DNRM2 nagf_blas_dnrm2 Compute Euclidean norm of real vector
F06EKF (DASUM)	12	DASUM nagf_blas_dasum Sum absolute values of real vector elements
F06EPF (DROT)	12	DROT nagf_blas_drot Apply real plane rotation
F06ERF (DDOTI)	14	DDOTI nagf_blas_ddoti Dot product of a real sparse and a full vector
F06ETF (DAXPYI)	14	DAXPYI nagf_blas_daxpyi Add scalar times real sparse vector to a full vector
F06EUF (DGTHR)	14	DGTHR nagf_blas_dgthr Gather real sparse vector
F06EVF (DGTHRZ)	14	DGTHRZ nagf_blas_dgthrz Gather and set to zero real sparse vector
F06EWF (DSCTR)	14	DSCTR nagf_blas_dsctr Scatter real sparse vector
F06EXF (DROTI)	14	DROTI nagf_blas_droti Apply plane rotation to a real sparse and a full vector
F06FAF	12	nagf_blas_dvcos Compute cosine of angle between two real vectors
F06FBF	12	nagf_blas_dload Broadcast scalar into real vector
F06FCF	12	nagf_blas_dd scl Multiply real vector by diagonal matrix
F06FDF	12	nagf_blas_axpzy Multiply real vector by scalar, preserving input vector
F06FEF	21	nagf_blas_dr scl Multiply real vector by reciprocal of scalar
F06FGF	12	nagf_blas_dnegv Negate real vector
F06FJF	12	nagf_blas_dssq Update Euclidean norm of real vector in scaled form
F06FKF	12	nagf_blas_dnrm2w Compute weighted Euclidean norm of real vector
F06FLF	12	nagf_blas_darang Elements of real vector with largest and smallest absolute value
F06FPF	12	nagf_blas_drots Apply real symmetric plane rotation to two vectors
F06FQF	12	nagf_blas_dsrotg Generate sequence of real plane rotations
F06FRF	12	nagf_blas_dnhousg Generate real elementary reflection, NAG style
F06FSF	12	nagf_blas_dlhousg Generate real elementary reflection, LINPACK style
F06FTF	12	nagf_blas_dnhous Apply real elementary reflection, NAG style

F06FUF	12	nagf_blas_dlhous Apply real elementary reflection, LINPACK style
F06GAF (ZDOTU)	12	ZDOTU nagf_blas_zdotu Dot product of two complex vectors, unconjugated
F06GBF (ZDOTC)	12	ZDOTC nagf_blas_zdotc Dot product of two complex vectors, conjugated
F06GCF (ZAXPY)	12	ZAXPY nagf_blas_zaxpy Add scalar times complex vector to complex vector
F06GDF (ZSCAL)	12	ZSCAL nagf_blas_zscal Multiply complex vector by complex scalar
F06GFF (ZCOPY)	12	ZCOPY nagf_blas_zcopy Copy complex vector
F06GGF (ZSWAP)	12	ZSWAP nagf_blas_zswap Swap two complex vectors
F06GRF (ZDOTUI)	14	ZDOTUI nagf_blas_zdotui Dot product of a complex sparse and a full vector, unconjugated
F06GSF (ZDOTCI)	14	ZDOTCI nagf_blas_zdotci Dot product of a complex sparse and a full vector, conjugated
F06GTF (ZAXPYI)	14	ZAXPYI nagf_blas_zaxpyi Add scalar times complex sparse vector to a full vector
F06GUF (ZGTHR)	14	ZGTHR nagf_blas_zgthr Gather complex sparse vector
F06GVF (ZGTHRZ)	14	ZGTHRZ nagf_blas_zgthrz Gather and set to zero complex sparse vector
F06GWF (ZSCTR)	14	ZSCTR nagf_blas_zsctr Scatter complex sparse vector
F06HBF	12	nagf_blas_zload Broadcast scalar into complex vector
F06HCF	12	nagf_blas_zdsc1 Multiply complex vector by complex diagonal matrix
F06HDF	12	nagf_blas_zaxpzy Multiply complex vector by complex scalar, preserving input vector
F06HGF	12	nagf_blas_znegv Negate complex vector
F06HMF (ZROT)	21	ZROT nagf_blas_zrot Apply plane rotation with real cosine and complex sine
F06HPF	12	nagf_blas_zcrot Apply complex plane rotation
F06HQF	12	nagf_blas_zsrotg Generate sequence of complex plane rotations
F06HRF	12	nagf_blas_zhousg Generate complex elementary reflection
F06HTF	12	nagf_blas_zhous Apply complex elementary reflection

F06JDF (ZDSCAL)	12	ZDSCAL nagf_blas_zdscal Multiply complex vector by real scalar
F06JF (DZNRM2)	12	DZNRM2 nagf_blas_dznrm2 Compute Euclidean norm of complex vector
F06JKF (DZASUM)	12	DZASUM nagf_blas_dzasum Sum absolute values of complex vector elements
F06JLF (IDAMAX)	12	IDAMAX nagf_blas_idamax Index, real vector element with largest absolute value
F06JMF (IZAMAX)	12	IZAMAX nagf_blas_izamax Index, complex vector element with largest absolute value
F06KCF	12	nagf_blas_zddscl Multiply complex vector by real diagonal matrix
F06KDF	12	nagf_blas_zdaxpzy Multiply complex vector by real scalar, preserving input vector
F06KEF	21	nagf_blas_zdrscl Multiply complex vector by reciprocal of real scalar
F06KFF	12	nagf_blas_zdcopy Copy real vector to complex vector
F06KJF	12	nagf_blas_dzssq Update Euclidean norm of complex vector in scaled form
F06KLF	12	nagf_blas_idrank Last non-negligible element of real vector
F06KPF (ZDROT)	12	ZDROT nagf_blas_zdrot Apply real plane rotation to two complex vectors
F06PAF (DGEMV)	12	DGEMV nagf_blas_dgemv Matrix-vector product, real rectangular matrix
F06PBF (DGBMV)	12	DGBMV nagf_blas_dgbmv Matrix-vector product, real rectangular band matrix
F06PCF (DSYMV)	12	DSYMV nagf_blas_dsymv Matrix-vector product, real symmetric matrix
F06PDF (DSBMV)	12	DSBMV nagf_blas_dsbmv Matrix-vector product, real symmetric band matrix
F06PEF (DSPMV)	12	DSPMV nagf_blas_dspmv Matrix-vector product, real symmetric packed matrix
F06PFF (DTRMV)	12	DTRMV nagf_blas_dtrmv Matrix-vector product, real triangular matrix
F06PGF (DTBMV)	12	DTBMV nagf_blas_dtbmv Matrix-vector product, real triangular band matrix
F06PHF (DTPMV)	12	DTPMV nagf_blas_dtpmv Matrix-vector product, real triangular packed matrix
F06PJF (DTRSV)	12	DTRSV nagf_blas_dtrsv System of equations, real triangular matrix

F06PKF (DTBSV)	12	DTBSV nagf_blas_dtbsv System of equations, real triangular band matrix
F06PLF (DTPSV)	12	DTPSV nagf_blas_dtpsv System of equations, real triangular packed matrix
F06PMF (DGER)	12	DGER nagf_blas_dger Rank-1 update, real rectangular matrix
F06PPF (DSYR)	12	DSYR nagf_blas_dsyrr Rank-1 update, real symmetric matrix
F06PQF (DSPR)	12	DSPR nagf_blas_dspr Rank-1 update, real symmetric packed matrix
F06PRF (DSYR2)	12	DSYR2 nagf_blas_dsyrr2 Rank-2 update, real symmetric matrix
F06PSF (DSPR2)	12	DSPR2 nagf_blas_dspr2 Rank-2 update, real symmetric packed matrix
F06QFF	13	nagf_blas_dmcop Matrix copy, real rectangular or trapezoidal matrix
F06QHF	13	nagf_blas_dmloa Matrix initialization, real rectangular matrix
F06QJF	13	nagf_blas_dgeap Permute rows or columns, real rectangular matrix, permutations represented by an integer array
F06QKF	13	nagf_blas_dgeapr Permute rows or columns, real rectangular matrix, permutations represented by a real array
F06QMF	13	nagf_blas_dsysrc Orthogonal similarity transformation of real symmetric matrix as a sequence of plane rotations
F06QPF	13	nagf_blas_dutr1 $QR$ factorization by sequence of plane rotations, rank-1 update of real upper triangular matrix
F06QQF	13	nagf_blas_dutupd $QR$ factorization by sequence of plane rotations, real upper triangular matrix augmented by a full row
F06QRF	13	nagf_blas_duhqr $QR$ or $RQ$ factorization by sequence of plane rotations, real upper Hessenberg matrix
F06QSF	13	nagf_blas_dusqr $QR$ or $RQ$ factorization by sequence of plane rotations, real upper spiked matrix
F06QTF	13	nagf_blas_dutsqr $QR$ factorization of $UP$ or $RQ$ factorization of $PU$ , $U$ real upper triangular, $P$ a sequence of plane rotations
F06QVF	13	nagf_blas_dutsrh Compute upper Hessenberg matrix by sequence of plane rotations, real upper triangular matrix
F06QWF	13	nagf_blas_dutsrs Compute upper spiked matrix by sequence of plane rotations, real upper triangular matrix
F06QXF	13	nagf_blas_dgesrc Apply sequence of plane rotations, real rectangular matrix

F06RAF	15	nagf_blas_dlange 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, real general matrix
F06RBF	15	nagf_blas_dlangb 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, real band matrix
F06RCF	15	nagf_blas_dlansy 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, real symmetric matrix
F06RDF	15	nagf_blas_dlansp 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, real symmetric matrix, packed storage
F06REF	15	nagf_blas_dlansb 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, real symmetric band matrix
F06RJF	15	nagf_blas_dlantr 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, real trapezoidal/triangular matrix
F06RKF	15	nagf_blas_dlantp 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, real triangular matrix, packed storage
F06RLF	15	nagf_blas_dlantb 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, real triangular band matrix
F06RMF	15	nagf_blas_dlanhs 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, real upper Hessenberg matrix
F06RNF	21	nagf_blas_dlangt 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, real tridiagonal matrix
F06RPF	21	nagf_blas_dlanst 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, real symmetric tridiagonal matrix
F06SAF (ZGEMV)	12	ZGEMV nagf_blas_zgemv Matrix-vector product, complex rectangular matrix
F06SBF (ZGBMV)	12	ZGBMV nagf_blas_zgbmv Matrix-vector product, complex rectangular band matrix
F06SCF (ZHEMV)	12	ZHEMV nagf_blas_zhemv Matrix-vector product, complex Hermitian matrix
F06SDF (ZHBMV)	12	ZHBMV nagf_blas_zhbmw Matrix-vector product, complex Hermitian band matrix
F06SEF (ZHPMV)	12	ZHPMV nagf_blas_zhpmv Matrix-vector product, complex Hermitian packed matrix
F06SFF (ZTRMV)	12	ZTRMV nagf_blas_ztrmv Matrix-vector product, complex triangular matrix
F06SGF (ZTBMV)	12	ZTBMV nagf_blas_ztbmv Matrix-vector product, complex triangular band matrix
F06SHF (ZTPMV)	12	ZTPMV nagf_blas_ztpmv Matrix-vector product, complex triangular packed matrix

F06SJF (ZTRSV)	12	ZTRSV nagf_blas_ztrsv System of equations, complex triangular matrix
F06SKF (ZTBSV)	12	ZTBSV nagf_blas_ztbsv System of equations, complex triangular band matrix
F06SLF (ZTPSV)	12	ZTPSV nagf_blas_ztpsv System of equations, complex triangular packed matrix
F06SMF (ZGERU)	12	ZGERU nagf_blas_zgeru Rank-1 update, complex rectangular matrix, unconjugated vector
F06SNF (ZGERC)	12	ZGERC nagf_blas_zgerc Rank-1 update, complex rectangular matrix, conjugated vector
F06SPF (ZHER)	12	ZHER nagf_blas_zher Rank-1 update, complex Hermitian matrix
F06SQF (ZHPR)	12	ZHPR nagf_blas_zhpr Rank-1 update, complex Hermitian packed matrix
F06SRF (ZHER2)	12	ZHER2 nagf_blas_zher2 Rank-2 update, complex Hermitian matrix
F06SSF (ZHPR2)	12	ZHPR2 nagf_blas_zhpr2 Rank-2 update, complex Hermitian packed matrix
F06TAF	21	nagf_blas_zsymv Matrix-vector product, complex symmetric matrix
F06TBF	21	nagf_blas_zsyr Rank-1 update, complex symmetric matrix
F06TCF	21	nagf_blas_zspmv Matrix-vector product, complex symmetric packed matrix
F06TDF	21	nagf_blas_zspr Rank-1 update, complex symmetric packed matrix
F06TFF	13	nagf_blas_zmcopy Matrix copy, complex rectangular or trapezoidal matrix
F06THF	13	nagf_blas_zmload Matrix initialization, complex rectangular matrix
F06TMF	13	nagf_blas_zhesrc Unitary similarity transformation of Hermitian matrix as a sequence of plane rotations
F06TPF	13	nagf_blas_zutr1 $QR$ factorization by sequence of plane rotations, rank-1 update of complex upper triangular matrix
F06TQF	13	nagf_blas_zutupd $QR$ factorization by sequence of plane rotations, complex upper triangular matrix augmented by a full row
F06TRF	13	nagf_blas_zuhqr $QR$ or $RQ$ factorization by sequence of plane rotations, complex upper Hessenberg matrix
F06TSF	13	nagf_blas_zusqr $QR$ or $RQ$ factorization by sequence of plane rotations, complex upper spiked matrix
F06TTF	13	nagf_blas_zutsqr $QR$ factorization of $UP$ or $RQ$ factorization of $PU$ , $U$ complex upper triangular, $P$ a sequence of plane rotations

F06TVF	13	nagf_blas_zutsrh Compute upper Hessenberg matrix by sequence of plane rotations, complex upper triangular matrix
F06TWF	13	nagf_blas_zutsrs Compute upper spiked matrix by sequence of plane rotations, complex upper triangular matrix
F06TXF	13	nagf_blas_zgesrc Apply sequence of plane rotations, complex rectangular matrix, real cosine and complex sine
F06TYF	13	nagf_blas_zgesrs Apply sequence of plane rotations, complex rectangular matrix, complex cosine and real sine
F06UAF	15	nagf_blas_zlange 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, complex general matrix
F06UBF	15	nagf_blas_zlangb 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, complex band matrix
F06UCF	15	nagf_blas_zlanhe 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, complex Hermitian matrix
F06UDF	15	nagf_blas_zlanhp 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, complex Hermitian matrix, packed storage
F06UEF	15	nagf_blas_zlanhb 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, complex Hermitian band matrix
F06UFF	15	nagf_blas_zlansy 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, complex symmetric matrix
F06UGF	15	nagf_blas_zlansp 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, complex symmetric matrix, packed storage
F06UHF	15	nagf_blas_zlansb 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, complex symmetric band matrix
F06UJF	15	nagf_blas_zlantr 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, complex trapezoidal/triangular matrix
F06UKF	15	nagf_blas_zlantp 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, complex triangular matrix, packed storage
F06ULF	15	nagf_blas_zlantb 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, complex triangular band matrix
F06UMF	15	nagf_blas_zlanhs 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, complex Hessenberg matrix
F06UNF	21	nagf_blas_zlangt 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, complex tridiagonal matrix
F06UPF	21	nagf_blas_zlanht 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, complex Hermitian tridiagonal matrix
F06VJF	13	nagf_blas_zgeap Permute rows or columns, complex rectangular matrix, permutations represented by an integer array



F06VKF	13	nagf_blas_zgeapr Permute rows or columns, complex rectangular matrix, permutations represented by a real array
F06VXF	13	nagf_blas_zsgesr Apply sequence of plane rotations, complex rectangular matrix, real cosine and sine
F06WAF (DLANSF)	23	DLANSF nagf_blas_dlansf 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, real symmetric matrix, Rectangular Full Packed format
F06WBF (DTFSM)	23	DTFSM nagf_blas_dtfsm Solves a system of equations with multiple right-hand sides, real triangular coefficient matrix, Rectangular Full Packed format
F06WCF (DSFRK)	23	DSFRK nagf_blas_dsfrk Rank- $k$ update of a real symmetric matrix, Rectangular Full Packed format
F06WNF (ZLANHF)	23	ZLANHF nagf_blas_zlanhf 1-norm, $\infty$ -norm, Frobenius norm, largest absolute element, complex Hermitian matrix, Rectangular Full Packed format
F06WPF (ZTFSM)	23	ZTFSM nagf_blas_ztfsm Solves system of equations with multiple right-hand sides, complex triangular coefficient matrix, Rectangular Full Packed format
F06WQF (ZHFRK)	23	ZHFRK nagf_blas_zhfrk Rank- $k$ update of a complex Hermitian matrix, Rectangular Full Packed format
F06YAF (DGEMM)	14	DGEMM nagf_blas_dgemm Matrix-matrix product, two real rectangular matrices
F06YCF (DSYMM)	14	DSYMM nagf_blas_dsymm Matrix-matrix product, one real symmetric matrix, one real rectangular matrix
F06YFF (DTRMM)	14	DTRMM nagf_blas_dtrmm Matrix-matrix product, one real triangular matrix, one real rectangular matrix
F06YJF (DTRSM)	14	DTRSM nagf_blas_dtrsm Solves a system of equations with multiple right-hand sides, real triangular coefficient matrix
F06YPF (DSYRK)	14	DSYRK nagf_blas_dsyrk Rank- $k$ update of a real symmetric matrix
F06YRF (DSYR2K)	14	DSYR2K nagf_blas_dsy2k Rank- $2k$ update of a real symmetric matrix
F06ZAF (ZGEMM)	14	ZGEMM nagf_blas_zgemm Matrix-matrix product, two complex rectangular matrices

F06ZCF (ZHEMM)	14	ZHEMM nagf_blas_zhemm Matrix-matrix product, one complex Hermitian matrix, one complex rectangular matrix
F06ZFF (ZTRMM)	14	ZTRMM nagf_blas_ztrmm Matrix-matrix product, one complex triangular matrix, one complex rectangular matrix
F06ZJF (ZTRSM)	14	ZTRSM nagf_blas_ztrsm Solves system of equations with multiple right-hand sides, complex triangular coefficient matrix
F06ZPF (ZHERK)	14	ZHERK nagf_blas_zherk Rank- $k$ update of a complex Hermitian matrix
F06ZRF (ZHER2K)	14	ZHER2K nagf_blas_zher2k Rank- $2k$ update of a complex Hermitian matrix
F06ZTF (ZSYMM)	14	ZSYMM nagf_blas_zsymm Matrix-matrix product, one complex symmetric matrix, one complex rectangular matrix
F06ZUF (ZSYRK)	14	ZSYRK nagf_blas_zsyrk Rank- $k$ update of a complex symmetric matrix
F06ZWF (ZSYR2K)	14	ZSYR2K nagf_blas_zsyr2k Rank- $2k$ update of a complex symmetric matrix

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