

# Appendix G - Material Tables

Appendix of NASGRO User's Manual

Revision date: April 12, 2022

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# 1 Materials with NASGRO Equation Constants

Table 1: List of NASFLA Materials with NASGRO Equation Constants

Materials; Conditions; Environment	Code
<b>[A] Iron, alloy or cast</b>	
A536 Grd 80-55-06; As cast	A1AC50AB1
<b>[B] ASTM spec. grd. Steel</b>	
A36 Plt(Dyn $K_{Ic}$ <500Hz); LA HHA3% NaCl	B0CB10AB1
A36 ES Weld & HAZ(Dyn $K_{Ic}$ <500Hz); LA HHA3% NaCl	B0CZK1AB1
A203 Grd E (3.5% Ni) Plt; -100F to +100F	B2CE12AB1
A216 Grd WCC Casting	B2GC51AB1
A225 Grd B Rnd Bar;L-C & L-R;LA; RT	B2IB18AB1
A225 Grd B Rnd Bar;L-C & L-R;LA;-20F	B2IB18AB8
A225 Grd B Weld; RT	B2IBA1AB1
A225 Grd B Weld HAZ; RT	B2IBA7AB1
A285 Grd C Plt	B2LC10AB1
A289 Grd B Forg; C-R; LA & DW	B2NB26AB1
A302 Grd B Plt	B3AB12AB1
A372 Cls IV Forg	B3GD21AB1
A372 Cls V Forg; L-C; DA	B3GE28AC1
A387 Grd 22 Cl 2 Plt	B3IQ10AB1
A469 Cl 4 Forg	B4JD26AB1
A469 CL 5 Forg	B4JE20AB1
A508 Forg (>50 YS, 80-105 UTS)	B5AB21AB1
A514 Plt	B5BF10AB1
A514 Plt; GMA SR Weld	B5BFC2AB1
A517 Grd F (T1 Steel) Plt	B5DF12AB1
A533-B Cl 1 & Cl 2 Plt	B5HD10AB1
A533-B Plt SMA Weld	B5HDF1AB1
A542 CL 2&3 Plt; LA & WV	B5NC13AB1
A543 CL 1 Plt & SR Weld; 500F Air	B5PA11AA13
A553 Typ I Plt	B5QA12AB1
A553 Typ I Plt; -320F	B5QA12LA4
A579 Grd 75 (12% Ni) Plt	B5VW10AB1
A588 Grd A & Grd B plt	B5XA11AB1
A588 Grd A & Grd B Plt; 3% NaCl	B5XA11WB1
A612 Plt Grd B; Plt & Sht	B6CB10AB1
A645 (5% Ni) Plt	B6GA12AB1

Continued on next page

Table 1: List of NASFLA Materials with NASGRO Equation Constants (cont.)

<b>Materials; Conditions; Environment</b>	<b>Code</b>
A645 (5% Ni) Plt; -320F	B6GA12LA4
<b>[C] AISI - SAE Steel</b>	
1005-1012 Hot rolled plt	C1AB11AB1
1015-1025 Hot rolled plt	C1BB11AB1
4130; 150-170 UTS; Plt	C3KE11AB1
4130; 200-220 UTS; Plt	C3KG13AB1
4140; 200-220 UTS; Plt	C3NG13AB1
4330V MOD; 180-200 UTS; Plt & Forg	C4BS10AB1
4330V MOD; 200-220 UTS; Plt & Forg	C4BT10AB1
4330V MOD; 220-240 UTS; Plt & Forg	C4BU10AB1
4330V MOD; 220-240 UTS; Forg; L-C & L-R	C4BU28AB1
4340; Normalized; Plt & Bar	C4DB13AB1
4340; 120-140 UTS; Plt & Bar	C4DC13AB1
4340; 140-160 UTS; Plt	C4DD11AB1
4340; 160-180 UTS; Plt & Forg	C4DE13AB1
4340; 160-180 UTS; Plt & Forg; S-L & S-T	C4DE15AB1
4340; 180-200 UTS; Plt & Forg; 650F	C4DF13AA14
4340; 180-200 UTS; Plt & Forg; -50F	C4DF13AA7
4340; 180-200 UTS; Plt & Forg; LA & HHA	C4DF13AB1
4340; 180-200 UTS; Plt & Forg; T-L; DA	C4DF23AC1
4340; 180-200 UTS; Plt & Forg; -50F	C4DG13AA7
4340; 200-220 UTS; Plt & Forg	C4DG13AB1
4340; 220-240 UTS; Plt & Forg; -50F	C4DH13AA7
4340; 220-240 UTS; Plt & Forg	C4DH13AB1
4340; 240-260 UTS; Plt & Forg; -50F	C4DI13AA7
4340; 240-260 UTS; Plt & Forg	C4DI13AB1
4340; 260-280 UTS; Plt & Forg; -50F	C4DJ13AA7
4340; 260-280 UTS; Plt & Forg	C4DJ13AB1
4340; 260-280 UTS; Plt & Forg; -50F	C4DK13AA7
4340; 280+ UTS; Plt & Forg	C4DK13AB1
9310; Aus,OQ, T(290-350F); Forg	C8DE20AB1
<b>[D] Misc. U.S. Spec. Grade Steel</b>	
SAE 0030 Cast Steel	D5AC50AB1
<b>[E] Trade/common name steel</b>	
18 Ni Maraging 250 Grd; Plt & Forg	E1AD10AB1
18 Ni Maraging 300 Grdl Plt & Forg	E1AE10AB1

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Table 1: List of NASFLA Materials with NASGRO Equation Constants (cont.)

<b>Materials; Conditions; Environment</b>	<b>Code</b>
300M; 270-300 UTS; Plt & Forg	E1BF21AB1
AF1410; 220-240 UTS; Plt & Forg; -65F	E1CC12AA7
AF1410; 220-240 UTS; Plt & Forg; LA HHA/DW>1Hz	E1CC12AB1
D6AC 160-180(HRC35); Forg blk; T-L; LA	E1DA23AB1
D6AC; 220-240 UTS; Plt & Forg; Nom $K_{Ic}(70)$ ; -40F	E1DD10AA8
D6AC; 220-240 UTS; Plt & Forg; Nom $K_{Ic}(70)$	E1DD10AB1
D6AC; 220-240 UTS; Plt & Forg; Nom $K_{Ic}(70)$ ; HHA/DW; >0.1Hz	E1DD10AD1
D6AC; 220-240 UTS; Plt & Forg; High $K_{Ic}(90)$	E1DJ10AB1
HP-9-4-20; 190-210 UTS; Plt & Forg; LA HHA SW>1Hz	E1EB23AB1
HP-9-4-20; 190-210 UTS; Plt & Forg; -65F	E1EB23AC7
HP-9-4-20; 190-210 UTS; GTA Weld+SR; -65F	E1ECB2AC7
HP-9-4-20; 190-210 UTS; GTA Weld+SR; LA, HHA, SW>1Hz	E1ECB2WA1
HP-9-4-30; 220-240 UTS; Forg; LA	E1GC21AB1
HP-9-4-30; 220-240 UTS; Plt & Forg; 500F	E1GC23AA14
HP-9-4-30; 220-240 UTS; Plt & Forg; -65F	E1GC23AA7
HP-9-4-30; 220-240 UTS; Plt & Forg; LA, HHA, SW>1Hz	E1GC23AB1
HY-180(10Ni) Plt & Forg	E1IB13AB1
HY-180(10Ni) Plt & Forg; SW>0.1Hz	E1IB13WD1
HY-TUF220-240 UTS; VAR Forg	E1JB23AB1
H-11 MOD240-260 UTS; Plt & Forg	E1LE23AB1
AerMet 100 (280ksi/1931MPa UTS); Rnd Bar, C-R & L-R	E1NB18AB1
AerMet 100 (280ksi/1931MPa UTS); Rnd Bar, L-R, DA	E1NB18AC1
HY 80 Plt	E2AA13AB1
HY 80 Plt; 3.5% NaCl/SW>0.1Hz	E2AA13WB1
HY 130 (5% Ni) Plt	E2CA13AB1
HY 130; SW>0.1Hz	E2CA13WB1
HY 130 GMA & SMA Welds; LA & SW	E2CAC1AB1
HY140 (5% Ni) Plt	E2DA12AB1
AOS 1146A; PLT; L-T; LA; -20F	E2FB11AB8
AOS 1146A; PLT; L-T & T-L; LA; RT	E2FB13AB1
HT-80 Plt	E3BA13AB1
HT-80 SA Weld	E3BAH1AB1
Pyrowear 52; Rnd Bar; L-R & R-L	E4EB28AB1
Pyrowear 52; Rnd Bar; R-L; LA	E4EB29AB1
Pyrowear 52; Rnd Bar; R-L; DA	E4EB29AC1

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Table 1: List of NASFLA Materials with NASGRO Equation Constants (cont.)

<b>Materials; Conditions; Environment</b>	<b>Code</b>
<b>[F] AISI type stainless steel</b>	
AISI 301/302 Ann sht & plt	F3AA13AB1
AISI 301/3021/2 Hard Sht	F3AC13AB1
AISI 301/302 Full Hard Sht	F3AE13AB1
AISI 304/304L Plt, sht & castings; 550F Air	F3DA13AA13
AISI 304/304L Plt, sht & castings; 800F Air	F3DA13AA16
AISI 304/304L Plt, sht & castings	F3DA13AB1
AISI 304/304L Plt, sht & castings; -320F LN2	F3DA13LA4
AISI 304/304L SA weld(308 filler)+SR; 800F Air>1Hz	F3DAH2AA16
AISI 304/304L SA weld(308 filler)+SR	F3DAH2AB1
AISI 316/316L Ann sht & plt ; 600F Air	F3KA13AA14
AISI 316/316L Ann sht & plt ; 800F Air	F3KA13AA16
AISI 316/316L Ann sht & plt	F3KA13AB1
AISI 316/316L Ann sht & plt ; -452F LHe	F3KA13LA2
AISI 316/316L Ann sht & plt ; -320F LN2	F3KA13LA4
AISI 316/316L Cast; 600F Air	F3KA50AA14
AISI 316/316L Cast	F3KA50AB1
AISI 316/316L Cast; -452F LHe	F3KA50LA2
AISI 316/316L Cast; -320F LN2	F3KA50LA4
AISI 316/316L SMA weld(316 filler)+SR; 800F Air>1Hz	F3KAH2AA16
AISI 316/316L 20 % CW Sht & plt	F3KB13AB1
AISI 430 VAR Ann Rnd Bar C-R	F4LA16AB1
AISI 440C Sngl or Dbl Temper 450F/2hr	F4SE12AB1
<b>[G] Misc. CRES/heat resistant steel</b>	
PH13-8Mo H1000; T-L; -65F DA	G1AD13AA7
PH13-8Mo H1000; Plt forg extr	G1AD13AB1
PH13-8Mo H1000; Plt & forg; DW & SW> 1Hz	G1AD13WD1
PH13-8Mo H1050; Plt & forg	G1AF13AB1
PH13-8Mo H1050; Plt & forg; DW & SW> 0.1Hz	G1AF13WD1
15-5PH H900; Rnd Bar C-R	G2AB16AB1
15-5PH H1025; Plt	G2AD11AB1
15-5PH H1025; Rnd Bar C-R	G2AD16AB1
15-5PH H1025; Forg	G2AD23AB1
15-5PH H1100; Rnd Bar C-R	G2AF16AB1
17-4PH H900; Plt L-T	G2CB11AB1
17-4PH H900; Plt T-L	G2CB12AB1
17-4PH H1025; Plt; T-L	G2CE12AB1

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Table 1: List of NASFLA Materials with NASGRO Equation Constants (cont.)

<b>Materials; Conditions; Environment</b>	<b>Code</b>
17-4PH H1025; Rnd Bar C-R; LA	G2CE16AB1
17-4PH H1025; Rnd Bar R-L & C-L	G2CE19AB1
17-4PH H1025; Cast; HHA	G2CE50AD1
17-4PH H1100; Plt; HHA	G2CH13AD1
17-7PH RH1100; Plt	G2EF11AB1
17-7PH TH1050; Plt	G2EH13AB1
AM 350 CRT; Sht L-T	G4AH11AB1
AM 367 SCT(850); Sht	G4FC11AB1
Custom 455 H1000; Plt & forg	G5BD23AB1
Custom 455 H1025; Forg	G5BE26AB1
Nitronic 33 Ann; Plt	G7AA13AB1
Nitronic 33 Ann; Plt; -452F LHe	G7AA13LA2
Nitronic 33 Ann; Plt; -320F LN2	G7AA13LA4
Nitronic 50 Ann; Plt	G7CA13AB1
Nitronic 50 Ann; Plt; -452F LHe	G7CA13LA2
Nitronic 50 Ann; Plt; -320F LN2	G7CA13LA4
Nitronic 60 HR CR Rnd Bar	G7DC18AB1
INVAR 36; Cond. A; Plt	G8CA13AB1
<b>[H] High temperature steel</b>	
A286 (140ksi) Plt & sht; 600-800F	H1AB13AA15
A286 (140ksi) Plt & sht	H1AB13AB1
A286 (140ksi) Forg	H1AB23AB1
A286 (160ksi) Plt & sht; 600-800F	H1AC13AA15
A286 (160ksi) Plt & sht	H1AC13AB1
A286 (160ksi) Forg. rod L-R	H1AC28AB1
A286 (200ksi Bolt material) Forg. rod L-R	H1AD28AB1
JBK-75 ST-CR-A; Plt T-L	H1CB12AB1
<b>[J] Tool Steel</b>	
AISI Tool Steel M-50 61-63 Rc; Plt	J1IK10AB1
AISI Tool Steel T1(18-4-1) 60-63 Rc; Plt	J1MA10AB1
<b>[K] Foreign Steel (Russian)</b>	
EP695 Russian Stl Rnd Bar; 238 UTS; C-R	K8AA16AB1
EP678 Russian Stl Rnd Bar; 190 UTS; C-R	K8BA16AB1
EP767 Russian Stl Rnd Bar; 220 UTS; C-R	K8CA16AB1
O7X16H6 (16Cr6Ni) Russian Stl: Rnd Bar; C-R	K8DA16AB1

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Table 1: List of NASFLA Materials with NASGRO Equation Constants (cont.)

<b>Materials; Conditions; Environment</b>	<b>Code</b>
<b>[L] Foreign Steel(French)</b>	
Jethane M152 Stainless (T1300C, 150 UTS); Forg RB	L6AB28AB1
<b>[M] 1000-9000 Series aluminum</b>	
2014-T6 Plt & sht; L-T	M2AD11AB1
2014-T6 Plt & Sht; T-L	M2AD12AB1
2014-T6 Forg (propeller hub); DA;	M2AD23AB1
2014-T651 Plt & Sht; L-T & T-L	M2AF13AB1
2014-T651 Plt & Sht; GTA Weld	M2AFB1AB1
2014-T651 Plt & Sht; GTA Weld SR	M2AFB2AB1
2020-T651 Plt & Sht; L-T	M2CB11AB1
2020-T651 Plt & Sht; T-L	M2CB12AB1
2024-T3 Clad & Bare Sht; L-T; LA & HHA	M2EA11AB1
2024-T3 Clad sht; L-T; DW	M2EA11WA1
2024-T3 Clad & Bare Sht; T-L; LA & HHA	M2EA12AB1
2024-T3 Clad sht; T-L; DW	M2EA12WA1
2024-T351 Plt & Sht; L-T; 300F to 400F Air	M2EB11AA11
2024-T351 Plt & Sht; L-T; LA & HHA	M2EB11AB1
2024-T351 Plt & Sht; T-L; LA & HHA	M2EB12AD1
2024-T3511 Extr; L-T; LA & HHA	M2EC31AB1
2024-T42 Plt & Sht; L-T; LA	M2EF11AB1
2024-T42 Plt & Sht; T-L; LA	M2EF12AB1
2024-T62 Plt & Sht; L-T; LA HHA& ASW	M2EG11AB1
2024-T62 Plt & Sht; T-L; LA HHA& ASW	M2EG12AB1
2024-T81 Plt & Sht; L-T; 350F Air	M2EI11AA11
2024-T81 Plt & Sht; L-T	M2EI11AB1
2024-T81 Plt & Sht; L-T; DA	M2EI11AC1
2024-T81 Plt & Sht; L-T; HHA	M2EI11AD1
2024-T81 Plt & Sht; T-L; 350F Air	M2EI12AA11
2024-T81 Plt & Sht; T-L	M2EI12AB1
2024-T851 Plt & Sht; T-L; 300F to 350F Air	M2EJ12AA11
2024-T851 Plt & Sht; L-T T-L; LA DA JP-4	M2EJ13AB1
2024-T851 Plt & Sht; L-T & T-L; 3.5% NaCl	M2EJ13WB1
2024-T852 Forg; L-T & T-L; LA & DA	M2EK23AB1
2024-T861 Plt & Sht; L-T; 300F to 400F Air	M2EL11AA11
2024-T861 Plt & Sht; L-T; LA & HHA	M2EL11AB1
2024-T861 Plt & Sht; T-L	M2EL12AB1

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Table 1: List of NASFLA Materials with NASGRO Equation Constants (cont.)

<b>Materials; Conditions; Environment</b>	<b>Code</b>
2048-T851 Plt & Sht; L-T; LA	M2FC11AB1
2048-T851 Plt & Sht; T-L; LA	M2FC12AB1
2124-T851 Plt & Sht; L-T; 120F to 350F Air	M2GC11AA10
2124-T851 Plt & Sht; L-T; LA DA HHA	M2GC11AB1
2124-T851 Plt & sht; T-L; 300F to 400F Air	M2GC12AA11
2124-T851 Plt & Sht; T-L; LA HHA	M2GC12AB1
2124-T851 Plt & Sht; T-L; -200F to -150F GN2	M2GC12GB6
2124-T851 Plt & Sht; S-T S-L; LA HHA	M2GC15AB1
2219-T62 Plt & Sht; L-T	M2IA11AB1
2219-T62 Plt & Sht; T-L	M2IA12AB1
2219-T62 Plt & Sht; L-T & T-L; 350F Air	M2IA13AA11
2219-T62 Plt & Sht; L-T & T-L; -320F LN2	M2IA13LA4
2219-T851 Plt & Sht; L-T; LA DA	M2IC11AB1
2219-T851 Plt & sht; T-L; LA DA	M2IC12AB1
2219-T852 Forg; T-L; DA & HHA	M2IE23AD1
2219-T87 Plt & Sht; L-T; 300F to 350F Air	M2IF11AA11
2219-T87 Plt & Sht; L-T	M2IF11AB1
2219-T87 Plt & Sht; L-T; -320F LN2	M2IF11LA4
2219-T87 Plt & Sht; T-L; 300F to 350F Air	M2IF12AA11
2219-T87 Plt & Sht; T-L	M2IF12AB1
2219-T87 Plt & Sht; -320F LN2	M2IF12LA4
2219-T87 Plt & Sht; GTA Weld PAR; 300F Air	M2IFB1AA10
2219-T87 Plt & Sht; GTA Weld PAR	M2IFB1AB1
2219-T87 Plt & Sht; GTA Weld PAR; -320F LN2	M2IFB1LA4
2224-T3511 Extrusion; L-T; LA	M2IN31AB1
2324-T39 Plt & Sht; L-T	M2JA11AB1
2324-T39 Plt & Sht; L-T; HHA	M2JA11AD1
2419-T851 Plt; L-T & T-L	M2KB13AB1
2524-T3; Clad .063in Sht; L-T; DA	M2KN11AC1
2524-T3; Clad .063in Sht; T-L; DA	M2KN12AC1
2524-T3; Clad Plt & Sht; L-T & T-L; DA	M2KN13AC1
2618-T6 Sht; L-T & T-L	M2LA13AB1
2618A-T851 Plt; T-L; HHA	M2MC12AD1
2025-T6 Forg (Propeller Blade), L-T & T-L	M2NA23AB1
2090-T8E41 Plt & Sht; L-T	M2PA11AB1
2090-T8E41 Plt; T-L	M2PA12AB1
2090-T8E41 Plt; S-L	M2PA15AB1

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Table 1: List of NASFLA Materials with NASGRO Equation Constants (cont.)

<b>Materials; Conditions; Environment</b>	<b>Code</b>
2090-T81 Plt; L-T	M2PB11AB1
2090-T83 Sht; L-T	M2PC11AB1
2090-T83 Sht; T-L	M2PC12AB1
2091-T8 Plt; L-T; HHA	M2QD11AD1
2198-T8 Al-Li; Plt; L-T & T-L; LA	M2RA11AB1
2050-T84 4in/100mm Plt; L-T & T-L; DA	M2SA13AC1
2050-T84 4in/100mm Plt; S-L; DA	M2SA15AC1
2195-T8MA; Plt; L-T & T-L; LA	M2TA13AB1
2099-T83; Extrusion; L-T; LA	M2UA31AB1
2099-T83; Extrusion; T-L; LA	M2UA32AB1
5083-O Plt; T-L	M5BA12AB1
5083-O Plt & Sht; T-L; LHe; -452F/-269C	M5BA12LA2
6061-T6 Plt; T-L	M6AB13AB1
6061-T6 Extr; T-L	M6AB32AB1
6061-T6 Extr; T-L; SW	M6AB32WD1
6061-T6 Plt; GTA Weld PAR	M6ABA1AB1
6061-T651 Plt; L-T & T-L; 300F Air	M6AC13AA10
6061-T651 Plt; L-T & T-L	M6AC13AB1
6061-T651 Extr; T-L	M6AC32AB1
6063-T5 Plt & Sht; T-L; LA	M6BA12AB1
6063-T6 Plt & Sht; T-L; LA	M6BB12AB1
6082-T651 Plt; L-T	M6DE11AB1
6082-T651 Plt; T-L	M6DE12AB1
6156-T6; AL Clad Sht, L-T & T-L, LA & DA	M6GB13AB1
7005-T6 & T63 Plt & Sht; L-T & T-L	M7BA13AB1
7005-T6 Plt, GMAW Weld, Par	M7BAC1AB1
7010-T7451 (was -T73651) Plt & Sht; L-T & L-S	M7DA11AB1
7010-T7451 (was -T73651) Plt & Sht; T-L& T-S	M7DA12AB1
7010-T7451 (was -T73651) Plt & Sht; L-T & T-S; 250F Air	M7DA13AA10
7010-T7451 Plt; T-L	M7DB12AB1
7049-T73 Forg; L-T; DA	M7FA21AC1
7049-T73 Forg; L-T; HHA	M7FA21AD1
7049-T73 Forg; T-L; DA	M7FA22AC1
7049-T73 Forg; T-L; HHA	M7FA22AD1
7049-T73 Forg; S-T; HHA	M7FA25AD1
7049-T7351 Plt; L-T; DA	M7FB11AC1
7049-T73511 Extr; L-T	M7FC31AB1

Continued on next page

Table 1: List of NASFLA Materials with NASGRO Equation Constants (cont.)

<b>Materials; Conditions; Environment</b>	<b>Code</b>
7049-T73511 Extr; L-T; HHA	M7FC31AD1
7049-T73511Extr; T-L	M7FC32AB1
7049-T7352 Forg; L-T; DA	M7FD21AC1
7050-T6 Sht; T-L; DA	M7GA12AC1
7050-T6 Sht; T-L; HHA	M7GA12AD1
7050-T7351 Plt; L-T; LA & DA	M7GD11AB1
7050-T7351 Plt; L-T; HHA	M7GD11AD1
7050-T7351 Plt; T-L; LA	M7GD12AB1
7050-T7351 Plt; T-L; HHA	M7GD12AD1
7050-T7351 Plt; S-L; DA	M7GD15AC1
7050-T7351 Plt; S-L; HHA	M7GD15AD1
7050-T73511 Extr; L-T; DA/LA/HHA	M7GE31AD1
7050-T73511 Extr; T-L; DA/LA/HHA	M7GE32AD1
7050-T74 (was -T736) Forg; L-T; LA	M7GI21AB1
7050-T74 (was -T736) Forg; T-L; LA	M7GI22AB1
7050-T74 (was -T736) Forg; S-L; LA	M7GI25AB1
7050-T7451 Plt & Sht; L-T; LA	M7GJ11AB1
7050-T7451 Plt; 4-6in/102-152mm thk; L-T; LA	M7GJ11AB9
7050-T7451 Plt & Sht; L-T; DA	M7GJ11AC1
7050-T7451 Plt & Sht; L-T; HHA	M7GJ11AD1
7050-T7451 Plt & Sht; L-T; Salt Fog/ NACL/ASM >5 Hz	M7GJ11WB1
7050-T7451 Plt & Sht; T-L; LA	M7GJ12AB1
7050-T7451 Plt & Sht; T-L; DA	M7GJ12AC1
7050-T7451 Plt & Sht; T-L; HHA	M7GJ12AD1
7050-T7451 Plt & Sht; S-L; LA/DA/HHA	M7GJ15AB1
7050-T7452 Plt; L-T; LA	M7GK11AB1
7050-T7452 Plt; T-L; LA	M7GK12AB1
7050-T7452 Forg; L-T; LA	M7GK21AB1
7050-T7452 Forg; L-T; HHA/DW/Salt Fog	M7GK21WA1
7050-T7452 Forg; T-L; DA/LA	M7GK22AB1
7050-T7452 Forg; T-L; HHA/DW/Salt Fog	M7GK22WA1
7050-T74511 Extr; L-T; LA/DW	M7GL31AB1
7050-T76 Clad Sht; L-T; DA	M7GN01AC1
7050-T76 Clad Sht; L-T; HHA	M7GN01AD1
7050-T76 Clad Sht; T-L; DA	M7GN02AC1
7050-T76 Clad Sht; T-L; HHA	M7GN02AD1
7050-T76 Clad Sht; T-L; Salt Fog	M7GN02AG1

Continued on next page

Table 1: List of NASFLA Materials with NASGRO Equation Constants (cont.)

<b>Materials; Conditions; Environment</b>	<b>Code</b>
7050-T76 Sht; L-T; LA	M7GN11AB1
7050-T76 Sht; L-T; HHA	M7GN11AD1
7050-T76 Sht; T-L; DA	M7GN12AC1
7050-T76 Sht; T-L; HHA	M7GN12AD1
7050-T7651 Plt & Sht; L-T; LA	M7GQ11AB1
7050-T7651 Plt & Sht; L-T; HHA	M7GQ11AD1
7050-T7651 Plt & Sht; L-T; JP-4	M7GQ11PE1
7050-T7651 Plt & Sht; L-T; DW > 1 Hz	M7GQ11WA1
7050-T7651 Plt & Sht; NaCl/SW >2 HZ	M7GQ11WB1
7050-T76511 Extr; L-T; LA	M7GS31AB1
7050-T76511 Extr; L-T; HHA >20 Hz	M7GS31AD1
7050-T76511 Extr; T-L; HHA >20 Hz	M7GS32AD1
7075-T6 Clad Sht; L-T & T-L; LA	M7HA03AB1
7075-T6 Plt & Sht; L-T; LA	M7HA11AB1
7075-T6 Plt; T-L; LA	M7HA12AB1
7075-T651 Plt & Sht; L-T; LA	M7HB11AB1
7075-T651 Plt & Sht; L-T; DA	M7HB11AC1
7075-T651 Plt & Sht; L-T; HHA	M7HB11AD1
7075-T651 Plt & Sht; L-T; NaCl >0.1 Hz	M7HB11WB1
7075-T651 Plt & Sht; T-L; DA	M7HB12AC1
7075-T651 Plt & Sht; T-L; DW >1Hz	M7HB12WA1
7075-T651 Plt & Sht; S-T; LA	M7HB15AB1
7075-T6510 Extr; L-T; LA/DA	M7HC31AB1
7075-T6511 Extr; L-T; LA & HHA	M7HD31AB1
7075-T73 Plt & Sht; L-T; LA	M7HG11AB1
7075-T73 Plt & Sht; T-L; LA	M7HG12AB1
7075-T73 Forg; L-T; LA	M7HG21AB1
7075-T7351 Plt & Sht; L-T; LA/DA	M7HH11AB1
7075-T7351 Plt & Sht; L-T; HHA	M7HH11AD1
7075-T7351 Plt & Sht; L-T; JP-4 Fuel	M7HH11PE1
7075-T7351 Plt & Sht; L-T; DW/NaCl/SW >0.1 Hz	M7HH11WD1
7075-T7351 Plt & Sht; T-L; LA	M7HH12AB1
7075-T7351 Plt; S-T; LA	M7HH15AB1
7075-T73510 Extr; L-T; LA	M7HI31AB1
7075-T73510 Extr; T-L; LA	M7HI32AB1
7075-T73511 Extr; L-T; LA/DA	M7HJ31AB1
7075-T73511 Estr; T-L; DA/LA	M7HJ32AB1

Continued on next page

Table 1: List of NASFLA Materials with NASGRO Equation Constants (cont.)

<b>Materials; Conditions; Environment</b>	<b>Code</b>
7075-T7352 Plt;L-T; LA	M7HK11AB1
7075-T7352 Plt; T-L; LA	M7HK12AB1
7075-T7352 Forg; L-T; LA	M7HK21AB1
7075-T7352 Forg; T-L & TS; LA	M7HK22AB1
7075-T7352 Forg; T-L & T-S; HHA	M7HK24AD1
7075-T7352 Forg; S-L & S-T; LA	M7HK25AB1
7075-T76; Sht; L-T; LA	M7HL11AB1
7075-T76; Sht; L-T; DA	M7HL11AC1
7075-T76; Sht; T-L; HHA	M7HL12AD1
7075-T7651 Plt; L-T; DA/LA	M7HM11AB1
7075-T7651 Plt; L-T; 265F DA	M7HM11AC10
7075-T7651 Plt; L-T; ASW	M7HM11WE1
7075-T7651 Plt; T-L; DA/LA	M7HM12AB1
7075-T76511 Extr; L-T; LA	M7HN31AB1
7075-T76511 Extr; L-T; DA	M7HN31AC1
7075-T76511 Extr; T-L; DA	M7HN32AC1
7079-T6 Plt & Forg; L-T & T-L; LA	M7IA23AB1
7079-T6 Plt & Forg; L-T & T-L; HHA	M7IA23AD1
7079-T651 Plt & Forg; L-T & T-L; LA	M7IC23AB1
7079-T651 Plt & Forg; L-T & T-L; DW	M7IC23WA1
7079-T652 Forg; L-T, T-L, L-S, T-S; LA/HHA	M7IE23AB1
7090-T6 P/M; L-T; LA	M7KA32AB1
7149-T73511 Extr; L-T; LA	M7NA31AB1
7149-T73511 Extr; L-T; SW > 1Hz	M7NA31WD1
7149-T73511 Extr; T-L; LA	M7NA32AB1
7149-T73511 Extr; T-L; SW > 1 Hz	M7NA32WD1
7150-T651 Plt; L-T; LA	M7PB11AB1
7150-T651 Plt; L-T; HHA	M7PB11AD1
7150-T7751 Plt; L-T; LA	M7PF11AB1
7175-T7351 Plt; L-T; LA	M7QA11AB1
7175-T7351 Plt; T-L; LA	M7QA12AB1
7175-T7351 Plt;T-L; HHA >1 Hz	M7QA12AD1
7175-T74 Forg; L-T; LA	M7QC21AB1
7175-T736 (T74) Forg; T-L; DA/LA, 0-200F	M7QC22AD1
7175-T736 (T74) Forg; S-T; DA/HHA	M7QC25AD1
7175-T7452 (was -T73652) Forg; L-T; DA/LA	M7QD21AB1
7175-T7452 (was -T73652) Forg; L-T; JP-4 Fuel	M7QD21PE1

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Table 1: List of NASFLA Materials with NASGRO Equation Constants (cont.)

<b>Materials; Conditions; Environment</b>	<b>Code</b>
7175-T7452 (was -T73652) Forg; L-T; SW/250F Air	M7QD21WD1
7175-T7452 (was -T73652) Foeg; T-L; DA/LA	M7QD22AB1
7175-T7452 (was -T73652) Forg; T-L; SW>1Hz	M7QD22WD1
7175-T76511 Extr; L-T; DA	M7QI31AC1
7178-T6 & T651 Plt & Sht; L-T; LA/HHA	M7RA11AB1
7178-T6 & T651 Plt & Sht; T-L; LA/HHA/DW	M7RA12AB1
7178-T76 Sht; L-T; LA	M7RE11AB1
7178-T7651 Plt; L-T & T-L; LA	M7RF13AB1
7178-T76510 Extr; L-T; LA	M7RG31AB1
7249-T76511 Extr; L-T; LA	M7SN31AB1
7475-T61 Clad Sht; L-T & T-L; LA/HHA	M7TB01AB1
7475-T61 Sht; L-T; LA/HHA	M7TB11AB1
7475-T61 Sht; T-L; DA/LA	M7TB12AB1
7475-T6151 Sht; L-T & T-L; LA	M7TC11AB1
7475-T651 Plt; L-T; LA/HHA	M7TD11AB1
7475-T731 Sht; L-T; LA	M7TE11AB1
7475-T7351 Plt; L-T; LA/JP-4 Fuel	M7TF11AB1
7475-T7351 Plt; L-T; HHA	M7TF11AD1
7475-T7351 Plt; T-L; LA/HHA	M7TF12AB1
7475-T7351 Plt; T-L; DA	M7TF12AC1
7475-T7351 Plt; T-L; ASW >1 Hz	M7TF12WE1
7475-T7351 Plt; T-L; ASW >0.1 Hz	M7TF12WE2
7475-T7351 Plt; S-L; LA	M7TF15AB1
7475-T7351 Plt; S-L; DA	M7TF15AC1
7475-T7351 Plt; S-L;ASW >1Hz	M7TF15WE1
7475-T76 Sht; T-L; LA	M7TH12AB1
7475-T761Clad Sht; L-T; LA/HHA/DW >1 Hz	M7TI01AB1
7475-T761 Clad Sht; T-L; LA/HHA	M7TI02AB1
7475-T761 Sht; L-T; LA/HHA/DW	M7TI11AB1
7475-T761 Sht; T-L; LA/HHA	M7TI12AB1
7475-T7651 Plt & Sht; L-T; LA DA HHA DW3.5% NaCl	M7TJ11AB1
7085-T7452; Die Forg; T-L; LA	M7WB22AB1
<b>[N] Foreign Aluminum (Russian)</b>	
AMg6M Russian Al Plt; T-L	N8AA12AB1
AMg6H Russian Al Plt; L-T	N8AB11AB1
AMg6H Russian Al Plt; T-L	N8AB12AB1

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Table 1: List of NASFLA Materials with NASGRO Equation Constants (cont.)

<b>Materials; Conditions; Environment</b>	<b>Code</b>
AK6 Russian Al Rnd Bar; C-R	N8BB16AB1
<b>[O] Misc. and cast aluminum</b>	
A356-T60 Cast	O3FB50AB1
A357-T6 Cast Al; T6; Cast; LA	O3GA50AB1
<b>[P] Titanium alloys</b>	
Ti-55 Sht & Plt	P1AA13AB1
Ti-55 Sht & Plt: DW & SW	P1AA13WA1
Ti-70 Sht & Plt	P1CA13AB1
Ti-70 Sht & Plt; DW & SW	P1CA13WA1
Ti-2.5 Cu; STA Sht; LA HHA DW	P2AA13AB1
Ti-5Al-2.5Sn; Ann. Sht; LA HHA DW	P3CA13AB1
Ti-5Al-2.5Sn(ELI); Ann. Forg	P3CB23AB1
Ti-5Al-2.5Sn(ELI); Ann. Forg; -423F LH2	P3CB23LA3
Ti-3Al-2.5V; CW SR(750F) Extr	P3DB33AB1
Ti-6Al-4V; MA(1350F/2h) Plt & Sht100F	P3EA13AA7
Ti-6Al-4V; MA(1450F/788C/.5hr) Plt & Sht	P3EA11AB1
Ti-6Al-4V; MA(1350F/2h) Forg	P3EA23AB1
Ti-6Al-4V; MA(1350F/2h) Extr	P3EA33AB1
Ti-6Al-4V; BA(1900F/.5h+1325F/2h) Plt&Sht; LA DA3.5% NaCl	P3EB12AB1
Ti-6Al-4V; BA(1900F/.5h+1325F/2h) Forg; LA DA HHA3.5% NaCl	P3EB23AB1
Ti-6Al-4V; RA(1700F/4h) Sht; L-T; LA DA HHA DW3.5% NaCl	P3EC11AB1
Ti-6Al-4V; RA(1700F/4h) Sht; T-L; LA DA HHA DW3.5% NaCl	P3EC12AB1
Ti-6Al-4V; RA(1700F/4h) Plt; -100F	P3EC13AA7
Ti-6Al-4V; RA(1700F/4h) Plt; LA DA HHA DW	P3EC13AB1
Ti-6Al-4V; RA(1700F/4h) Forg; LA DA HHA3.5% NaCl	P3EC23AB1
Ti-6Al-4V; ST(1750F)+A(1000F/4h) Plt & Sht; SR(1000F/4h)	P3ED13AA1
Ti-6Al-4V; ST(1750F)+A(1000F/4h) Plt & Sht; SR(1000F/8h)	P3ED13AB1
Ti-6Al-4V; ST(1750F)+A(1000F/4h) Plt&Sht; SR(1000F/4h); -320FLN2	P3ED13LA4
Ti-6Al-4V; ST(1750F)+A(1000F/4h) Forg; SR(1000F/4h)	P3ED20AB1
Ti-6Al-4V; ST(1750F)+A(1000F/4h) Forg; SR(1000F/4h); -320F LN2	P3ED20LA4
Ti-6Al-4V STA GTA Weld SR; thk < 0.2 in.	P3EDB2AA1
Ti-6Al-4V STA GTA Weld SR; thk >= 0.2 in.	P3EDB2AB1
Ti-6Al-4V Beta STOA Forg	P3EE20AB1
Ti-6Al-4V; STOA(1750F; WQ; 1300F) Plt & Forg; L-T & T-L	P3EE23AB1
Ti-6Al-4V(ELI); BA(1900F/.5h+1325F/2h) Plt&Sht; LA3.5% NaCl	P3EL12AB1
Ti-6Al-4V (ELI); RA(1700F/4h) Plt	P3EM13AB1

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Table 1: List of NASFLA Materials with NASGRO Equation Constants (cont.)

<b>Materials; Conditions; Environment</b>	<b>Code</b>
Ti-6Al-4V (ELI); RA(1700F/4h) Forg; -100F	P3EM23AA7
Ti-6Al-4V (ELI); RA(1700F/4h) Forg	P3EM23AB1
Ti-6Al-4V (ELI); RA(1700F/4h) Forg; -452F LHe	P3EM23LA2
Ti-6Al-4V (ELI); RA(1700F/4h) Forg; -320F LN2	P3EM23LA4
Ti-6Al-4V (ELI); RA(1700F/4h) Forg; EB-welded-SR; weldline	P3EMD2AB1
Ti-6Al-4V (ELI); RA(1700F/4h) Forg; EB-welded-SR; weldline; -320F LN2	P3EMD2LA4
Ti-6Al-4V (ELI); RA(1700F/4h) Forg; EB-welded-SR; HAZ	P3EMD8AB1
Ti-6Al-4V (ELI); RA(1700F/4h) Forg; EB-welded-SR; HAZ; -320F LN2	P3EMD8LA4
Ti-4.5Al-5Mo-1.5Cr Plt; LA3.5% NaCl	P4BA10AB1
Ti-8Al-1Mo-1V Sht	P4CB11AB1
Ti-6Al-6V-2Sn MA Plt Forg Extr; LA DA HHA DW	P4DA33AB1
Ti-6Al-6V-2Sn RA Plt	P4DB12AB1
Ti-6Al-6V-2Sn BA Plt	P4DC12AB1
Ti-6Al-6V-2Sn ST(1600F); A(1000F/6h) Forg; 300F	P4DD21AA1
Ti-6Al-6V-2Sn ST(1600F); A(1000F/6h) Forg; -65F	P4DD21AA7
Ti-6Al-6V-2Sn ST(1600F); A(1000F/6h) Forg; LA DA HHA	P4DD21AB1
Ti-10V-2Fe-3Al STA(140-160 UTS) Plt & Forg	P4MB20AB1
Ti-10V-2Fe-3Al STA(180-200 UTS)Plt & forg	P4MD23AB1
Ti-6Al-2Zn-2Sn-2Mo-2Cr (ST or STA) Plt; HHA	P5FB11AD1
Ti-62222 STA (1350F/950F/AC) Sht; L-T; 347F	P5FC11AA11
Ti-62222 STA (1350F/950F/AC) Sht; L-T; LA	P5FC11AB1
Beta-21S Ti STA (1564F/967F/AC) Sht; 347F	P5SC11AB1
BT3-1 Russian Ti; 170 ksi UTS; Rnd Bar; C-R	P6AA16AB1
BT14 Russian Ti; 217 ksi UTS; Rnd Bar; C-R	P6AB16AB1
BT23 Russian Ti; 198 ksi UTS; 0.12" Sht; L-T	P6AC11AB1
BT23 Russian Ti; 198 ksi UTS; 0.12" Sht; T-L	P6AC12AB1
<b>[Q] Ni alloys/superalloys</b>	
Hastelloy B Rnd Rod	Q1AA16AB1
Hastelloy X-280 ST(2150F) Plt; 600-800F Air	Q1QA10AA15
Hastelloy X-280 ST(2150F) Plt; 1000-1200F Air; >.67Hz	Q1QA10AA19
Hastelloy X-280 ST(2150F) Plt	Q1QA10AB1
Inconel 600 Sht & Plt; 600F/316C	Q3AB10AA14
Inconel 600 Sht & Plt; 800F/427C	Q3AB10AA16
Inconel 600 Sht & Plt; 1000F	Q3AB10AA18
Inconel 600 Sht & Plt; 1200F/649C	Q3AB10AA20
Inconel 600 Sht & Plt; 75-800F	Q3AB10AB1
Inconel 625 Sht & Plt; 600F	Q3EA10AA14

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Table 1: List of NASFLA Materials with NASGRO Equation Constants (cont.)

<b>Materials; Conditions; Environment</b>	<b>Code</b>
Inconel 625 Sht & Plt; 800F	Q3EA10AA16
Inconel 625 Sht & Plt; 1000F	Q3EA10AA18
Inconel 625 Sht & Plt	Q3EA10AB1
Inconel 706; STA Forg & Extr	Q3JB33AB1
Inconel 706; STA Forg & Extr; -452F LHe	Q3JB33LA2
Inconel 706; ST Plt-GTA welded-STA	Q3JBB3AB1
Inconel 706; ST Plt-GTA welded-STA; -452F LHe	Q3JBB3LA2
Inconel 718; Ann Plt	Q3LA12AB1
Inconel 718; STA(1700F,- -) Plt & Forg; 600F Air	Q3LB23AA14
Inconel 718; STA(1700F,- -) Plt & Forg; 800F Air	Q3LB23AA16
Inconel 718; STA(1700F, - -) Plt & Forg; 1000F Air	Q3LB23AA18
Inconel 718; STA(1700F,- -) Plt & Forg; -100F to 400F Air	Q3LB23AB1
Inconel 718; STA(1700F,- -) Forg; C-R; LA & 600F Air	Q3LB26AA14
Inconel 718; STA(1700F,- -) Forg; C-R; 800F Air	Q3LB26AA16
Inconel 718; STA(1700F,- -) Forg; C-R; 1000F Air	Q3LB26AA18
Inconel 718; STA(1700F,- -) Forg RB; L-R & S-L; LA	Q3LB28AB1
Inconel 718; STA(1700F,- -) Plt GTA weld-STA; 600F	Q3LBB3AA14
Inconel 718; STA(1700F,- -) Plt-GTA weld-STA; 800F	Q3LBB3AA16
Inconel 718; STA(1700F,- -) Plt- GTA weld-STA; 1000F	Q3LBB3AA18
Inconel 718; STA(1700F,- -) Plt-GTA weld-aged	Q3LBB3AB1
Inconel 718; STA(1700F,- -) Plt-GTA weld-aged; LN2	Q3LBB3LA4
Inconel 718; STA(1700F,- -) Plt-EB weld-aged	Q3LBD3AB1
Inconel 718; STA(1700F,- -) Plt-EB weld-aged; LN2	Q3LBD3LA4
Inconel 718; STA(1900F,- -) Plt; LN2	Q3LC10LA4
Inconel 718; STA(1900F,- -) Plt; 600F Air	Q3LC11AA14
Inconel 718; STA(1900F,- -) Plt; 1000F Air	Q3LC12AA18
Inconel 718; STA(2000F,- -) Plt	Q3LE13AB1
Inconel 718; STA(2000F,- -) Plt; 800F Air	Q3LE11AA16
Inconel 718; STA(2000F,- -) Plt; 1000F Air	Q3LE13AA18
Inconel 718; STA(2000F,- -) GTA weld-STA; 600F Air	Q3LEB3AA14
Inconel 718; STA(2000F,- -) GTA weld-STA; 800F Air	Q3LEB3AA16
Inconel 718; STA(2000F,- -) GTA weld-STA; 1000F Air	Q3LEB3AA18
Inconel 718; STA(2000F,- -)Plt-GTA weld-STA	Q3LEB3AB1
Inconel 718 Rnd Rod; 185 ksi UTS Bolts	Q3LP18AB1
Inconel 718 Rnd Rod; 225 ksi UTS Bolts	Q3LQ18AB1
Inconel X-750; STA(2100F,- -) Plt & Forg	Q3SD26AB1
Inconel X-750; STA(2100F,- -) Forg; - 452F LHe	Q3SD26LA2

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Table 1: List of NASFLA Materials with NASGRO Equation Constants (cont.)

<b>Materials; Conditions; Environment</b>	<b>Code</b>
Inconel X-750; STA(2100F,- -) Plt; 600F Air	Q3SD10AA14
Inconel X-750; ST(2100F,- -) Plt; 800F Air	Q3SD10AA16
Inconel X-750; STA(2100F,- -) Plt; 1000F Air	Q3SD10AA18
K-500 Monel; Rnd Bar C-R	Q4VB16AB1
Rene 41; STA Plt & Forg	Q7AD13AB1
Rene 41; STA Forg; 1100F Air	Q7AD26AA19
Rene 41; STA Forg; 1200F Air	Q7AD26AA20
<b>[R] Misc. superalloys</b>	
MP35N Rnd Rod	R3AB18AB1
MP98T; Age 1000F/4 hr; 2in Rnd Bar; C-R	R3CB18AB1
<b>[S] Copper/Bronze alloys</b>	
CDA 172 Rnd Rod	S0BA13AB1
C17510 PA Plt	S1LB11AB1
C17510 PA Plt; -320F LN2	S1LB11LA4
C17510 Overaged Plt	S1LC11AB1
CDA 630 Al-Bronze Extr	S6JB36AB1
C95800 Ni-Al Bronze Casting; SW	S9FH50WD1
<b>[T] Magnesium alloys</b>	
AM 503 Plt	T1AA11AB1
AZ-31B-H24 Plt	T1DA12AB1
ZK-60A-T5 Plt	T1MA12AB1
ZW1 Plt	T1NA11AB1
QE22A-T6 Plt	T2LB13AB1
ZE41A-T5; Cast, L-T, T-L, L-S, S-L; DA	T2NA51AC1
<b>[U] Misc. non-ferrous alloys</b>	
Beryllium Cross-rolled sheet	U1CA90AB1
Beryllium Hot-pressed block	U1CA93AB1
C-103 Plt	U2CA10AB1

## 2 Weld Materials with NASGRO Equation Constants

Table 2: List of NASFLA Weld Materials with NASGRO Equation Constants

<b>Materials; Conditions; Environment</b>	<b>Code</b>
<b>[A] Iron, alloy or cast</b>	None
<b>[B] ASTM spec. grd. Steel</b>	
A36 ES Weld & HAZ(Dyn $K_{Ic}$ <500Hz); LA HHA3% NaCl	B0CZK1AB1
A225 Grd B Weld; RT	B2IBA1AB1
A225 Grd B Weld HAZ; RT	B2IBA7AB1
A514 Plt; GMA SR Weld	B5BFC2AB1
A533-B Plt SMA Weld	B5HDF1AB1
A543 CL 1 Plt & SR Weld; 500F Air	B5PA11AA13
<b>[C] AISI - SAE Steel</b>	None
<b>[D] Misc. U.S. Spec. Grade Steel</b>	None
<b>[E] Trade/common name steel</b>	
HP-9-4-20; 190-210 UTS; GTA Weld+SR; -65F	E1ECB2AC7
HP-9-4-20; 190-210 UTS; GTA Weld+SR; LA, HHA, SW>1Hz	E1ECB2WA1
HY 130 GMA & SMA Welds; LA & SW	E2CAC1AB1
HT-80 SA Weld	E3BAH1AB1
<b>[F] AISI type stainless steel</b>	
AISI 304/304L SA weld(308 filler)+SR; 800F Air>1Hz	F3DAH2AA16
AISI 304/304L SA weld(308 filler)+SR	F3DAH2AB1
AISI 316/316L SMA weld(316 filler)+SR; 800F Air>1Hz	F3KAH2AA16
<b>[G] Misc. CRES/heat resistant steel</b>	None
<b>[H] High temperature steel</b>	None
<b>[J] Tool Steel</b>	None
<b>[K] Foreign Steel (Russian)</b>	None
<b>[M] 1000-9000 Series aluminum</b>	
2014-T651 Plt & Sht; GTA Weld	M2AFB1AB1
2014-T651 Plt & Sht; GTA Weld SR	M2AFB2AB1
2219-T87 Plt & Sht; GTA Weld PAR; 300F Air	M2IFB1AA10
2219-T87 Plt & Sht; GTA Weld PAR	M2IFB1AB1
2219-T87 Plt & Sht; GTA Weld PAR; -320F LN2	M2IFB1LA4
6061-T6 Plt; GTA Weld PAR	M6ABA1AB1

Continued on next page

Table 2: List of Weld Materials with NASGRO Equation Constants (cont.)

<b>Materials; Conditions; Environment</b>	<b>Code</b>
7005-T6 Plt, GMAW Weld, Par	M7BAC1AB1
<b>[N] Foreign Aluminum (Russian)</b>	None
<b>[O] Misc. and cast aluminum</b>	None
<b>[P] Titanium alloys</b>	
Ti-6Al-4V STA GTA Weld SR; thk < 0.2 in.	P3EDB2AA1
Ti-6Al-4V STA GTA Weld SR; thk >= 0.2 in.	P3EDB2AB1
Ti-6Al-4V (ELI); RA(1700F/4h) Forg; EB-welded-SR; weldline	P3EMD2AB1
Ti-6Al-4V (ELI); RA(1700F/4h) Forg; EB-welded-SR; weldline; -320F LN2	P3EMD2LA4
Ti-6Al-4V (ELI); RA(1700F/4h) Forg; EB-welded-SR; HAZ	P3EMD8AB1
Ti-6Al-4V (ELI); RA(1700F/4h) Forg; EB-welded-SR; HAZ; -320F LN2	P3EMD8LA4
<b>[Q] Ni alloys/superalloys</b>	
Inconel 706; ST Plt-GTA welded-STA	Q3JBB3AB1
Inconel 706; ST Plt-GTA welded-STA; -452F LHe	Q3JBB3LA2
Inconel 718; STA(1700F,- -) Plt GTA weld-STA; 600F	Q3LBB3AA14
Inconel 718; STA(1700F,- -) Plt-GTA weld-STA; 800F	Q3LBB3AA16
Inconel 718; STA(1700F,- -) Plt- GTA weld-STA; 1000F	Q3LBB3AA18
Inconel 718; STA(1700F,- -) Plt-GTA weld-aged	Q3LBB3AB1
Inconel 718; STA(1700F,- -) Plt-GTA weld-aged; LN2	Q3LBB3LA4
Inconel 718; STA(1700F,- -) Plt-EB weld-aged	Q3LBD3AB1
Inconel 718; STA(1700F,- -) Plt-EB weld-aged; LN2	Q3LBD3LA4
Inconel 718; STA(2000F,- -) GTA weld-STA; 600F Air	Q3LEB3AA14
Inconel 718; STA(2000F,- -) GTA weld-STA; 800F Air	Q3LEB3AA16
Inconel 718; STA(2000F,- -) GTA weld-STA; 1000F Air	Q3LEB3AA18
Inconel 718; STA(2000F,- -)Plt-GTA weld-STA	Q3LEB3AB1

### 3 Materials with Walker Equation Constants

Table 3: List of NASFLA Materials with Walker Equation Constants

<b>Materials; Conditions; Environment<sup>1</sup></b>	<b>Code</b>
<b>[A] Iron, alloy or cast</b>	None
<b>[B] ASTM spec. grd. Steel</b>	None
<b>[C] AISI - SAE Steel</b>	
9310; Plt and forg; LHA	C7DB20AC1
9310; Plt and forg; Sump tank water	C7DB20AD1
<b>[D] Misc. U.S. Spec. Grade Steel</b>	None
<b>[E] Trade/common name steel</b>	
300M; 270–300 UTS; Forg; LHA	E1BF20AC1
HP 9-4; 190–210 UTS; Plt and forg; LHA	E1EB10AC1
HP 9-4; 190–210 UTS; Plt and forg; HHA	E1EB10AD1
HP 9-4; 190–210 UTS; Forged Bar; LHA	E1EB20AC1
<b>[F] AISI type stainless steel</b>	None
<b>[G] Misc. CRES/heat resistant steel</b>	
PH 13-8Mo H1000; Rolled bar; LHA	G1AD10AC1
PH 13-8Mo H1000; Rolled bar; Sump tank water	G1AD10WE1
PH 13-8Mo H1000; Extruded bar; LHA	G1AD30AC1
<b>[H] High temperature steel</b>	None
<b>[J] Tool Steel</b>	None
<b>[K] Foreign Steel (Russian)</b>	None
<b>[M] 1000-9000 Series aluminum</b>	
2024-T81 Sht; LHA	M2EI10AC1
2024-T851 Plt; LHA	M2EJ10AC1
2124-T851 Plt; LHA	M2GC10AC1
2124-T851 Plt; Sump tank water	M2GC10WE1
2124-T851 Plt; HHA	M2GC10AD1
2219-T851 Plt; LHA	M2IC10AC1
2219-T851 Plt; Sump tank water	M2IC10WE1
2219-T851 Plt; HHA	M2IC10AD1

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<sup>2</sup>Unless noted, assume Lab Air (LA) environment and any orientation except S-T, S-L, C-R, C-L, and R-L

Table 3: List of Materials with Walker Equation Constants (cont.)

<b>Materials; Conditions; Environment<sup>2</sup></b>	<b>Code</b>
7075-T7351 Plt and Sht; LHA	M7HH10AC1
7075-T73511 Extr; LHA	M7HJ10AC1
7075-T7651 Plt and Sht; Sump tank water	M7HM10WE1
7075-T76511 Plt and Sht; Sump tank water	M7HM30WE1
7175 Hand forging; LHA	M7VA20AC1
<b>[N] Foreign Aluminum (Russian)</b>	None
<b>[O] Misc. and cast aluminum</b>	None
<b>[P] Titanium alloys</b>	
Ti-6Al-4V; RA(1700F/4h) Plt; LHA	P3EC10AC1
Ti-6Al-4V; RA(1700F/4h) Plt; Sump tank water	P3EC10WE1
Ti-6Al-4V; RA(1700F/4h) Hand forging; LHA	P3EC20AC1
<b>[Q] Ni alloys/superalloys</b>	
Inconel 718; ST(1700-1850F)+A(1325F/8h+1150F/10h) Plt; 70F LA	Q3LB10AB1
Inconel 718; ST(1700-1850F)+A(1325F/8h+1150F/10h) Plt; 400F LA	Q3LB10AA12

<sup>2</sup>Unless noted, assume Lab Air (LA) environment and any orientation except S-T, S-L, C-R, C-L, and R-L

## 4 Abbreviations in NASGRO Material ID Descriptions

Table 4: Abbreviations in Material ID Descriptions

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<b>MATERIAL SYSTEMS</b>	
AL	Aluminum Alloys
BE	Beryllium Alloys
CB	(NB) Columbium (Niobium) Alloys
CU	Copper Alloys
MG	Magnesium Alloys
MO	Molybdenum Alloys
SS	Stainless Steels
TI	Titanium Alloys
ZN	Zinc Alloys
<b>ALLOY CONDITIONING AND HEAT TREATMENTS</b>	
ABQ	Aus Bay Quench
AC	Air Cool
AH	Age Harden
AM	Air Melt
ANN	Anneal
AQ	Rapid Air Quench
AUS	Austenitize
BA	Beta Anneal
BF	Beta Forge
BR	Beta Rolled
CR	Cold Rolled/Reduced
CRT	Cold Rolled & Tempered
CW	Cold Worked
D-ANN	Duplex Anneal
DAH	Double Age Harden
DS	Directionally Solidified
ELI	Extra Low Interstitial (O <sub>2</sub> )
FC	Furnace Cooled
FH	Full Hard
FM	Filler Metal
G	Gatorized
HIP	Hot Isostatic Processing

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Continued on next page

Table 4: Abbreviations in Material ID Descriptions (cont.)

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HR	Hot Rolled
HT	Heat Treat
MA	Mill Anneal
MAR	Marage
NOR	Normalize
OA	Over age
OQ	Oil Quench
P/M	Powder Metallurgy
PER	SPEC Per Specification
RA	Recrystallize Anneal
SR	Stress Relieved
ST	Solution Treat
STA	Solution Treat & Age
T	Temper
VAR	Vacuum Arc Remelting
VIM	Vacuum Induction Melting
WQ	Water Quench
WR	Wrought
WW	Warm Work

**PRODUCT FORMS**

BT	Billet
CAST	Cast
EXTR	Extrusion
FORG	Forging
HAZ	Heat Affected Zone
HIP	Hot Isostatically Pressed
PLT	Plate
PM	Powder Metallurgy
RB	Round Bar
RCS	Round Corner Square
SHT	Sheet

**WELD TYPES**

Unk	Unknown
GTA	Gas tungsten arc
GMA	Gas metal arc

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Continued on next page

Table 4: Abbreviations in Material ID Descriptions (cont.)

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EB	Electron beam
PA	Plasma arc
SMA	Shielded metal arc
FCA	Flux cored arc
SA	Submerged arc
ER	Electric resistance
LB	Laser beam
ES	Electro slag
DB	Diffusion bond
FSW	Friction Stir Weld

## ENVIRONMENTS

### Atmospheric Environments

AIR	0 – 100% relative humidity air
LA	Lab or 50% relative humidity air
DA	Dry/low humidity air
HHA	High humidity air
LHA	Low humidity air
SA	Seacoast atmosphere
VAC	Vacuum
SF	Salt fog

### Cleaning Fluids and Solvents

ACETONE	Acetone
CCL4	Carbon tetrachloride
ETHANOL	Ethanol
FREON TF	Freon TF
C3OH	Alcohol

### Miscellaneous Gases

AR	Argon
N2	Nitrogen
HE	Helium
NH3	Ammonia
CO2	Carbon dioxide
H2S04	Hydrogen sulfide
CH4	Methane

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Continued on next page



Table 4: Abbreviations in Material ID Descriptions (cont.)

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NE	Neon
R. FREON	Refrigerant Freon

**Miscellaneous Liquids**

LG	Liquified gases
EDI	Ethanol + dry ice

**Propellants and Fuels**

A-50	Aerozine 50
N <sub>2</sub> H <sub>4</sub>	Hydrazine
H <sub>2</sub> (LP)	Hydrogen (<100 psi)
H <sub>2</sub> (HP)	Hydrogen (>100 psi)
JP4	JP4 aircraft fuel
MMH	Monomethyl hydrazine
N <sub>2</sub> O <sub>4</sub>	Nitrogen tetroxide
O <sub>2</sub>	Oxygen
JP4 + H <sub>2</sub> O	JP4 aircraft fuel and water

**Water Environments**

DW	Distilled water
NACL	Sodium chloride solution
NACL CP	Sodium chloride with cathodic protection
SW	Seawater
ASW	Aircraft sump water
SWCP	Seawater with cathodic protection
NaBO <sub>3</sub>	Sodium Borate
NaNO <sub>3</sub>	Sodium Nitrate
WV	Water vapor
STM	Steam
BW	Boiler water
PW	Pressurized water reactor (PWR) water

**SPECIMEN TYPES****Configuration (Loading)**

A (T)	Arc Compact (Tension)
C (T)	Compact (Tension)
DB (Mx)	Double Beam (Moment x-axis)

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Continued on next page

Table 4: Abbreviations in Material ID Descriptions (cont.)

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DB (Mz)	Double Beam (Moment z-axis)
DB (W)	Double Beam (Wedge)
DB (T)	Double Beam (Tension)
DC (T)	Disk-shaped Compact (Tension)
DE (T)	Double Edge (Tension)
MC (T)	Modified Compact (Tension)
MC (W)	Modified Compact (Wedge)
M (T)	Middle (Tension)
PS (T)	Part-through Surface (Tension)
R-Bar (T)	Round Bar (Tension)
RDB (T)	Round Double Beam (Tension)
SE (B)	Single Edge (Bending)
SE (T)	Single Edge (Tension)
STIF M (T)	Stiffened Middle (Tension)

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## 5 Specimen Crack Orientations (Ref: ASTM E399-06)

The following figures show different orientations of cracked specimens. The convention for labeling cracked specimens is such that the first letter indicates the direction of the loading and the second letter indicates the direction of the crack.

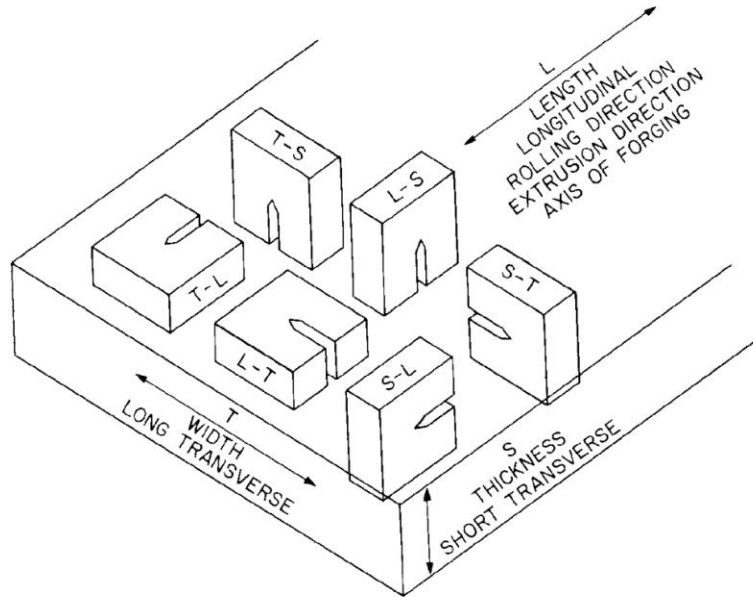


Figure 5.1: Rectangular Sections – Specimens Aligned with Reference Directions

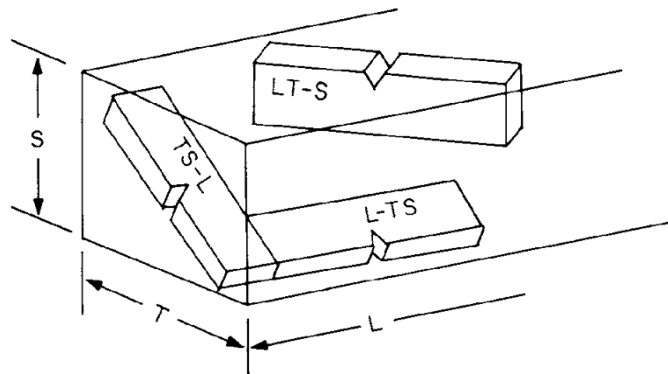


Figure 5.2: Rectangular Sections – Specimens Not Aligned with Reference Directions

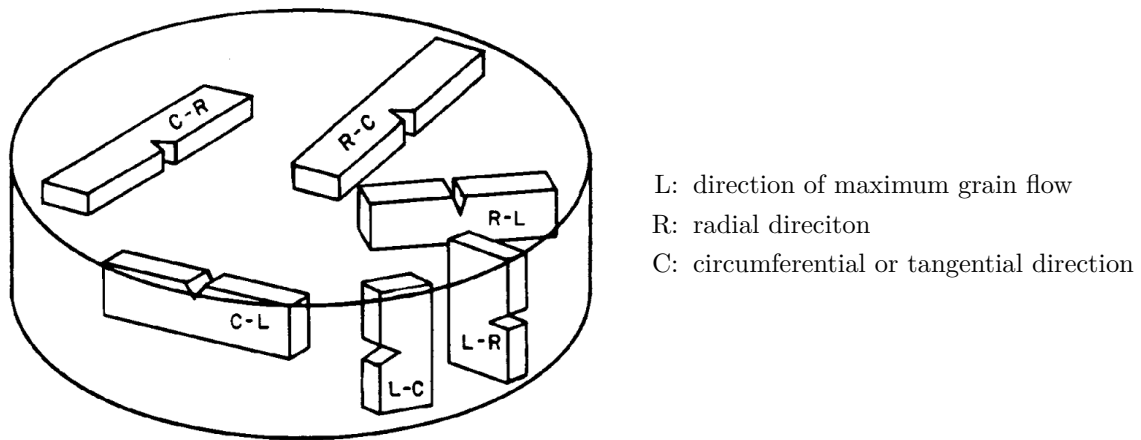


Figure 5.3: Cylindrical Bars and Tubes