Esterline
Engineered Materials

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Bulletin 120: Materials Selection Guide

METAL STRAP MATERIALS

	Materials			Mechanical						
Code for Part Number	Metal & MIL Specs.	Heat Treatment & MIL Specs.	Finish & MIL Specs.	Tensile PSI Min.	Yield PSI Min.	Hardness	Elong-ation	Temp. Range	Weight (Ref.) lbs/in^3	**Remarks.** The information shown below has been obtained from specifications, manufacturer's literature and TA's tests and experience.
DO	Aluminum 2024-0 AMS-QQ-A250/5	T42 Condition AMS 2770	None	57000	34000	57 HRB min	15%	-65°F (-54°C) +250°F (121°C)	.101	Used basically for wire bundle clamps in low vibration and noncorrosive environments where weight saving is desired.
DC	Aluminum 2024-0 AMS-QQ-A250/5	T42 Condition AMS 2770	Chemical Film Gold MIL-DTL-5541	57000	34000	57 HRB min	15%	-65°F (-54°C) +250°F (121°C)	.101	The addition of chemical film provides added corrosion resistance and is specified when a conductive finish is required. Chemical film is also a good paint or primer base.
DA	Aluminum 2024-0 AMS-QQ-A250/5	T42 Condition AMS 2770	Anodize Gray MIL-A-8625	57000	34000	57 HRB min	15%	-65°F (-54°C) +250°F (121°C)	.101	This finish provides better corrosion resistance but is nonconductive. Also, it is more expensive than chemical film.
SO	Steel No. 4 Temper ASTM A366/ ASTM A109	None	None	48000 (Mean)	25000	65 HRB Max	32%	-65°F (-54°C) +400°F (204°C)	.283	Specified for applications where painting is performed after clamp installation.
SZ	Steel No. 4 Temper ASTM A366/ ASTM A109	None	Zinc Plate ASTM B 633	48000 (Mean)	25000	65 HRB Max	32%	-65°F (-54°C) +400°F (204°C)	.283	Generally used for automotive applications. Less expensive than cadmium plating.
SC	Steel No. 4 Temper ASTM A366/ ASTM A109	None	Cad. Plate QQ-P-416	48000 (Mean)	25000	65 HRB Max	32%	-65°F (-54°C) +400°F (204°C)	.283	The standard anti-corrosion resistant plating for steel used by the aircraft industry.
CO	Stainless Steel 302 Annealed AMS 5516	None	Ball Burnish and Passivate Per AMS 2700*	25000 to 100000	36000 to 60000	92 HRB	40% min	-320°F (-196°C) +1300°F (704°C)	.286	Commonly specified where good atmospheric and chemical corrosion resistance is required. Resists food products, acids, and other chemicals.
HO	Stainless Steel 321 Annealed AMS 5510	None	Ball Burnish and Passivate Per AMS 2700*	70000 to 100000	25000	None	40% min	-320°F (-196°C) +1300°F (704°C)	.286	Excellent corrosion and high temperature properties. Used where immunity to intergranular corrosion is essential.
H1	Stainless Steel 321 AMS 5510	None	Ball Burnish and Passivate Per AMS 2700*	100000	50000	None	None	-320°F (-196°C) +1300°F (704°C)	.286	The same properties as "HO" but slightly tempered for better shape retention and strength.
PH	Stainless Steel 17-7PH/ Annealed AMS 5528	Condition TH 1100 AMS2759/3	Ball Burnish and Passivate Per AMS 2700*	150000	None	34-39 HRC	6% min	-320°F (-196°C) +1900°F (1038°C)	.276	Excellent fatigue requirements at high temperatures. Superior to any listed materials for shape retention thus enhancing clamp reusability.

*Passivation is validated using the Copper Sulfate Test

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METAL MATERIALS (NON-STANDARD)

Code for Part Number	Materials			Mechanical						Remarks. The information shown below has been obtained from specifications, manufacturer's literature and TA's test and experience.
	Metal & MIL Specs.	Heat Treatment & MIL Specs.	Finish & MIL Specs.	Tensile PSI Min.	Yield PSI Min.	Hardness	Elong-ation	Temp. Range	Weight (Ref.) lbs/in³	
AG	A 286 AMS 5525 Annealed Stainless Steel	Precipitation H.T. to Condition STA AMS 2759/3	Ball Burnish and Passivate Per AMS 2700*	140000	95000	24-35 HRC	15%	+1300°F (+704°C)	.287	Primarily used in jet engine environments. Has excellent high temperature fatigue resistance.
JN	Inconnel 625 Annealed AMS 5599	None	Ball Burnish	120000 Min	60000 Min	None	30%	+1800°F (980°C)	.305	Long term, high stress use at elevated temperature. Resists high temperature corrosion. Note: Non-standard item. Be fore specifying this material please contact Kirkhill-TA for application support
JO	Titanium Annealed AMS 4901	None	None	80000	70000	None	15%	+400°F (204°C)	.163	Used for applications where a high strength to weight ratio is required. Will work harder under high vibration conditions. Subject to attack by some chemicals.
GO	Aluminum 6061-0 AMS 4025	T42 Condition AMS 2770	None	30000	14000	None	14%-16%	-65°F (-54°C) +250°F (121°C)	.098	Used in missile and space applications where environmental conditions preclude the use of 2024 Aluminum
GC	Aluminum 6061-0 AMS 4025	T42 Condition AMS 2770	Chemical Film Gold MIL-DTL-5541	30000	14000	None	14%-16%	-65°F (-54°C) +250°F (121°C)	.098	Used in missile and space applications where environmental conditions preclude the use of 2024 Aluminum
GA	Aluminum 6061-0 AMS 4025	T42 Condition AMS 2770	Anodize Gray MIL-A-8625	30000	14000	None	14%-16%	-65°F (-54°C) +250°F (121°C)	.098	Used in missile and space applications where environmental conditions preclude the use of 2024 Aluminum

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ORGANIC COMPOUNDS

Code for Part Number	Trade or Popular and Chemical Name	Color Id.	Specifications	Hardness Durometer A	Tensile Strength PSI	Tear Str. PPI	Temp. Range	Ozone Resis.	Flammability	Titanium Compat.	**Application Information.** The information shown below is of a general nature. If more specific information is required, please contact your TA representative.*
CR	Neoprene	Black	TA69 AMS 3209	70	1700 Min.	125 Min.	-40°F (-40°C) +210°F (99°C)	Test not Reqd.	Test not Reqd.	Not Recom.	A general purpose elastomer with good water, ozone and weather resistance. Generally used for automotive and ground support applications. Can be corrosive under elevated temperature and high humidity conditions. Also can attack some vinyl insulation materials.
CL	Neoprene (Chloroprene)	Black with Blue Identifier	TA69A AMS3209 (mod.) MIL-C-8603 LAC422544 (Ozone)	70	1700 Min.	125 Min.	-40°F (-40°C) +210°F (99°C)	No Failures at 600 PPHM	Test not Reqd.	Not Recom.	Similar to "CR", except with improved ozone resistance to meet the requirements of MIL-C-8603A
NB	Buna N or Hycar (Nitrile Butadiene)	Yellow	TA77-2A M85052/1 M85449/1 U/L 95V-0 (fire) FAA FAR 25.853 (Ozone)	70	2000 Min.	300 Min.	-65°F (static) +275°F (135°C)	Non-cracking at 600 PPHM	U/L 94V-0 FAA FAR 25.853 Vertical	Test required per M85052 & M85449	An improved nitrile elastomer compounded to meet the most rigorous requirements of aerospace hydraulic and fuel systems. Has excellent resistance to hydrocarbon based fluids, ozone, fire and corrosion. Exceeds specification AMS 3215. Replaces "AF", TA Compound 85; "HT", TA Compound 74 and "AW", TA Compound 77. Caution: Do not use with phosphate ester based hydraulic fluids.
NH	Buna N or Hycar (Nitrile Butadiene)	Golden Rod	TA9977	55	1700 Min.	225	-65°F (static) +275°F (135°C)	Non-cracking at 600 PPHM	M85032 Vertical	Tested per M85052	A lower durometer hardness variation of "NB", TA Compound 77-2A. Used in the same environments, but being a softer stock provides more flexibility, especially in electrical applications where various insulations cause clamp sizing problems.
EP	EPR (Ethylene Propylene)	Purple	TA79-1A M85052/2 M85449/2 MIL-C-8603 DMS 1849 LAC 423557	70	2000 Min.	200 Min.	-65°F (static) +275°F (135°C)	Test not applic.	DMS 1502 FAA FAR 25.853 Horiz.	Test required per M85052 & M85449	This elastomer has been designed for use in commercial transport aircraft for wiring and tube clamps where phosphate ester hydraulic oil is used. It has excellent ozone and abrasion resistance but should not be used in environments where it will be in contact with hydrocarbon base fluids. Replaces "PR", TA Compound 79, and Butyl (SR) Compound No. TA73-1.
ES	EPR (Ethylene Propylene)	Plum	TA1231	55	1500 Min.	150 Min.	-65°F (static) +275°F (135°C)	Test not applic.	DMS 1502 FAA FAR 25.853 Horiz.	Not tested	A lower durometer hardness of "EP", TA Compound TA79-A and is also resistant to hydraulic oil, ozone and abrasion.

*These physical properties are based on ASTM Molded Test Slabs. When material is extruded, these physical properties may be reduced by approximately 20%.

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SILICONE COMPOUNDS

Code for Part Number	Trade or Popular and Chemical Name	Color Id.	Specifications	Hardness, Durometer A	Tensile Strength PSI	Tear Strength PPI	Temp. Range	Flammability	Titanium Compat.	**Application Information.** The information shown below is of a general nature. If more specific information is required, please contact your TA representative.*
FS	Flurosilicone (Unsupported)	Med. Blue	TA3109 MIL-R-25988 Class I, Type II Grade 60 AMS 3325B	60	900	40	-70°F (-57°C) +400°F (204°C)	Test not Reqd.	Test not required per MIL-R-25988	A hydrocarbon fluid resistant elastomer developed primarily for confined seals. Has low mechanical strength and tear resistance. Does not perform well in contact with phosphate ester base hydraulic fluids.
FK	High Strength Flurosilicone (Unsupported)	Med. Blue	TA9799 MIL-R-25988 Class 2, Type II Grade 50	50	1150	150	-70°F (-57°C) +400°F (204°C)	Test not Reqd.	Test not required per MIL-R-25988	A high strength version of "FS". Physical properties and testing per MIL-R-25988
HA	Silicone (Unsupported)	White	TA6711 ATS 1000 BMS 1-63 DMS 2221	55	1100	160	-65°F (-54°C) +400°F (204°C)	BSS 7230 60 sec Vertical burn test	Not Tested	A Compound designed especially for aircraft pressurized cabin environment where fire resistance, low smoke density and toxicity requirements are essential. Also has good resistance to phosphate ester hydraulic fluids.
HU	Silicone (Unsupported)	White	TA8827 ATS 1000 BMS 1-63 DMS 2221	70	1100	160	-65°F (-54°C) +400°F (204°C)	BSS 7230 60 sec Vertical burn test	Tested per MIL-C-85052 as "HA"	A higher durometer version of "HA" developed specifically for line block applications in pressurized cabin areas of aircraft. Has same basic properties
HB	Silicone (Fabric supported) Non-Reverting	Pink	TA88 MIL-R-3065 TA612 A_6 B_3,F_3,G_1,K_2, M,Z_6	60	1200	300	-150°F (-100°C) +500°F (260°C) intermittant to 600°F	FAA FAR 25.853 12 sec Vertical burn test	Tested per MIL-C-85052	A high strength, silicone elastomer/fabric combination with an extremely wide temperature range and nonreverting properties. Widely used for rocket and turbine engine applications.
HC	Silicone (Fabric supported)	Light Blue	TA101 M85052/3 M85449/3	70	1200	300	-65°F (-54°C) +500°F (260°C)	Test required per MIL-C-85052	Test required per MIL-C-85052	A high strength, silicone fabric/elastomer combination with good "across-the-board" fluid resistance and high temperature properties. Used primarily for turbine engine applications. A.Q.P.L. material per MIL-C-85052 and MIL-C-85449
HD	Silicone (Unsupported)	Light Blue	TA101	65	900	150	-65°F (-54°C) +500°F (260°C)	Not Tested but elastomer the same as "HC"	Not Tested but elastomer the same as "HC"	An unsupported version of "HC" primarily used for inserts, grommets, and other applications where the increased strength of "HC" is not required.
HR	Silicone (Unsupported)	White	TA9575 AMS 3303 (mod) MIL-C-8603	60	600	100	-65°F (-54°C) +400°F (204°C)	Test not Reqd. by MIL-C-8603	Test not Reqd. by MIL-C-8603	A general purpose silicone compound for elevated temperatures which has been modified to provide increased tear strength. Fluid resistance tests are not required by specification AMS 3303, except for ASTM No. 1 Oil

*These physical properties are based on ASTM Molded Test Slabs. When material is extruded, these physical properties may be reduced by approximately 20%.

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SILICONE COMPOUNDS (CONTINUED)

Code for Part Number	Trade or Popular and Chemical Name	Color Id.	Specifications	Hard-ness, Duro-meter A	Tensile Strength PSI	Tear Strength PPI	Temp. Range	Flam-mability	Titanium Compat.	**Application Information.** The information shown below is of a general nature. If more specific information is required, please contact your TA representative.*
WC	Silicone (Fabric supported)	Brown	TA9798 PWA 36450	60	1000	300	-65°F (-54°C) +600°F (316°C)	M85052 Vertical Burn test	Tested per MIL-C-85052	A new ultra high temperature elastomer developed for the new higher operating temperature turbine engines which permits its substitution for Teflon/ asbestos in many applications. Has excellent fluid, fire, and corrosion resistance.
WD	Silicone (Unsup-ported)	Brown	TA9798 PWA 36453	60	900	90	-65°F (-54°C) +600°F (316°C)	Not Tested	Tested per MIL-C-85052	The same compound as "WC" except without fabric reinforcement. Used primarily for inserts, grommets, and other parts not requiring the high strength of "WC".
WF	Silicone (Unsup-ported)	Dark Grey	TA2417 NASA SP-R-0022A (outgassing)	65	900	150	+500°F (260°C)	Not Tested	Not Tested	A special elastomer developed especially for spacecraft applications where "low outgassing" is a consideration. Surpassed NASA's specification SP-R-0022A by approximately 10 fold, and does not require any supplemental baking operations.
WG	Silicone (Fabric supported)	Light Green	TA7110	70	1100	300	-65°F (-54°C) +500°F (260°C)	M85052 12 sec Vertical burn test	Tested per MIL-C-85052	A high strength, high modulus elastomer developed for high vibration and high temperature applications. Has exceptional fluid resistance making it an outstanding choice for engine environments.
WH	Silicone (Unsup-ported)	Med. Green	TA7110	70	900	150	-65°F (-54°C) +500°F (260°C)	Not Tested	Tested per MIL-C-85052	An unsupported version of "WG" developed specifically for line block applications in turbine engine environ-ments. Also used for grommets and inserts.
RA	Hybrid Elastomer (Unsup-ported)	Orange	TA7476	75	1000	275	-50°F (-45.6°C) +500°F (260°C)	FAA FAR 25.853 App.F Horiz. M85052 Vertical	Tested per MIL-C-85052	A hybrid stock developed primarily for high temperature resistance to CTFE Hydraulic Fluid but in addition having resistance to both hydrocarbon and phosphate ester fluid. A very advanced compound for propulsion and other aerospace applications. Note: Non-standard item. Before specifying this material, please contact TA Mfg. for application support.
RB	Hybrid Elastomer (Unsup-ported)	Brown	TA6332	70	900	250	-65°F (-54°C) +600°F (260°C)	FAA FAR 25.853 App.F Horiz. M85052 Vertical	Tested per MIL-C-85052	Another new hybrid stock developed for maximum heat resistance and strength as well as resistance to phosphate ester hydraulic fluid. **Note:** Non-standard item. Before specifying this material, please contact Kirkhill-TA for application support.

*These physical properties are based on ASTM Molded Test Slabs. When material is extruded, these physical properties may be reduced by approximately 20%.

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PLASTICS

Code for Part Number	Trade or Popular and Chemical Name	Color Id.	Specifications	Hard-ness, Duro-meter A	Tensile Strength PSI	Tear Strength PPI	Temp. Range	Flam-mability	Titanium Compat.	**Application Information.** The information shown below is of a general nature. If more specific information is required, please contact your TA representative or the applicable specification.
TF	Teflon Formed From Tape (TFE)	White	ASTM D3308 Type I, Grade 1	N/A	2800 min.	Not Specified	-320°F (-196°C) +500°F (260°C)	Non-burning but will outgas at approx. 500°F	Not tested	A Teflon film cushion material available in clip-strap configuration only, formed from tape approximately .015 to .025 thick. Used primarily in cryogenic and chemical environments. Has good thermal stability, aging, weathering and electrical insulatin properties. Ideal for LOX applications. See notes #1, #2 below.
XF	Teflon Formed from Tape and Sodium Etched	Brown	ASTM D3308 Type I, Grade 1	N/A	2800 min.	Not Specified	-320°F (-196°C) +500°F (260°C)	Non-burn-ing but will outgas at approx. 500°F	Not tested	Same as above PLUS sodium etching, which reduces lubricity. See notes #1,#2,#3 below.
TM	Teflon Molded Cushion With Wedge (TFE)	White	Federal Specification ASTM D4894 Type 1 GR.1	N/A	2000 min.	Not Specified	-320°F (-196°C) +500°F (260°C)	Non-burning but will outgas at approx. 500°F	Not tested	A molded Teflon cushion/wedge combina-tion available in clip-strip configuration only, molded with approximately .025 to .035 pad thickness. Used primarily in cryogenic and chemical environments. Has good thermal stability, aging, weathering and electrical insulation properties. Ideal for LOX applications. See notes #1, #2 below.
XM	Teflon Mold-ed Cushion With Wedge Sodium Etched	Brown	Federal Specification ASTM D4894 Type 1 GR.1	N/A	2000 min.	Not Specified	-320°F (-196°C) +500°F (260°C)	Non-burn-ing but will outgas at approx. 500°F	Not tested	Same as above PLUS sodium etching, which reduces lubricity. See notes #1,#2,#3 below.
PV	Vinyl (PVC)	Yellow	MIL-I-631D Type F Grade A	N/A	1800 min.	Not Specified	-25°F (-32°C) +160°F (71°C)	Will burn see note on toxicity	Not tested	A polyvinyl chloride material used primarily for compatibility with vinyl insulated wiring. CAUTION: Will emit toxic fumes in event of fire. Not suitable for use with aromatics and ketones.
FT	Fiberglass Sleeve	Silver	TA81A(Ref.)	N/A	N/A	N/A	-100°F (-73°C) +1000°F (538°C)	Non-burning	Not tested	A braided fiberglass sleeving with aluminized finish. Has approximately .050" wall thickness and the cut ends are sealed with a silicone resin to prevent fraying. A replacement for "FG" to reduce abrasion and provide better cushioning.
N	Nylon DuPont 6/6 Polhexa-methylene Adipamide	Opaque White (Nat-ural)	L-P-410A	118 RA	11000 min.	N/A	See Spec for deflecting temper-atures.	N/A	Not tested	A low temperature plastic supplied ONLY in the form of clamp inserts. See Bulletin 130.
T	Teflon	White	Federal Specification ASTM D4894 Type 1 GR.1	See TM, or specification for physical properties						A plastic same as "TM" except available only in the form of a clamp insert. See Bulletin 130. See applicable notes #1, #2, below.
X	Teflon	Brown	Federal Specification ASTM D4894 Type 1 GR.1	See XM, or specification for physical properties						A plastic same as "XM" except available only in the form of a clamp insert. See Bulletin 130. See applicable notes #1, #2, #3 below.

Notes
1 All Teflon (TFE Flurocarbon) materials above are formulated with virgin Teflon, Free from repossessed materials, fillers plasticizers or color pigment except required molding powder according to ASTM D-1457, Type 1 (which replaces Federal Specification L-P403C, Type 1 or 11) and Federal Specification for film tape MIL-P22241A.
2 Caution: Teflon material will outgas at approximately +500°F and soften at +650°F.
3 Caution: Teflon, particularly etched TFE, can be abrasive under some operating conditions

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METALLIC CUSHIONS

Code for Part Number	Trade or Popular and Chemical Name	Color Id.	Specifications	Ultimate Tensile PSI	Tear Strength PSI	Hardness	Temp. Range	Application Information. The information shown below is of a general nature. If more specific information is required, please contact your TA representative or the applicable specification.
CB Steel	Stainless Finish Corrugated	Bright Type 321	AMS 5510	85,000	31,400	Rockwell B90	-320°F (-196°C) +1300°F (704°C)	A corrugated stainless steel cushion fusion welded to a band of the same material (see Section D for details). Superior high temperature clamp/cushion. Corrugations provide air passage between clamp and line promoting cooling and aiding removal of abrasive foreign matter. Thoroughly tested and proven for retaining hard lines on turbine engines and thrush reversers. Also used on various lines on diesel equipment. (Edges of corrugations are beveled to reduce danger of galling.)
CC	Stainless Steel Corrugated & Coated	Dull Finish	AMS 5510 Type 321 Coating Melco 57NS Powder GE B50TF-42-S4 Class A	85,000	31,400	Rockwell B65 (Surface)	-320°F (-196°C) +1300°F (704°C)	Identical to "CB" cushion with the addition of a 3 Mil flame spray coating of copper nickel alloy to provide additional protection against galling and fretting corrosion during high temperature and extreme vibration cycles. (Coating reduces surface hardness to Rockwell B65)