



# MATERIAL SPECIFICATIONS

# CONTENTS

Alloy Steel 4140.....	2
Carbon Steel 1045 cr .....	3
UHB SS716 Stainless Steel .....	4
316 Stainless Steel Cable .....	5
304 Stainless Steel .....	6
3003-H14 Aluminum .....	7
5052 Aluminum (H32) .....	8
6063 Aluminum (T6).....	9
Hardened & Coated	
Polycarbonate (Lexan™ MR10) .....	10
Tritan™ Copolyester TX1501HF .....	11
BASF Ultrad® 8202C Polyamide 6.....	12
DuPont Tynex® A 612 Nylon.....	13
HDPE (High-density Polyethylene).....	14
Closed Cell EPDM Sponge Rubber .....	15
EA E-30CL Adhesive .....	16
ABS (Acrylonitrile Butadiene Styrene) Plastic .....	17

# ALLOY STEEL 4140

## USED IN:

Helical Blade

## DESCRIPTION:

Oil-hardening chromium-molybdenum steel has good strength and wear resistance, excellent toughness and ductility with the ability to resist stress and creep at prolonged high temperatures (up to 1,000°F).

## TYPICAL APPLICATIONS:

Drill collars, high temperature bolts, sprockets, kelly bars, reamer bodies, rotary table shafting, oil well tool joints, spindles, stay bolts, tractor axles, tractor arms, axle shafts, valves, bolts, subs, couplings, trailer axles, winch shafts, piston rods, rams, hydraulic machinery shafts, precision lead screws, chain links, zinc die-casting dies.

## TREATMENT(S):

The Mobius part this material is used in is liquid nitrided and black oxidized.

CHEMICAL COMPOSITION (% NOMINAL)		MECHANICAL PROPERTIES	
C	0.38/0.43 Max.	Tensile Strength	70,000 PSI
Mn	0.75/1.00	Yield Point	60,000 PSI
P	0.035 Max.	Elongation***	20
S	0.04 Max.	Brinell Hardness	200
Si	0.15/0.35	** Ranges shown are for 4140 Annealed. All values are minimum values and are representative.	
Cr	0.80/1.10	*** % in 2"	
Mo	0.15/0.25		

\* Chemical Analysis will vary on each heat number.

# CARBON STEEL 1045 CR

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## USED IN:

Helical Blade Shaft

Carbon steel 1045 is designed to be able to function in areas requiring greater strength and hardness. This steel possesses excellent size accuracy, concentricity, and straightness which together enable to minimize wear in high speed applications.

## TYPICAL APPLICATIONS:

Typical uses include gears, shafts, axles, bolts, studs, and machine parts.

## TREATMENT(S):

The Mobius part this material is used in is liquid nitrided and black oxidized.

CHEMICAL COMPOSITION (% NOMINAL)		MECHANICAL PROPERTIES	
C	0.42 - 0.50	Tensile Strength	90,600 PSI
Mn	0.60 - 0.90	Yield Point	73,900 PSI
P	0.040 Max.	Elongation***	12%
S	0.050 Max.	Brinell Hardness	179

\* Chemical Analysis will vary on each heat number.

# UHB SS716 STAINLESS STEEL

## USED IN:

Bed Knife Cutting Edge

## DESCRIPTION:

UHB SS716 is a cold rolled martensitic stainless steel grade designed for applications where toughness and impact fatigue strength are essential (even at temperatures as high as 400°C). The 13% chromium steel is delivered in the hardened and tempered condition and has proven to offer exceptional bending and impact fatigue properties and good corrosion resistance.

## TYPICAL APPLICATIONS:

Surgical blades, culinary knives, assembly parts, motor parts.

### CHEMICAL COMPOSITION (% NOMINAL)

C	0.38
Mn	0.55
P max	0.025
S max	0.015
Si	0.45
Cr	13.5
Mo	1.00

### PHYSICAL PROPERTIES

Density, $\rho$	7.7 g/cm <sup>3</sup>
Thermal Expansion, <100°C (210°F)	10.6 x 10 <sup>-6</sup> /°C
Thermal Conductivity, RT	24 W/m °C
Specific Heat Capacity, RT to 100°C (210°F)	460 j/kg °C
Resistivity, RT	0.75 $\Omega$ mm <sup>2</sup> /m
Damping loss factor, (215 Hz, <150°C)	0.0011

### MECHANICAL PROPERTIES

Ultimate Tensile Strength, Rm	1810 MPa
Proof Strength, Rp <sub>0.2</sub>	1450 MPa
Elongation, A <sub>50</sub>	4-6 %
Modulus of Elasticity	210 GPa
Hardness	540 HV

### FATIGUE PROPERTIES

Tensile Fatigue Limit Ratio, $\sigma_u / R_m$ , (20°C)	0.33
Bending Fatigue Limit Ratio, $\sigma_u / R_m$ , (20°C)	0.35
Compressive residual stresses	-350±100 MPa

# 316 STAINLESS STEEL CABLE

## USED IN:

Wire Tumbler Body

## DESCRIPTION:

Stainless steel Type 316 is an Austenitic alloy that was developed for added corrosion resistance, when compared to other stainless steels (e.g. Type 304). It generally has a slightly higher nickel content but is distinguished by the addition of molybdenum.

## TYPICAL APPLICATIONS:

Often used in marine environments and refrigeration applications, where corrosion resistance is key. General grade for food processing, chemical storage and transport, textile dyeing equipment, cladding of nuclear fuel, and oil refining equipment as well as some medical implants.

### CHEMICAL COMPOSITION (% NOMINAL)

Cr	16 – 18
Ni	10 – 14
C	0.08
Mn	2
Si	0.75
P	0.045
S	0.03
N	0.10
Mo	2.0 – 3.0

### OTHER PROPERTIES

Type	Aircraft Cable
Type Description	Strand
Application	Commercial
Strand Construction	1 x 7
Material	Pre-formed 316 Stainless Steel
Diameter	$\frac{1}{32}$ Inch
Minimum Break Strength	150 lbs. / 68.03 kg
Coating	Bare

# 304 STAINLESS STEEL

## USED IN:

Brush Shaft, Separator Housing, Fan Housing, Input Hopper

## DESCRIPTION:

Stainless steel Type 304 is a commonly used form stainless steel that demonstrates excellent corrosion resistance to most oxidizing acids and is easy to sanitize.

## TYPICAL APPLICATIONS:

Kitchen and food applications.

### CHEMICAL COMPOSITION (% NOMINAL)

C	0.08
Mn	2
P max	0.045
S max	0.03
Si	1
Cr	18 – 20

### MECHANICAL PROPERTIES

Tensile Strength	85 ksi
Yield Strength	35 ksi
Elongation in 2 Inches	55%
Reduction of Area	70%
Brinell Hardness	150

### PHYSICAL PROPERTIES

Density Lb/In <sup>3</sup>	0.29
Coefficient of Thermal Expansion 32 – 212°F x 10 <sup>-6</sup> per °F	9.6
Specific Heat 32 – 212°F BTU/°F/Lb	0.12
Thermal Conductivity at 212 °F BTU/Ft/Ft <sup>2</sup> /Hr/°F	9.4
Electrical Resistivity at 70°F Microhm-cm	70

# 3003-H14 ALUMINUM

## USED IN:

Aluminum Honeycomb Screens on Lid Assembly

## DESCRIPTION:

General purpose, moderate strength, good workability and weldability, high resistance to corrosion.

## TYPICAL APPLICATIONS:

Grilles and guards, architectural and decorative applications, cooking utensils, panels, railings, storage tanks.

## TREATMENT(S):

The Mobius parts this material is used in are anodized.

CHEMICAL COMPOSITION (% NOMINAL)		MECHANICAL PROPERTIES	
Si	0.6	Tensile Strength (ksi)	Ultimate: 22 Yield: 21
Fe	0.7	Elongation % in 2" Specimen	$\frac{1}{16}$ " thick: 8 $\frac{1}{2}$ " diam.: 16
Cu	0.05 – 0.20	Brinell Hardness 500 Kg Load 10 mm Ball	40
Mn	1.0 – 1.5	Ultimate Shearing Strength (ksi)	14
Mg	–	Fatigue Endurance Limit (ksi)	9
Cr	–	Modulus of Elasticity (ksi x 103)	10.0
Zn	0.10		
Ti	–		

PHYSICAL PROPERTIES	
Density Lb/In <sup>3</sup>	0.099
Avg. Coefficient of Thermal Expansion 68 to 212°F x 10 <sup>-6</sup> per °F	12.9
Melting Range Approximate °F	1190 – 1210
Temper	H14
Thermal Conductivity at 77 °F BTU/Ft/Ft <sup>2</sup> /Hr/°F	92
Electrical Conductivity at 68°F Percent of Int'l Annealed Cu Standard	Equal Volume: 41 Equal Weight: 134
Electrical Resistivity at 68°F Ohms-Cir/Mil/Ft	25



# 5052 ALUMINUM (H32)

## USED IN:

Aluminum Flat Plates and Sheet Metal Parts (Mobius Body Tray and Impeller Housing)

## DESCRIPTION:

Excellent resistance to salt water corrosion, good weldability and workability, good finishing characteristics.

## TYPICAL APPLICATIONS:

Home appliances, vehicle bodies, small boats, sheet metal parts, fan blades.

## TREATMENT(S):

The Mobius parts this material is used in are anodized.

### CHEMICAL COMPOSITION (% NOMINAL)

Si	0.25
Fe	0.40
Cu	0.10
Mn	0.10
Mg	2.2 – 2.8
Cr	0.15 – 0.35
Zn	0.10
Ti	–

### MECHANICAL PROPERTIES

Tensile Strength (ksi)	Ultimate: 35 Yield: 28
Elongation % in 2" Specimen	1/16" thick: 12 1/2" diam.: 18
Brinell Hardness 500 Kg Load 10 mm Ball	60
Ultimate Shearing Strength (ksi)	20
Fatigue Endurance Limit (ksi)	17
Modulus of Elasticity (ksi x 10 <sup>3</sup> )	10.2

### PHYSICAL PROPERTIES

Density Lb/In <sup>3</sup>	0.097
Avg. Coefficient of Thermal Expansion 68 to 212°F x 10 <sup>-6</sup> per °F	13.2
Melting Range Approximate of	1125 – 1200
Thermal Conductivity at 77 °F BTU/Ft/Ft <sup>2</sup> /Hr/°F	80
Electrical Conductivity at 68°F Percent of Int'l Annealed Cu Standard	Equal Volume: 35 Equal Weight: 116
Electrical Resistivity at 68°F Ohms-Cir/Mil/Ft	30

# 6063 ALUMINUM (T6)

## USED IN:

Aluminum Extrusion Parts (Lid Extrusions, Bed Knife Bar, Spacer Bar and Impeller Housing)

## DESCRIPTION:

Solution heat treated, then artificially aged. High corrosion resistance, medium strength, good natural finish.

## TYPICAL APPLICATIONS:

Irrigation pipe, store fronts, architectural trim, pipe railing, furniture.

## TREATMENT(S):

The Mobius parts this material is used in are anodized or powder coated.

CHEMICAL COMPOSITION (% NOMINAL)		MECHANICAL PROPERTIES	
Si	0.20 – 0.6	Tensile Strength (ksi)	Ultimate: 35 Yield: 31
Fe	0.35	Elongation % in 2 in. 1/16 in. Thick Specimen	12
Cu	0.10	Brinell Hardness 500 Kg Load 10 mm Ball	73
Mn	0.10	Ultimate Shearing Strength (ksi)	22
Mg	0.45 – 0.9	Fatigue Endurance Limit (ksi)	10
Cr	0.10	Modulus of Elasticity (ksi x 10 <sup>3</sup> )	10.0
Zn	0.10		
Ti	0.10		

## PHYSICAL PROPERTIES

Density Lb/In <sup>3</sup>	0.097
Avg. Coefficient of Thermal Expansion 68 to 212°F x 10 <sup>-6</sup> per °F	13.0
Melting Range Approximate °F	1140 – 1210
Temper	T6
Thermal Conductivity at 77 °F BTU/Ft <sup>2</sup> /Hr/°F	116
Electrical Conductivity at 68°F Percent of Int'l Annealed Cu Standard	Equal Volume: 53 Equal Weight: 175
Electrical Resistivity at 68°F Ohms-Cir/Mil/Ft	20

# HARDENED & COATED POLYCARBONATE (LEXAN™ MR10)

## USED IN:

Transparent Top Lid Shield and Trim Tote Window

## DESCRIPTION:

LEXAN™ MR10 sheets are transparent polycarbonate sheets, coated on both sides to be both Mar and UV-resistant.

## TYPICAL APPLICATIONS:

Transparent surfaces on equipment, furniture and finishes in high-traffic areas.

### MECHANICAL PROPERTIES

Tensile Strength, Ultimate	9,500 psi
Flexural Strength	13,500 psi
Flexural Endurance @ 1,800 Cycles/Min, 73°F, 50% RH	1,000 psi
Compressive Strength	12,500 psi
Modulus of Elasticity	345,000 psi
Drop Ball Impact Strength	>200 ft-lbs at all temps. tested

### PHYSICAL PROPERTIES

Specific Gravity	1.20
Light Transmission (avg.), 1/8" thick	88%
Chemical Resistance	Gasoline and kerosene: No tackiness, crazing or loss of transparency for a minimum of 48 hours.

### THERMAL PROPERTIES

Coefficient of Thermal Expansion	3.75 x 10 <sup>-5</sup> in/in/°F
Heat Deflection Temp. @ 264 psi	270°F

### FLAMMABILITY

Horizontal Burn (Flame Spread)	<1 in
Ignition Temperature	Flash: 873°F Self: 1,076°F

# TRITAN™ COPOLYESTER TX1501HF

## USED IN:

Tumbler End Caps – Versions E and later

## DESCRIPTION:

Eastman Tritan™ copolyester TX1501HF contains a mold release derived from vegetable-based sources. Outstanding features include good toughness, hydrolytic stability, and heat and chemical resistance. Tritan™ copolyester TX1501HF may be used in repeated use food contact articles under US FDA regulations and is certified to NSF/ANSI Standard 51 for Food Equipment Materials and to NSF/ANSI Standard 61 - Drinking Water System Components-Health Effects.

## TYPICAL APPLICATIONS:

Appliances, baby bottles, auto plastics, consumer electronics, housewares, tools, toys, water bottles.

### PHYSICAL PROPERTIES

Specific Gravity	1.18
Mold Shrinkage	0.005 - 0.007 mm / mm (0.005 - 0.007 in. / in.)

### THERMAL PROPERTIES

Deflection Temperature	
@ 0.455 MPa (66 psi)	94°C (201°F)
@ 1.82 MPa (264 psi)	81°C (178°F)

### MECHANICAL PROPERTIES

Tensile Stress @ Yield	43 MPa (6200 psi)
Tensile Stress @ Break	52 MPa (7500 psi)
Elongation @ Yield	7%
Elongation @ Break	210%
Tensile Modulus	1575 MPa (2.28 x 10 <sup>5</sup> psi)
Flexural Modulus	1575 MPa (2.28 x 10 <sup>5</sup> psi)
Flexural Yield Strength	64 MPa (9300 psi)
Rockwell Hardness, R Scale	111
Izod Impact Strength, Notched @ 23°C (73°F)	860 J/m (16.1 ft·lbf/in.)
Impact Strength, Unnotched @ 23°C (73°F)	NB

# BASF ULTRAMID® 8202C POLYAMIDE 6

## USED IN:

Tumbler Rings

## DESCRIPTION:

Ultramid 8202C is a modified crystalline and low viscosity PA6 injection molding homopolymer. Its crystalline structure results in increased strength, stiffness, heat distortion temperature and performance under load as a homopolymer

## TYPICAL APPLICATIONS:

Furniture casters, gears, window hardware and fittings, insulators, valves, relays, wiring devices and other electrical components.

	PROPERTIES
Melt Temperature	240 – 285 °C
Mold Temperature	65 – 80 °C
Injection & Packing Pressure	35 – 125 bar

# DUPONT TYNEX® A 612 NYLON

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## USED IN:

Brush Bristles

## DESCRIPTION:

Tynex® A is an abrasive filament made by extruding a mixture of nylon and abrasive grit. Nylon has several characteristics that make it attractive for abrasive filaments. Nylon is tougher and more durable than common alternative polymers. It is also resistant to abrasion, a fact that helps extend its useful life.

## TYPICAL APPLICATIONS:

Industrial brushes for cleaning and equipment applications.

## PHYSICAL PROPERTIES

Melting Point	> 200 °C
Decomposition Temperature	> 190 °C

# HDPE (HIGH-DENSITY POLYETHYLENE)

## USED IN:

Trim Tote

## DESCRIPTION:

Flexible, translucent/waxy, weatherproof, good low temperature toughness (to -60°C), easy to process by most methods, good chemical resistance.

## TYPICAL APPLICATIONS:

Food storage containers, piping, plastic bottles, geomembranes, fuel tanks.

PROPERTIES	
Tensile Strength	0.20 – 0.40 N/mm <sup>2</sup>
Notched Impact Strength	No break
Thermal Coefficient of Expansion	100 – 200 x 10 <sup>-6</sup>
Max. Continued Use Temp.	65°C (149°F)
Melting Point	126°C (259°F)
Density	0.941 – 0.965 g/cm <sup>3</sup>

# CLOSED CELL EPDM SPONGE RUBBER

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## USED IN:

Trim Tote Gasket/Seal

## DESCRIPTION:

Exhibits very good aging properties, compressibility, and shows an excellent resistance to UV, ozone and oxidation.

## TYPICAL APPLICATIONS:

Various industrial and commercial applications such as HVAC systems, automotive parts and electrical enclosures.

PROPERTIES	
Density	0.65
Compression Deflection (CD) to 25%	0.052 MPa
Heat Resistance (% change from original CD value after oven-aged 7 days @ 70°C	-3.9%
Compression Set 22 hrs. @ 70°C, 50% deflection with 30 min. recovery	24.6%
Compression Set 22 hrs. @ 70°C, 50% deflection with 24 hr. recovery	18.5%
Compression Set 22 hrs. @ 23°C, 50% deflection with 24 hr. recovery	5.2%
Fungus Resistance	Pass



# EA E-30CL ADHESIVE

## USED IN:

Bed Knife Assembly

## DESCRIPTION:

LOCTITE® EA E-30CL, also known as Hysol E-30CL Epoxy ADH Ultra, is a clear, colorless to slightly yellowish, 2-part, low viscosity, industrial grade epoxy adhesive. It cures at room temperature with minor shrinkage to form an ultra clear adhesive bondline with excellent impact resistance. It resists a wide range of chemicals and solvents and bonds most materials including glass, optical fibers, ceramics, metals and many rigid plastics.

## TYPICAL APPLICATIONS:

Used in bonding, small potting, staking and laminating applications where optical clarity and excellent structural, mechanical and electrical insulating properties are required

PROPERTIES	
Cure Type	Room Temperature Cure
Fixture Time	3 hours
Full Cure Temperature (°C)	25
Full Cure Temperature (°F)	77
Full Cure Time	24 hours
Key Characteristics	Chemical Resistant, Impact Resistant, Performance: High Performance, Viscosity: Low Viscosity, Work Life: Medium Work Life
Number of Components	2 Part
Shear Strength, Steel (psi)	3100
Technology	Epoxy
Substrates	Ceramic, Metal, Plastic

# ABS (ACRYLONITRILE BUTADIENE STYRENE) PLASTIC

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## USED IN:

Output Chute

## DESCRIPTION:

Acrylonitrile Butadiene Styrene (ABS) is an opaque thermoplastic and amorphous polymer. ABS plastics can be heated to their melting point, cooled, and re-heated again without significant degradation. Instead of burning, thermoplastics like ABS liquefy which allows them to be easily injection molded and then subsequently recycled.

## TYPICAL APPLICATIONS:

Power-tool housings, home décor applications, toys

	PROPERTIES
Tensile Strength	450 kg/cm <sup>2</sup>
Flexural Strength	820 kg/cm <sup>2</sup>
Flexural Modulus	31,000 kg/cm <sup>2</sup>
Rockwell Hardness	R-108
Izod Impact Strength	1/4" bar: 25 kg-cm/cm 1/8" bar: 29 kg-cm/cm
Heat Deflection	85°C
Melt Flow	21 g/10 min
Specific Gravity	1.05