TIVAR[™] 88-2 ESD UHMW-PE



Ultra High Molecular Weight Polyethylene

TIVAR[™] 88-2 ESD UHMW-PE electro static dissipative shapes prevent the build-up of electrical charges in dusty or volatile environments. As a premium ESD grade that offers low moisture absorption, the lowest coefficient of friction of all TIVAR[™] 88 grades and excellent chemical resistance, TIVAR[™] 88-2 ESD UHMW-PE components can be fabricated and welded for any application that requires a seamless drop-in liner, a framed-in liner, or a replacement liner. For these reasons, this UV stabilized grade is considered the material of choice for the lining of storage and transport containers, hoppers, chutes, tubes, bunkers, conveyors, vibratory pans and stand pipes. Furthermore, TIVAR[™] 88-2 ESD UHMW-PE liners are available in kits and can be self-installed or professionally-installed through our extensive network of global SystemTIVAR[™] Engineering partners.

PRODUCT DATASHEET

Melling temperature (BSC, L0°C (50°F) / min) ISO 11357-1/3 °C ASTM 02418 °F 272 Giss straintion temperature (MM- The 10; c) V			ISO*			ASTM*		
Image: Standing temperature (DMA- Tan 8) (2) Image: Standing temperature (DMA- Tan 8			Test methods	Units	Indicative values	Test methods	Units	Indicative values
Planmability: Oxygen Index ISO 4589-1/-2 9% 20 Increase Increase Increase Increase Statu	Thermal properties (1)	Melting temperature (DSC, 10°C (50°F) / min)	ISO 11357-1/-3	°C		ASTM D3418	۴	275
Planmability: Oxygen Index ISO 4589-1/-2 9% 20 Increase Increase Increase Increase Statu		Glass transition temperature (DMA- Tan δ) (2)		°C			°F	
Planmability: Oxygen Index ISO 4589-1/-2 9% 20 Increase Increase Increase Increase Statu		Thermal conductivity at 23°C (73°F)		W/(K.m)			BTU in./(hr.ft ² .°F)	
Planmability: Oxygen index ISO 4589-1/-2 % 20 Increase Increrase </td <td>Coefficient of linear thermal expansion (-40 to 150 $^{\circ}\text{C})$ (-40 to 300$^{\circ}\text{F})$</td> <td></td> <td></td> <td></td> <td>ASTM E-831 (TMA)</td> <td>µin./in./°F</td> <td>110</td>		Coefficient of linear thermal expansion (-40 to 150 $^{\circ}\text{C})$ (-40 to 300 $^{\circ}\text{F})$				ASTM E-831 (TMA)	µin./in./°F	110
Planmability: Oxygen index ISO 4589-1/-2 % 20 Increase Increrase </td <td>Coefficient of linear thermal expansion (23 to 100°C) (73°F to 210°F)</td> <td></td> <td>μm/(m.K)</td> <td></td> <td></td> <td></td> <td></td>		Coefficient of linear thermal expansion (23 to 100°C) (73°F to 210°F)		μm/(m.K)				
Planmability: Oxygen index ISO 4589-1/-2 % 20 Increase Increrase </td <td>Heat Deflection Temperature: method A: 1.8 MPa (264 PSI)</td> <td>ISO 75-1/-2</td> <td>°C</td> <td></td> <td>ASTM D648</td> <td>°F</td> <td>116</td>		Heat Deflection Temperature: method A: 1.8 MPa (264 PSI)	ISO 75-1/-2	°C		ASTM D648	°F	116
Planmability: Oxygen index ISO 4589-1/-2 % 20 Increase Increrase </td <td>Continuous allowable service temperature in air (20.000 hrs) (3)</td> <td></td> <td>°C</td> <td></td> <td></td> <td>°F</td> <td>180</td>		Continuous allowable service temperature in air (20.000 hrs) (3)		°C			°F	180
Planmability: Oxygen index ISO 4589-1/-2 % 20 Increase Increrase </td <td>Min. service temperature (4)</td> <td></td> <td>°C</td> <td></td> <td></td> <td>°F</td> <td></td>		Min. service temperature (4)		°C			°F	
Tensile strain (elongation) at yield ISO 527-1/-2 (7) MPa ASTM D638 (8) PSi 4400 Tensile strain (elongation) at yield ISO 527-1/-2 (7) % ASTM D638 (8) % 250 Tensile strain (elongation) at treak ISO 527-1/-2 (7) % ASTM D638 (8) % 250 Shear Strength ASTM D532 (10) MPa ASTM D538 (8) %51 116 Compressive stress at 1/2 15 % inominal strain ISO 0604 (10) MPa ASTM D588 (8) KS1 116 Compressive strength Compressive strength MPa ASTM D688 (8) KS1 126 Charpy impact strength - notched ISO 179-1/LeU K/Im ² ASTM D256 ft.Ib./in ASTM D256 ft.Ib./in Izod Impact double notched ISO 178 (12) MPa ASTM D790 ISI 106 ASTM D790 KS1 106 Relative volume loss "and-stury" (ISO vsTIVAR®1000, ASTM vs1018 Stee) ISO 178 (12) MPa ASTM D790 KS1 106 Strind D250 Index-100 ASTM D790 KS1 106 Relative volume		Flammability: UL 94 (3 mm (1/8 in.)) (5)			HB			HB
Tensile strain (elongation) at yield ISO 527-1/-2 (7) % ASTM D638 (8) % 250 Tensile strain (elongation) at break ISO 527-1/-2 (7) % ASTM D638 (8) % 250 Tensile strain (elongation) at break ISO 527-1/-2 (9) MPa ASTM D638 (8) % 250 Shear Strength Shear Strength ISO 527-1/-2 (9) MPa ASTM D638 (8) % 4800 Compressive strength ISO 527-1/-2 (9) MPa ASTM D638 (8) % 4800 Compressive strength ISO 1627-11/-2 (9) MPa ASTM D638 (8) % 4800 Compressive strength ISO 179-11/-2 (10) MPa ASTM D698 (11) PS1 2900 Charpy impact strength - unched ISO 179-11/-2 (14) k/lm ² ASTM D630 (11) PS1 2900 Izod Impact notched ISO 179-11/-2 (15) k/lm ² ASTM D630 (11) PS1 3100 Izod Impact notched ISO 178-11/-2 (10) MPa ASTM D790 (13) PS1 3100 Relative volume loss 'sand-slury' (ISO vsTIVAR®1000, ASTM vs1018 Stee) ISO 178-12 (12) MPa ASTM D790 (13) PS1 3100 </td <td>Flammability: Oxygen Index</td> <td>ISO 4589-1/-2</td> <td>%</td> <td>20</td> <td></td> <td></td> <td></td>		Flammability: Oxygen Index	ISO 4589-1/-2	%	20			
Paralle strain (elongation) al break ISO 527-1/-2 (?) % ASTM D638 (?) % 250 Tensile modulus of elasticity ISO 527-1/-2 (?) MPa ASTM D638 (?) KSI 116 Shear Strength ASTM D732 MPa ASTM D638 (?) KSI 14800 Compressive stress at 1/2 /5 % nominal strain ISO 604 (10) MPa ASTM D638 (?) KSI 48000 Charpy impact strength - unotched ISO 179-1/1240 KJ/m ² ASTM D695 (1) PSI 48000 Charpy impact strength - notched ISO 179-1/1240 KJ/m ² ASTM D695 (1) PSI	(6)	Tensile strength	ISO 527-1/-2 (7)	MPa		ASTM D638 (8)	PSI	4800
Image: Partial modulus of elasticity ISO 527-1/-2 (9) MPa ASTM D638 (8) KSI 116 Shear Strength ASTM D732 MPa ASTM D732 MPa ASTM D732 PSI 4800 Compressive strength ISO 604 (10) MPa ASTM D732 PSI 4800 Compressive strength unotched ISO 179-1/LeU KJ/m ² ISO 179-1/LeU ISO 179-1/LeU KJ/m ² ISO 179-1/LeU ISO 179-1/LeU ISO 179-1/LeU ISO 179		Tensile strain (elongation) at yield	ISO 527-1/-2 (7)	%		ASTM D638 (8)	%	
Piezural modulus of elasticity INC 100 (Cl) MPa ASTM 0700 KSI 106 Piezural modulus of elasticity ISO 178 (12) MPa ASTM 0700 KSI 106 Relative volume loss "sand-slumy" (ISO vsTIVAR®1000; ASTM vs1018 Steel) ISO 15527 Index=100 ASTM D4020 Index=100 ASTM D2240 Volume 240 64 Shore Hardness D (14) IEC 60243-1(15) KV/mm ASTM D1290 Volume 240 Volume 240 64 Volume resistivity IEC 60243-1(15) KV/mm ASTM D149 Volume 240 Volume		Tensile strain (elongation) at break	ISO 527-1/-2 (7)	%		ASTM D638 (8)	%	250
Piezural modulus of elasticity INC 100 (Cl) MPa ASTM 0700 KSI 106 Piezural modulus of elasticity ISO 178 (12) MPa ASTM 0700 KSI 106 Relative volume loss "sand-slumy" (ISO vsTIVAR®1000; ASTM vs1018 Steel) ISO 15527 Index=100 ASTM D4020 Index=100 ASTM D2240 Volume 240 64 Shore Hardness D (14) IEC 60243-1(15) KV/mm ASTM D1290 Volume 240 Volume 240 64 Volume resistivity IEC 60243-1(15) KV/mm ASTM D149 Volume 240 Volume		Tensile modulus of elasticity	ISO 527-1/-2 (9)	MPa		ASTM D638 (8)	KSI	116
Image of the storing in the storing	SS	Shear Strength	ASTM D732	MPa		ASTM D732	PSI	4800
Piezural modulus of elasticity INC 100 (Cl) MPa ASTM 0700 KSI 106 Piezural modulus of elasticity ISO 178 (12) MPa ASTM 0700 KSI 106 Relative volume loss "sand-slumy" (ISO vsTIVAR®1000; ASTM vs1018 Steel) ISO 15527 Index=100 ASTM D4020 Index=100 ASTM D2240 Volume 240 64 Shore Hardness D (14) IEC 60243-1(15) KV/mm ASTM D1290 Volume 240 Volume 240 64 Volume resistivity IEC 60243-1(15) KV/mm ASTM D149 Volume 240 Volume	al Propertie	Compressive stress at 1 / 2 / 5 % nominal strain	ISO 604 (10)	MPa				
Image of the storing in the storing		Compressive strength				ASTM D695 (11)	PSI	2900
Piezural modulus of elasticity INC 100 (Cl) MPa ASTM 0700 KSI 106 Piezural modulus of elasticity ISO 178 (12) MPa ASTM 0700 KSI 106 Relative volume loss "sand-slumy" (ISO vsTIVAR®1000; ASTM vs1018 Steel) ISO 15527 Index=100 ASTM D4020 Index=100 ASTM D2240 Volume 240 64 Shore Hardness D (14) IEC 60243-1(15) KV/mm ASTM D1290 Volume 240 Volume 240 64 Volume resistivity IEC 60243-1(15) KV/mm ASTM D149 Volume 240 Volume		Charpy impact strength - unnotched	ISO 179-1/1eU	kJ/m ²				
Piezural modulus of elasticity INC 100 (Cl) MPa ASTM 0700 KSI 106 Piezural modulus of elasticity ISO 178 (12) MPa ASTM 0700 KSI 106 Relative volume loss "sand-slumy" (ISO vsTIVAR®1000; ASTM vs1018 Steel) ISO 15527 Index=100 ASTM D4020 Index=100 ASTM D2240 Volume 240 64 Shore Hardness D (14) IEC 60243-1(15) KV/mm ASTM D1290 Volume 240 Volume 240 64 Volume resistivity IEC 60243-1(15) KV/mm ASTM D149 Volume 240 Volume		Charpy impact strength - notched	ISO 179-1/1eA	kJ/m ²				
Piezural modulus of elasticity INC 100 (Cl) MPa ASTM 0700 KSI 106 Piezural modulus of elasticity ISO 178 (12) MPa ASTM 0700 KSI 106 Relative volume loss "sand-slumy" (ISO vsTIVAR®1000; ASTM vs1018 Steel) ISO 15527 Index=100 ASTM D4020 Index=100 ASTM D2240 Volume 240 64 Shore Hardness D (14) IEC 60243-1(15) KV/mm ASTM D1290 Volume 240 Volume 240 64 Volume resistivity IEC 60243-1(15) KV/mm ASTM D149 Volume 240 Volume	jc	Charpy impact strength - double 14° notched	ISO 21304-2	kJ/m²				
Piezural modulus of elasticity INC 100 (Cl) MPa ASTM 0700 KSI 106 Piezural modulus of elasticity ISO 178 (12) MPa ASTM 0700 KSI 106 Relative volume loss "sand-slumy" (ISO vsTIVAR®1000; ASTM vs1018 Steel) ISO 15527 Index=100 ASTM D4020 Index=100 ASTM D2240 Volume 240 64 Shore Hardness D (14) IEC 60243-1(15) KV/mm ASTM D1290 Volume 240 Volume 240 64 Volume resistivity IEC 60243-1(15) KV/mm ASTM D149 Volume 240 Volume	Mechar	Izod Impact notched				ASTM D256	ft.lb./in	
Image of the storing in the storing		Izod Impact double notched				ASTM D4020	ft.lb./in	
Relative volume loss "sand-slury" (ISO vSTIVAR®1000; ASTM vs1018 Steel) ISO 15527 Index=100 ASTM D4020 ASTM D4020 Index=100 ASTM D4020		Flexural strength	ISO 178 (12)	MPa		ASTM D790 (13)	PSI	3100
Shore Hardness D (14) ISO 868 I ASTM D2240 I 64 ISO 868 IEC 60243·1 (5) KV/mm ASTM D240 Volts/mil Volture resistivity IEC 60243·1 (5) KV/mm ASTM D257 Ohm.cm Voltar cersistivity IEC 62631·3-1 Ohm.cm ASTM D257 Ohm.cm Voltar cersistivity ANSI/ESD STM 11.11 Ohm ANSI/ESD STM 11.11 Ohm Diedcric constant at 1 MHz IEC 62631·2-1 IEC 62631·2-1 ASTM D150 IEC 6271·2-1 Dissipation factor at 1MHz IEC 62631·2-1 IEC 62631·2-1 ASTM D150 IEC 6271·2-1 Color IEC 62631·2-1 IEC 62631·2-1 IEC 62631·2-1 IEC 62631·2-1 IEC 62631·2-1 Voltar cersistivity IEC 62631·2-1 IEC 62631·2-1 IEC 62631·2-1 IEC 62631·2-1 IEC 62631·2-1 Voltar cersistivity IEC 62631·2-1		Flexural modulus of elasticity	ISO 178 (12)	MPa		ASTM D790	KSI	106
Belectric strength IEC 60243-1 (15) kV/mm ASTM D149 Volts/mil Volume resistivity IEC 62631-3-1 Ohm.cm ASTM D257 Ohm.cm Surface resistivity ANSI/ESD STM 11.11 Ohm ANSI/ESD STM 11.11 Ohm Dielectric constant at 1 MHz IEC 62631-2-1 IEC 62631-2-1 ASTM D150 IEC Color IEC 62631-2-1 IEC 62631-2-1 Black IEC 62631-2-1 Black Density ISO 1183-1 g/cm³ IEC 62631-2-1 IEC 62631-2-1 IEC 62631-2-1		Relative volume loss "sand-slurry" (ISO vsTIVAR®1000; ASTM vs1018 Steel)	ISO 15527	Index=100		ASTM D4020	Index=100	10
Volume resistivity IEC 62631-3-1 Ohm.cm ASTM D257 Ohm.cm Surface resistivity ANSI/ESD STM 11.11 Ohm Ohm ANSI/ESD STM 11.11 Ohm Dielectric constant at 1 MHz IEC 62631-2-1 IEC 62631-2-1 ASTM D150 IEC ASTM D150 IEC Dissipation factor at 1MHz IEC 62631-2-1 IEC 62631-2-1 ASTM D150 IEC ASTM D150 IEC Color Density ISO 1183-1 g/cm³ Black IEC 62631-2-1 IEC IEC IEC 62631-2-1 IEC 62631-2-1 <td></td> <td>Shore Hardness D (14)</td> <td>ISO 868</td> <td></td> <td></td> <td>ASTM D2240</td> <td></td> <td>64</td>		Shore Hardness D (14)	ISO 868			ASTM D2240		64
Color Black Black Density ISO 1183-1 g/cm³	Electrical Properties	Electric strength	IEC 60243-1 (15)	kV/mm		ASTM D149	Volts/mil	
Color Black Black Density ISO 1183-1 g/cm³		Volume resistivity	IEC 62631-3-1	Ohm.cm		ASTM D257	Ohm.cm	
Color Black Black Density ISO 1183-1 g/cm³		Surface resistivity	ANSI/ESD STM 11.11	Ohm		ANSI/ESD STM 11.11	Ohm	<10^9
Color Black Black Density ISO 1183-1 g/cm³		Dielectric constant at 1 MHz	IEC 62631-2-1			ASTM D150		
Density ISO 1183-1 g/cm ³		Dissipation factor at 1MHz	IEC 62631-2-1			ASTM D150		
	Miscellaneous	Color			Black			Black
Specific Gravity ASTM D792 0.94 Water absorption after 24h immersion in water of 23 °C (73°F) ISO 62 (16) % ASTM D570 (17) %		Density	ISO 1183-1	g/cm ³				
Open Water absorption after 24h immersion in water of 23 °C (73°F) ISO 62 (16) % ASTM D570 (17) %		Specific Gravity				ASTM D792		0.94
		Water absorption after 24h immersion in water of 23 °C (73°F)	ISO 62 (16)	%		ASTM D570 (17)	%	
Water absorption at saturation in water of 23 °C (73°F) % ASTM D570 (17) %		Water absorption at saturation in water of 23 °C (73°F)		%		ASTM D570 (17)	%	
Φ Wear rate ISO 7148-2 (18) μm/km QTM 55010 (19) In*.min/Libs.hr/x10-#		Wear rate	ISO 7148-2 (18)	μm/km		QTM 55010 (19)	In3.min/ft.lbs.hrX10-10	
Openamic Coefficient of Friction (-) ISO 7148-2 (18) QTM 55007 (20) 0.08		Dynamic Coefficient of Friction (-)	ISO 7148-2 (18)		-	QTM 55007 (20)		0.08
E Limiting PV at 100 FPM (safety factor 4) QTM 55007 (21) ft.bss/rv/min 4000		Limiting PV at 100 FPM (safety factor 4)				QTM 55007 (21)	ft.lbs/in².min	4000
Limiting PV at 0.1 / 1 m/s cylindrical sleeve bearings MPa.m/s		Limiting PV at 0.1 / 1 m/s cylindrical sleeve bearings		MPa.m/s				
Chemical Resistance www.mcam.com/en/support/chemical-resistance-information www.mcam.com/en/support/chemical-resistance-information			www.mcam.com/er	n/support/chemica	al-resistance-information	www.mcam.com/er	n/support/chemica	al-resistance-information

Note: 1 g/cm³ = 1,000 kg/m³ ; 1 MPa = 1 N/mm² ; 1 kV/mm = 1 MV/m

This table, mainly to be used for comparison purposes, is a valuable help in the choice of a material. The data listed here fall within the normal range of product properties of dry material. However, they are not guaranteed and they should not be used to establish material specification limits nor used alone as the basis of design. See the remaining notes on the next page. NYP: there is no yield point

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Notes, see datasheet on page 1

- 1. The figures given for these properties are for the most part derived from raw material supplier data and other publications.
- Values for this property are only given here for amorphous materials and for materials that do not show a melting temperature (PBI & PI).
- 3. Temperature resistance over a period of min. 20,000 hours. After this period of time, there is a decrease in tensile strength measured at 23 °C of about 50 % as compared with the original value. The temperature value given here is thus based on the thermal-oxidative degradation which takes place and causes a reduction in properties. Note, however, that the maximum allowable service temperature depends in many cases essentially on the duration and the magnitude of the mechanical stresses to which the material is subjected.
- 4. Impact strength decreasing with decreasing temperature, the minimum allowable service temperature is practically mainly determined by the extent to which the material is subjected to impact. The value given here is based on unfavourable impact conditions and may consequently not be considered as being the absolute practical limit.
- 5. These estimated ratings, derived from raw material supplier data and other publications, are not intended to reflect hazards presented by the material under actual fire conditions. There is no 'UL File Number' available for these stock shapes.
- Most of the figures given for the mechanical properties are average values of tests run on dry test specimens machined out of rods 40-60 mm when available, else out of plate 10-20mm. All tests are done at room temperature (23° / 73°F)
- 7. Test speed: either 5 mm/min or 50 mm/min [chosen acc. to ISO 10350-1 as a function of the ductile behaviour of the material (tough or brittle)] using type 1B tensile bars
- 8. Test speed: either 0.2"/min or 2"/min or [chosen as a function of the ductile behaviour of the material (brittle or tough)] using Type 1 tensile bars
- 9. Test speed: 1 mm/min, using type 1B tensile bars
- 10. Test specimens: cylinders Ø 8 mm x 16 mm, test speed 1 mm/min
- 11. Test specimens: cylinders Ø 0.5" x 1", or square 0.5" x 1", test speed 0.05"/min
- 12. Test specimens: bars 4 mm (thickness) x 10 mm x 80 mm ; test speed: 2 mm/min ; span: 64 mm.
- 13. Test specimens: bars 0.25" (thickness) x 0.5" x 5" ; test speed: 0.11"/min ; span: 4"
- 14. Measured on 10 mm, 0.4" thick test specimens.
- 15. Electrode configuration: Φ 25 / Φ 75 mm coaxial cylinders ; in transformer oil according to IEC 60296 ; 1 mm thick test specimens.
- 16. Measured on discs Ø 50 mm x 3 mm.
- 17. Measured on 1/8" thick x 2" diameter or square
- Test procedure similar to Test Method A: "Pin-on-disk" as described in ISO 7148-2, Load 3MPa, sliding velocity= 0,33 m/s, mating plate steel Ra= 0.7-0.9 μm, tested at 23°C, 50%RH.
- Test using journal bearing system, 200 hrs, 118 ft/min, 42 PSI, steel shaft roughness 16±2 RMS micro inches with Hardness Brinell of 180-200
- 20. Test using Plastic Thrust Washer rotating against steel, 20 ft/min and 250 PSI, Stationary steel washer roughness 16±2 RMS micro inches with Rockwell C 20-24
- 21. Test using Plastic Thrust Washer rotating against steel, Step by step increase pressure, Test ends when plastic begins to deform or if temperature increases to 300°F, a 4:1 safety factor has been applied to the posted value.

This product data sheet and any data and specifications presented on our website shall provide promotional and general information about the Engineering Plastic Products (the "Products") manufactured and offered by Mitsubishi Chemical Advanced Materials and shall serve as a preliminary guide. All data and descriptions relating to the Products are of an indicative nature only. Neither this data sheet nor any data and specifications presented on our website shall create or be implied to create any legal or contractual obligation.

Any illustration of the possible fields of application of the Products shall merely demonstrate the potential of these Products, but any such description does not constitute any kind of covenant whatsoever. Irrespective of any tests that Mitsubishi Chemical Advanced Materials may have carried out with respect to any Product, Mitsubishi Chemical Advanced Materials does not possess expertise in evaluating the suitability of its materials or Products for use in specific applications or products manufactured or offered by the customer respectively. The choice of the most suitable plastics material depends on available chemical resistance data and practical experience, but often preliminary testing of the finished plastics part under actual service conditions (right chemical, concentration, temperature and contact time, as well as other conditions) is required to assess its final suitability for the given application.

It thus remains the customer's sole responsibility to test and assess the suitability and compatibility of Mitsubishi Chemical Advanced Materials' Products for its intended applications, processes and uses, and to choose those Products which according to its assessment meet the requirements applicable to the specific use of the finished product. The customer undertakes all liability in respect of the application, processing or use of the aforementioned information or product, or any consequence thereof, and shall verify its quality and other properties.

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