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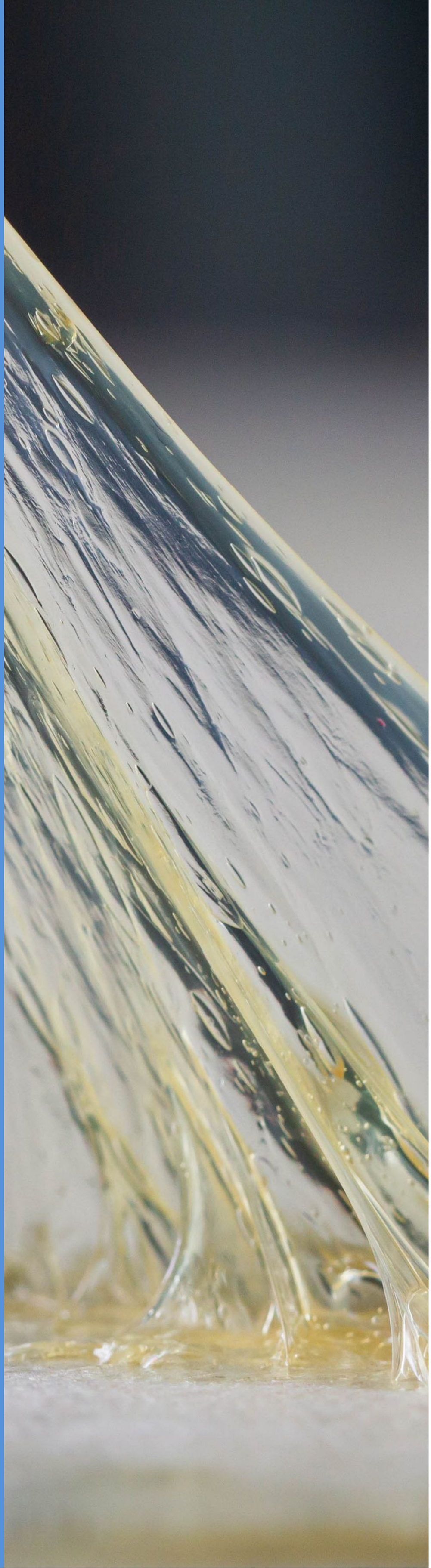
Performance additives for Adhesives & Sealants and pressure sensitive adhesives



Content

Overview: performance additives for Adhesives & Sealants and pressure sensitive adhesives

An adhesive is a material that is used to hold two surfaces together. They must wet the surfaces and develop strength which remains stable over time. Adhesives include liquid glue, cement gum, glue slurry, latex, glue paste, double-sided adhesive tape and solid hot melt adhesive, etc. Adhesives can be divided into four types by curing mode: solvent type, reaction type, hot melt and pressure sensitive. Adhesives can be divided by binding strength into structural adhesive, sub- structural adhesive and non-structural adhesives. Adhesives can be divided by end use category into: adhesives for building, machinery, aerospace, vehicle, ship, packaging, electric appliances, furniture, clothing, leather, glass ceramic and household life, etc. Pressure sensitive adhesives, commonly known as self- adhesive, is not directly used to connect materials in general, but is prepared into pressure sensitive adhesive products through various materials, including three major types: pressure sensitive adhesive tapes, pressure sensitive adhesive labels and pressure sensitive adhesive sheets. Base materials and pressure sensitive adhesives are two parts of the final pressure sensitive adhesive product. Common base materials include: paper, cloth, plastic film, rubber sheet, foam and composite, etc.

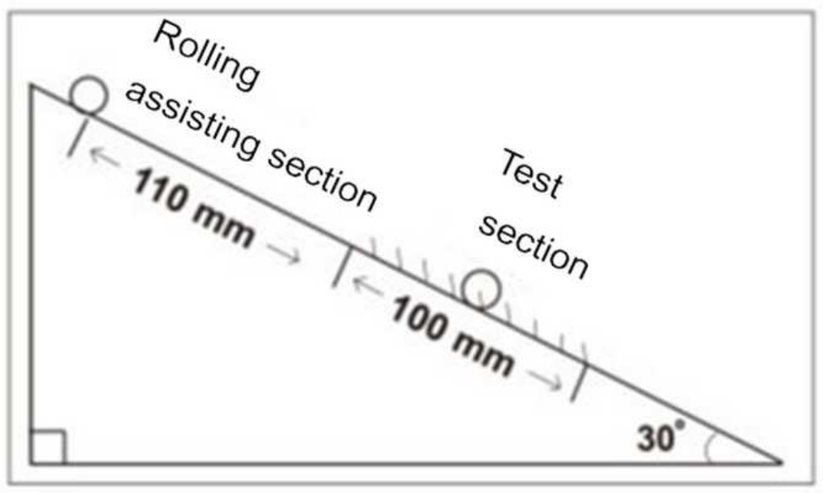
Main differences between ordinary adhesives and pressure sensitive adhesives

	Ordinary Adhesives	Pressure Sensitive Adhesives
Phase transition in binding process	Occurring (liquid - solid)	Not occurring
Binding strength	High	Relatively low
Initial adhesion	Poor	Good
Application state in binding	Liquid application needed	No liquid application needed, but in solid wetting state
Binding process	Heating, pressurizing, adhesive mixing, surface treatment, bound surface design, etc.	Finger touch pressure
Curing process	Heating, pressurizing and curing time, etc.	No heating, pressurizing and curing needed
When destroyed or peeled	Contaminating or damaging adhered surfaces	Not contaminating adhered surfaces

The main properties of pressure sensitive adhesive products include: anti- peeling property, initial adhesion property and cohesive force (or cohesive strength) All are important use properties of pressure sensitive adhesives and have an important effect on the quality of pressure sensitive adhesives. These are important test indicators for assessing the properties of pressure sensitive adhesive. Performance additives used for pressure sensitive adhesives, such as an adhesion promoter, wetting agent, thickener and defoaming agent, may have influences on the above properties of pressure sensitive adhesives.

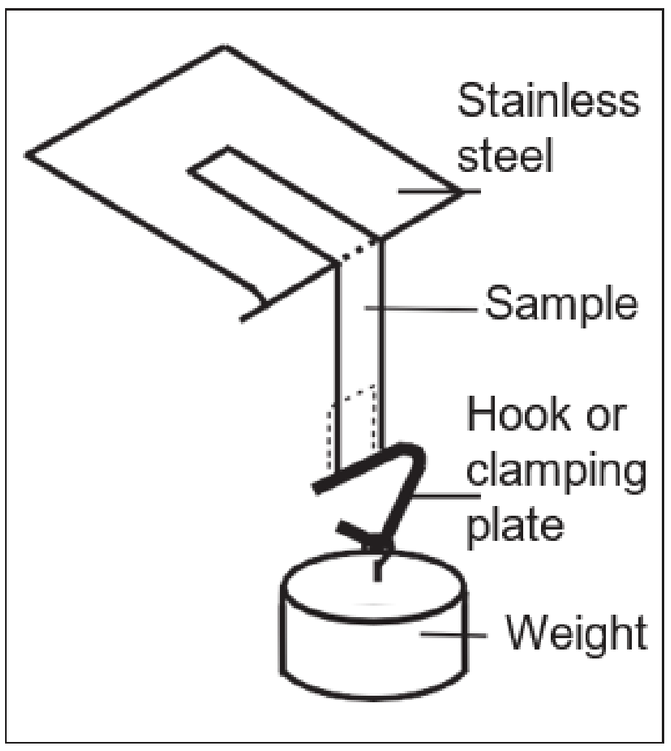
In general, the capability of a pressure sensitive adhesive to resist shear creep failure caused by persistent shear stress, i.e., shear creep retention force (permanent adhesion), is used to characterize its cohesive force and this is a commonly used test method for shear permanent adhesion.

Schematic diagram of test method for initial adhesion of pressure sensitive adhesive tape (rolling ball method)



Take a #29 steel ball with a diameter of 1.588 25.4 mm and observe whether or not the steel ball rolling down is stuck (stopping for over 5 s) in the test section. Test steel balls from the large number to the small one until the steel ball stuck in the test section, with the largest number, is found.

Schematic diagram of test method for permanent adhesion of pressure sensitive adhesive tape



After 48 hours of the action of the weight, determine whether or not the sample loosens or determine the slide displacement of the sample.

Test method for peeling strength of pressure sensitive adhesive tape

Adhesive tape and adherend Material	Peeling angle
Adhesive tape and stainless-steel plate	180° / 90°
Adhesive tape and its back film	180° / 90°
Double-sided adhesive tape and transfer adhesive tape and stainless-steel plate	180° / 90°
Adhesive tape and isolating material	180° / 90°

Test apparatus:

a. Quick tensile testing machine
b. 304 stainless steel plate (Length 125 mm, width 50 mm, thickness 1.1 mm)
c. Stainless steel roll with surface covered with 6 mm, with a diameter of 85 mm and a weight of 2 kg.

Test method:

Test at room temperature of 23 °C and humidity of 50% ± 5% normally using 180 °C peeling method.

Performance additives used for adhesive and sealants

Additives are crucial components in the formulation of adhesives (including sealants). Additives for adhesives can not only significantly improve the properties of the product itself, the process properties and use properties of the product and give the product special functions, but also expand the application scope, extend the useful life, enhance the storage stability and so on. For example, curing agent or coupling agent is added to make the main adhesive material form net or cubic structure, increasing the cohesive strength of the adhesive layer. Curing promoter or catalysts are added to speed up curing and reduce reaction temperature. Rheological agents are added to increase the viscosity of the adhesive, improve the mechanical properties and increase storage stability so that the adhesive can meet the requirements for different process and use properties. Defoaming agents are used to eliminate the air bubbles generated during production and use. As a leading global leading performance additive producer, Elementis produces a series of a products that can comprehensively meet the market demands for adhesives.

The THIXATROL® series of powdered amide wax rheological agents are quite universal and suitable for low-, medium- and high- polarity systems, to provide high thickening and thixotropic properties. They meet different construction requirements and they can have low-temperature activation properties and are convenient to use in production. They are suitable for various solvent types and solvent- free adhesives. Examples include THIXATROL® AS 8053, THIXATROL® PM 8056, and THIXATROL® AS 8024.

THIXATROL® and THIXCIN® series modified castor oil derivative type rheological agents are suitable for medium- and low-polarity systems, and are mainly used for solvent-free epoxy, and modified silate adhesives and sealants. Examples include THIXATROL® ST, and THIXCIN® R.

BENTONE® and BENGEL® series smectite clay type rheological auxiliary agents are suitable for adhesive and sealant systems with different polarity and rheology requirements, providing different thickening and thixotropic effects. Examples include BENTONE SD® -2, BENTONE® 38, and BENGEL® 828.

RHEOLATE® and BENTONE® series PU and polyether polyol association type, acrylic alkali swelling type and hectorite clay type water- based rheological auxiliary agents can meet the use requirements of water-based adhesives and sealants. Examples include RHEOLATE® 299, RHEOLATE® HX 6008, RHEOLATE® 350D, and BENTONE® LT.

DAPRO® solvent and water-based defoaming agents can meet the foam-inhibiting and defoaming requirements in various application scenarios. Examples include DAPRO® DF 7160, and DAPRO® DF 21.

Performance additives used for pressure sensitive adhesives

Pressure sensitive adhesive products include water-based and solvent types. They are usually applied through rod, blade and cast coating and there have high requirements for rheology, leveling and air bubble control during the coating process. In particular, these problems need to be solved for water-based pressure sensitive adhesive in order to run on high speed coating applications. Therefore, suitable rheological agent, defoaming agent, and wetting agent, etc. need to be selected. Elementis can provide the right additives to meet different process requirements.

RHEOLATE® HX 6008 and RHEOLATE® 350D
can effectively provide high shear viscosity of water-based pressure sensitive adhesives, to meet the requirement for viscosity in high speed coating applications. They can prevent the occurrence of adhesive throwing phenomenon, so they are specially recommended for packaging adhesive tape and label adhesive.

DAPRO® W-77 and SUPREAD® 2059 are
non-silicone type wetting agents and can meet the requirement for base material wetting in high speed coating of water-based pressure sensitive adhesives. SUPREADT®M 2059 also has low foaming properties compared to competitive wetting agents..

DAPRO® DF 21 and DAPRO® DF 7160
have good water solubility, have good compatibility and foam-inhibiting and defoaming properties in water-based pressure sensitive adhesives and can meet the defoaming requirement in high speed coating. DAPRO® DF 7160 is specially recommended for low-viscosity pressure sensitive adhesives.

Application of rheological agents in label adhesives

In order to obtain a pressure sensitive adhesive layer with sufficient thickness in one time of coating, it is sometimes necessary to use a thickener to adjust the viscosity of the emulsion to a suitable range. Acrylic alkali swelling types and polyether polyol or polyether polyurethane association type thickeners are commonly used for water-based pressure sensitive adhesives. The association type thickeners can not only provide suitable rheological property according to the coating process, but is also has a wide pH adaption range and good stability. In addition, water resistance is not impacted, so they are more widely used in pressure sensitive adhesives.

In an acrylic pressure sensitive adhesive, RHEOLATE® 350 D and RHEOLATE CVS® -11 are tested for ICI viscosity and coated film leveling property at an addition dosage of 0.1% or 0.15 % wt. The results are as follows:

Test	Zahn4# cup viscosity/ Second	ICI viscosity	Film scrapping flatness
Blank adhesive	10	0.52	Shrink to form a line
RHEOLATE® 350 D 0.1%	24	0.782	Flat
RHEOLATE® 350 D 0.15%	35	0.905	Flat
RHEOLATE CVS®-11 0.15%	86	0.808	Flat

Viscosity and coated film effect

Effect of coating with #18 bar on release paper

Analysis with the above test results shows that, at the same addition dosage, RHEOLATE CVS® -11 can provide higher thickening efficiency, but the ICI viscosity is lower than that with RHEOLATE® 350 D. In low speed coating, both have good resistance to edge shrinkage. However, in high speed coating, the coating equipment has higher shear force than in low speed coating, and RHEOLATE® 350 D has higher ICI viscosity, thus it is improved to meet the requirement for of adhesive application in high speed coating.

Dispersant agents used for solvent type and solvent free type adhesives and sealants

Product	Type	Solvent type epoxy adhesive	Solvent free type epoxy adhesive	Silane modified adhesive	Silicone adhesive	PU adhesive	Other adhesives	Property
NUOSPERSE® FX 9360	High molecular weight dispersing agent	●	●			●	●	Suitable for dispersion of carbon black and metal pigments
NUOSPERSE® FA 196	Surface active compound	●	●	●	●	●	●	Having wetting and dispersing effects on filler

Rheological agents used for solvent type and solvent free type adhesives and sealants

Product	Type	Solvent type epoxy adhesive	Solvent free type epoxy adhesive	Silane modified adhesive	Silicone adhesive	PU adhesive	Other adhesives	Property
BENTONE® 34	Organic modified smectite	●	●	●	●	●	●	Having strong thickening efficiency and thixotropic property
BENTONE® 38	Hectorite	●	●	●	●	●	●	Having strong thickening efficiency and thixotropic property

● Recommended use | ○ Allowable use

Rheological agents used for solvent and solvent free type adhesives and sealants

Product	Type	Solvent type epoxy adhesive	Solvent free type epoxy adhesive	Silane modified adhesive	Silicone adhesive	PU adhesive	Other adhesives	Property
BENTONE® SD-1	Easily dispersible bentonite		●	●	●	●	●	Provides thickening and anti-settlement properties, suitable for low- and medium- polarity systems
BENTONE® SD-2	Easily dispersible bentonite	●	●			●	●	Provides thickening and anti-settlement properties, suitable for high-polarity systems
THIXATROL® AS 8053	Special polyamide series compound	●	●	●	●	●	●	Suitable for low, medium and high polarity systems, having good low temperature activation property and providing excellent thickening and thixotropic properties
THIXATROL® PM 8056	Special polyamide series compound	●	●	●	●	●	●	Suitable for low-, medium- and high- polarity systems, having good low temperature activation property and providing excellent thickening and thixotropic properties
THIXATROL® AS 8024	Special polyamide series compounds	●	●	●		●	●	Suitable for low- medium- and high-polarity systems, having high resistance to temperature, and providing excellent thickening and thixotropic properties
THIXATROL® PLUS	Special diamine series compounds	●	●	●		●	●	Providing excellent thickening efficiency and rheological property

Product	Type	Solvent type epoxy adhesive	Solvent free type epoxy adhesive	Silane modified adhesive	Silicone adhesive	PU adhesive	Other adhesives	Property
THIXATROL® MAX	Special diamine series compounds	●	●	●		●	●	Providing excellent thickening and thixotropic properties and having good anti- granulation property
THIXATROL® ST	Modified castor oil derivative		●				●	Suitable for low- and medium-polarity systems, providing thickening and thixotropic effects
THIXCIN® R	Modified castor oil derivative		●	●	●	●	●	Suitable for low- polarity systems, providing thickening and thixotropic effects, having low activation temperature and capable of shortening production period

● Recommended use | ○ Allowable use

Recommended defoaming agents used for water-based pressure sensitive adhesive and other adhesives

Product	Type	PSAe for packaging	Label adhesive	Adhesive	Property
DAPRO® DF 677	Modified siloxane emulsion		●	●	Having good foam-inhibiting and defoaming properties
DAPRO® DF 7072	Hydrophobic silica, emulsifying agent and mineral oil	●		●	Having good foam-inhibiting and defoaming properties and compatibility
DAPRO® DF 7160	Hydrophobic silica, emulsifying agent and mineral oil	●	○	●	Having excellent foam-inhibiting and defoaming properties and compatibility
DAPRO® DF 21	Hydrophobic silica, emulsifying agent and mineral oil	●	●	●	Having good foam-inhibiting and defoaming properties
DAPRO® BIO 9910	Liquid vegetable oil based defoamer, with small addition of special silicone	●	●	●	Excellent foam-inhibiting and defoaming properties 96% renewable carbon content

Recommended wetting and dispersing agents used for water-based adhesives

Product	Type	PSAe for packaging	Label adhesive	Adhesive	Property
DAPRO® W-77	An-ionic/non-ionic surface-active agent	●	●	●	Free of silicone, eliminating surface defects and improving base materials wetting property
NUOSPERSE® FX 600	Polycarboxylate type dispersing agent	●			Having strong adsorption effect on pigment and filler, to make the dispersing system obtain optimum stability
SUPREAD® 2059	Multi-functional wetting agent	●	●	●	Having excellent base material wetting property, capable of controlling static and dynamic surface tensions and having defoaming property

● Recommended use | ○ Allowable use

Recommended rheological agents used for water-based pressure sensitive adhesives and other adhesives

Product	Type	PSAe for packaging	Label adhesive	Adhesive	Property
BENTONE® EW NA	Hectorite clay			●	Providing high thickening and rheological properties and providing thermal stability of viscosity
RHEOLATE® 299	PU association type			●	Providing low- and medium-shear viscosity and having excellent rheological property and thickening efficiency, suitable for spray coating and brush coating
RHEOLATE® 350 D	Polyether polyol	●	●	○	Providing high-shear viscosity, and having excellent fluidity and leveling property, suitable for high-speed coating
RHEOLATE® 425	Acrylic alkali swelling			●	Having high thickening efficiency and providing good medium-shear viscosity
RHEOLATE® FX 1010	PU association type			●	Providing high thickening efficiency in low and medium shear range
RHEOLATE® HX 6008	PU association type	●	●	●	Providing high-shear viscosity, and having excellent fluidity and leveling property, suitable for high-speed coating
RHEOLATE CVS®-11	PU association type	○	●	●	Effectively increasing medium-shear viscosity and having good fluidity
RHEOLATE® 212	PU association type	●	●	●	Providing excellent high-shear viscosity and excellent leveling and anti-splashing effect.

● Recommended use | ○ Allowable use

Talc is commonly used in adhesives and sealants formulation due to excellent barrier properties against humidity and adhesion promotion.

Recommended product for adhesives and sealants application are:

Product	Type	PSAe for packaging	Label adhesive	Adhesive	Property
FINNTALC® M15	Pure, lamellar, medium particle size talc, stable color, very hydrophobic, inert and soft.	●	●	●	Good barrier properties, excellent wet scrub resistance, balanced optical properties, good outdoor durability, good anti-corrosion properties, good sand ability and adhesion.
FINNTALC® M05SL	Pure, lamellar, white talc with fine particle size very hydrophobic, inert and soft.	●	●	●	Good barrier properties, booster of white opacity and smooth surface, good outdoor durability and good corrosion resistance
FINNTALC® M50	Pure, lamellar, coarse particle size talc with reduced oil absorption value, very hydrophobic, inert and soft.	●	●	●	Good barrier and good anti-corrosion properties at low VOC levels of highly filled formulations, good adhesion and sand ability.

● Recommended use | ○ Allowable use

Adding future

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NOTE:
The information herein is currently believed to be accurate. We do not guarantee its accuracy. Purchasers shall not rely on statements herein when purchasing any products. Purchasers should make their own investigations to determine if such products are suitable for a particular use. The products discussed are sold without warranty, express or implied, including a warranty of merchantability and fitness for use. Purchasers will be subject to a separate agreement which will not incorporate this document.

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