

**UNITED STATES PATENT AND TRADEMARK OFFICE**

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**BEFORE THE PATENT AND TRIAL AND APPEAL BOARD**

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HENKEL CORPORATION  
Petitioner

v.

H.B. FULLER COMPANY  
Patent Owner

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*Inter Partes* Review of U.S. Patent No. 6,833,404  
Case IPR: Unassigned

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**DECLARATION OF SHAW LING HSU, PH.D. (EX. 1015)**

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I, Shaw Ling Hsu, Ph.D., declare:

1. I have been retained by Finnegan, Henderson, Farabow, Garrett & Dunner, LLP, counsel for Henkel Corporation (“Henkel”), to provide expert opinions relating to U.S. Patent No. 6,833,404 (“the ’404 patent”; Ex. 1001) assigned to H.B. Fuller Company (“Patent Owner”). I am being compensated for my time spent in this capacity at \$375.00 per hour, or \$3,000.00 per day, plus expenses. My compensation is not dependent in any way on the institution or outcome of an *inter partes* review of the ’404 patent.

2. Other than my retention as an expert in this proceeding, I currently have no financial interest in Henkel. I do, however, have a relationship with Henkel as a technical consultant. I have no financial or consulting relationship with the Patent Owner.

**I. Qualifications**

3. I am an expert in the field of polymer science and engineering.

4. I obtained a B.S. in Physics from Rutgers, the State University of New Jersey in 1970 and a Ph.D. in Physics from the University of Michigan in 1975.

5. I have worked in the Department of Polymer Science and Engineering at the University of Massachusetts—Amherst for over thirty-five years. Specifically, I have been a Professor of Polymer Science and Engineering since 1987, was an Associate Professor from 1982 to 1987, and was an Assistant Professor from 1978 to 1982. From 2002 to 2010, I also served as Head of the Department.

6. I have worked as a Visiting Professor of Chemistry at the California Institute of Technology (6 months), a Visiting Professor of Chemistry at the University of California, Berkeley (6 months), a Visiting Professor of Macromolecular Science at the University of Freiburg (9 months), a Visiting Professor of Macromolecular Science at Kyoto University (3

months), a Visiting Professor of Chemistry at the University of Pisa (9 months), a Visiting Professor of Polymer Engineering at Chengdu University of Science and Technology (1 month), a Visiting Research Fellow at Abbott Vascular in Santa Clara, California (5 months), and a Visiting Fellow at the Materials and Chemical Laboratory of the Taiwan Industrial Technology Research Institute.

7. I have served as Advisor to the Chinese Academy of Sciences (25 years), Chair of the Materials Advisory Committee of Taiwan Industrial Technology Research Institute (10 years), Co-Principal Investigator of the Center for University of Massachusetts Industrial Cooperative Research Program (CUMIRP) (1998-2006), Associate Director of the National Science Foundation (NSF) Materials Research Science and Engineering Center (MRSEC) (1991-2006), Director of the NSF Materials Research Laboratory for Polymer Research (MRL) at the University of Massachusetts (1984-1991), and Research Chemist at Allied-Signal Corporation (1976-1978).

8. I have received numerous honors and awards, including Phi Beta Kappa, Danforth Foundation Fellow, Sigma Xi Honorary Research Society, National Science Foundation Creativity Award, American Physical Society Fellowship, University of Massachusetts Faculty Fellowship, University Outstanding Faculty Leadership Award, USDA National Panel Manager for Bioenergy Production and Byproducts, Distinguished International Scholar award from the Society of Polymer Science of Japan, and Chair of the Advanced Materials Platform Panel in Taiwan.

9. My research activities over the last thirty-five years have included hot melt adhesives, spectroscopic analysis of polymers, development of environmentally appropriate materials, development and characterization of multiphase materials including reactive blends,

development of new polymer morphologies for controlled drug delivery, structural characterization of polymer structure in restricted geometry (surfaces/interfaces), deformation behavior of polymers, deformation induced structural transformation in polymers, aging behavior of polymers, and residual stress in coatings.

10. I have published over two-hundred articles on polymer science and engineering in peer-reviewed journals, including *Macromolecules*, *Journal of Physical Chemistry*, *Macromolecular Chemistry and Physics*, and *Journal of Materials Science*.

11. In addition to gaining expertise through my educational training and professional experiences, I have kept abreast of the field of polymer science and engineering by reading scientific literature and attending and presenting at conferences, including being an invited presenter at meetings for the American Chemical Society, the American Physical Society, the Polymer Physics Series in China, and the Polymer Crystallization Conference in Greece.

## II. Materials Reviewed and Considered

12. In connection with my work on this matter, I have reviewed and considered the following documents:

Exhibit No.	Description
1001	U.S. Patent No. 6,833,404 (“the ’404 patent”)
1002	Eastotac Hydrocarbon Resins Brochure by the Eastman Company (Aug. 1992) (“the Eastotac Brochure”)
1003	Specialty Polymers for Adhesives and Sealants by the Exxon Chemical Company (Oct. 1990) (“the Exxon Reference”)
1004	U.S. Patent No. 5,256,717 (issued Oct. 26, 1993) (“the ’717 patent”)
1005	Litz, R.J., <i>Developments in Ethylene-Based Hot Melt Adhesives</i> , <i>Adhesives Age</i> 17(8):35-38 (1974) (“Litz”)
1006	Clark, T., <i>Bookbinding with Adhesives</i> (3rd ed. McGraw-Hill, UK 1994) (“Clark”), p. 1
1007	Alger, M.S., <i>Polymer Science Dictionary</i> (Elsevier Applied Science, New York 1989) (“Alger”), p. 115

Exhibit No.	Description
1008	Lee, S.M., <u>Dictionary of Composite Materials Technology</u> (CRC Press, Technology & Engineering 1995) (“Lee”), p. 43
1009	U.S. Patent No. 4,233,432 (issued Nov. 11, 1980) (“the ’432 patent”)
1010	Young, R.J. & Lovell, P.A., <u>Introduction to Polymers</u> (2nd ed., Chapman & Hall, New York 1991) (“Young”), pp. 10-11, 292
1011	U.S. Patent No. 5,397,843 (issued Mar. 14, 1994) (“the ’843 patent”)
1012	U.S. Patent No. 5,171,628 (issued Dec. 15, 1992) (“the ’628 patent”)
1013	Publication No. WO 97/09393 (published Mar. 13, 1997) (“the ’393 publication”)
1014	<u>Handbook of Adhesives</u> (ed. Irving Skeist, Van Nostrand Reinhold Co. 1977) (“Skeist”), pp. 495-98
1016	Curriculum Vitae of Shaw Ling Hsu, Ph.D. (“Hsu CV”)
1017	American Society for Testing and Materials, <i>Standard Test Method for Softening Point by Ring-and-Ball Apparatus</i> , E-67, from <u>Annual Book of ASTM Standards</u> (1967) (“ASTM E-28”)
1018	Kraus et al., <i>Tack and Viscoelasticity of Block Copolymer Based Adhesives</i> , J. Adhesion 10:221-36 (1979) (“Kraus”)
1019	U.S. Patent No. 5,331,033 (issued Jul. 19, 1994) (“the ’033 patent”)

### III. Summary

13. Each and every element of claims 22-25 and 28, 31, and 32 is disclosed in the Eastotac Brochure and/or the Exxon Reference such that one of ordinary skill in the art could have made and used the claimed inventions without undue experimentation in light of the general knowledge available in the art. Specifically, the Eastotac Brochure discloses a hot melt adhesive composition comprising 30 to 50% by weight of Eastotac® hydrocarbon tackifying resin and 50 to 70% by weight of an amorphous polyalphaolefin (referred to herein as “the Amorphous Polyolefin Composition”). (Eastotac Brochure (Ex. 1002), Table 3.) The Eastotac Brochure also discloses a hot melt adhesive composition comprising 30 to 60% by weight of Eastotac® hydrocarbon tackifying resin and 30 to 50% by weight of ethylene-vinyl acetate copolymer (referred to herein as “the EVA Composition”). (Eastotac Brochure (Ex. 1002), Table 3.) It is clear from the ’404 patent’s own admissions that the Eastotac Brochure’s tackifying resin,

Eastotac® H-142, is derived, at least in part, from dicyclopentadiene and has a glass transition temperature of greater than about 65 °C. Indeed, it is listed in the '404 patent as an example for use in the invention. Thus all of the limitations of claim 22 are disclosed. Similarly, the Exxon Reference discloses a hot melt composition comprising 40% by weight of a hydrocarbon tackifying resin, 20% by weight of Escorene UL 7750 as a thermoplastic base polymer, and 40% by weight of 158 °F MP paraffin wax. (Exxon Reference (Ex. 1003) at 2, FN 1.) The Exxon Reference's hydrocarbon tackifying resin, Escorez® 5340, is listed in the '404 patent as an example of a resin for use in the invention and as a hydrocarbon resin that is derived, at least in part, from dicyclopentadiene and has a glass transition temperature of about 76 °C. Therefore, the Exxon Reference also discloses a composition of claim 22. Any additional limitations of claims 23-25, 28, 31, and 32 are likewise disclosed in the Eastotac Brochure and/or the Exxon Reference.

14. Claim 26 depends from claim 22 and “further compris[es] up to about 40% by weight of a solid benzoate plasticizer.” ('404 patent (Ex. 1001), col. 21, ll. 22-23.) There was nothing nonobvious or new about the additional limitation of claim 26. The use of a solid benzoate plasticizer as an additional ingredient in hot melt adhesives was well known and routine for one of skill in the art, as was using such a plasticizer at up to about 40% by weight. (*See, e.g.*, '717 patent (Ex. 1004).) Claim 27 depends from claim 22 and further requires “peel values . . . greater than about 70 °C.” ('404 patent (Ex. 1001), col. 21, ll. 24-25.) Obtaining such a composition wherein the peel values are greater than about 70 °C would have been obvious and routine for one of skill in the art. (*See, e.g.*, Litz (Ex. 1005) at p. 36, col. 2.)



#### IV. Background on Hot Melt Adhesives

15. Hot melt adhesives (interchangeably referred to as hot melts) “are 100[%] solid thermoplastic materials that flow when heated; the final bond is gained when the temperature has fallen to the ambient one, i.e. that of the material being glued.” (Clark, T., Bookbinding with Adhesives (3rd ed. McGraw-Hill, UK 1994) (“Clark”) (Ex. 1006) at 2.) Hot melts can bond wide possible ranges of paper stock and “consist of polymers, tackifying resins, and waxes.” (Clark (Ex. 1006) at 2.) Hot melts “have the distinct advantages of being capable of extremely high tack with medium to very fast setting speeds.” (Clark (Ex. 1006) at 2.)

16. By June 1998, it was known that “[h]ot melt adhesives generally comprise a thermoplastic polymeric component, a tackifying resin component and either a wax component, plasticizing component or a combination thereof.” (’404 patent (Ex. 1001), col. 1, ll. 21-24.)

17. “The tackifying resin [was] known to provide specific adhesion and to increase peel values which translates into heat resistance.” (’404 patent (Ex. 1001), col. 1, ll. 26-28.) “Petroleum based hydrocarbon resins [were] popularly used in the adhesives industry due to availability and economics.” (’404 patent (Ex. 1001), col. 2, ll. 4-5.) Dicyclopentadiene (DCPD) based resins are an example of such a hydrocarbon resin. (’404 patent (Ex. 1001), col. 2, ll. 9-11; *see also* Alger, M.S., Polymer Science Dictionary (Elsevier Applied Science, New York 1989) (Ex. 1007) (“Alger”) at 115.) Dicyclopentadiene resin is “[a] petroleum resin consisting of the low molecular weight polymer obtained by thermal polymerization of fractions from petroleum cracking containing large amounts of dicyclopentadiene, but also some styrene and indene.” (Alger (Ex. 1007) at 115.) By June 1998, dicyclopentadiene was readily available and low in cost and was thus used to form tackifiers (interchangeably referred to as tackifying resins). (*See, e.g.*, Lee, S.M., Dictionary of Composite Materials Technology (CRC Press,

Technology & Engineering 1995) (“Lee”) (Ex. 1008) at 43; U.S. Patent 4,233,432 (issued Nov. 11, 1980) (“the ’432 patent”) (Ex. 1009), col. 1, ll. 29-30.) Dicyclopentadiene is a by-product produced in large quantities during the steam cracking petroleum. (*See, e.g.*, Lee (Ex. 1008) at 43; ’404 patent (Ex. 1001), col. 4, ll. 55-65.) Hydrocarbon resins, including those that are dicyclopentadiene-based, may be aliphatic, meaning that they are non-aromatic compounds composed of carbon and hydrogen. (*See, e.g.*, ’404 patent (Ex. 1001), col. 10, l. 65 to col. 11, l. 1.)

18. “The temperature at which [a] polymer undergoes [a] transformation from a rubber to a glass is known as the glass transition temperature, T<sub>g</sub>.” (Young, R.J. & Lovell, P.A., Introduction to Polymers (2nd ed., Chapman & Hall, New York 1991) (“Young”) (Ex. 1010) at 292.) Aliphatic, hydrocarbon resins, including dicyclopentadiene based resins, with glass transition temperatures (T<sub>g</sub>) of greater than about 65 °C were known and commercially available by June 1998, including Eastotac® H-142 by Eastman Chemical Co. and Escorez® 5340 by Exxon Chemical Co. (’404 patent (Ex. 1001), col. 6, ll. 14-29.) The onset glass transition temperature (T<sub>g</sub>(onset)) is the temperature that corresponds to the beginning of the polymer mobility. The final glass transition temperature (T<sub>g</sub>(final)) denotes the end of the transition. The art also refers to a midpoint glass transition temperature (T<sub>g</sub>(midpoint)). The ’404 patent refers to the T<sub>g</sub>(onset) (’404 patent (Ex. 1001), col. 14, l. 61), while the Exxon Reference, for example, refers to the T<sub>g</sub>(midpoint) (Specialty Polymers for Adhesives and Sealants by the Exxon Chemical Company (Oct. 1990) (“the Exxon Reference”) (Ex. 1003) at 2).

19. T<sub>g</sub> is also related to softening point. Softening point is defined as the temperature at which a sample deforms or can deform under a specific heating rate and force. (American Society for Testing and Materials, *Standard Test Method for Softening Point by Ring-and-Ball*

*Apparatus*, E-67, from Annual Book of ASTM Standards (1967) (“ASTM E-28”) (Ex. 1017).)

Thus, as the softening point of a tackifying resin increases it becomes more resistant to heat. Because there is a direct correlation between the Tg and softening point within the same series of tackifying resins, as Tg increases for the resins, the resins are also more resistant to heat.

20. For example, as shown in the Exxon Reference, the softening point increases as the Tg increases for the Escorez® 5000 tackifying resin series. (Exxon Reference (Ex. 1003) at 2.) This information is reproduced below:

Escorez® 5000 Series	Ring & Ball Softening Point, °C	Tg(midpoint) by DSC, <sup>1</sup> °C
5380	85	36
5300	105	50
5320	125	66
5340	140	85

21. This direct correlation between softening point and Tg holds true for the rest of the Escorez® series shown in the brochure, namely the 1000 Series, the 2000 Series, and the 7000 Series. (Exxon Reference (Ex. 1003) at 2.) The Eastotac® H-Series of tackifying resins also display this direct correlation between softening point and Tg. (Eastotac Hydrocarbon Resins Brochure by the Eastman Company (Aug. 1992) (“the Eastotac Brochure”) (Ex. 1002), Table 1; ’404 patent (Ex.1001), col. 6, ll. 26-30; col. 17, Tables III, IV.)

Eastotac® H Series	Ring & Ball Softening Point, °C <sup>2</sup>	Tg(onset) by DSC, °C <sup>3</sup>
H-100	100	30
H-130	130	65
H-135	(not listed)	73
H-142	142	82

<sup>1</sup> “DSC” stands for differential scanning calorimetry.

<sup>2</sup> Eastotac Brochure (Ex. 1002), Table 1.

<sup>3</sup> ’404 patent (Ex. 1001), col. 6, ll. 26-30; col. 17, Tables III, IV.

22. By June 1998, it was known that the use of tackifiers in a hot melt adhesive would increase the use temperature of the adhesive, and particularly, using higher Tg tackifiers would increase the overall mechanical strength of the adhesive, and therefore increase the peel value and heat resistance of the adhesive. (*See, e.g., Kraus et al., Tack and Viscoelasticity of Block Copolymer Based Adhesives*, J. Adhesion 10:221-36 (1979) (“Kraus”) (Ex. 1018), Figure 1.) An adhesive with a higher Tg tackifier was thus known to deform at a higher temperature, which was preferable in certain applications. In addition to increasing peel value by using a higher Tg tackifier, it was routine in the art to increase peel value by varying the thermoplastic polymer and adding wax.

23. For example, U.S. Patent 5,331,033 (issued Jul. 19, 1994) (“the ’033 patent”) (Ex. 1019) is directed to high heat resistance hot melt adhesives. (’033 patent (Ex. 1019), col. 1, ll. 13-16.) The ’303 patent discloses, for example, an adhesive containing “20 to 50% by weight of an ethylene n-butyl acrylate copolymer . . . ; 30 to 60% of an aliphatic or cycloaliphatic (alicyclic) petroleum hydrocarbon resin . . . [;] and 10 to 30% by weight of a high melting point synthetic wax,” where the petroleum hydrocarbon resin has a Ring and Ball softening point of about 70 to 150 °C. (’033 patent (Ex. 1019), col. 2, ll. 13-22, 59-62.) According to the ’033 patent, adhesives with a petroleum hydrocarbon tackifying resin “possess excellent thermal stability,” and are particularly useful in packaging, transport and storage, especially when they are exposed to extremes in temperatures. (’033 patent (Ex. 1019), col. 2, ll. 28-42.) Thus, in view of the teachings of the ’033 patent and what was known in the art at the time, a skilled artisan would have been motivated to use a petroleum hydrocarbon tackifying resin with a high softening point and thus higher Tg to improve heat resistance at elevated temperature. There was

an expectation that using higher softening point and therefore higher Tg petroleum hydrocarbon tackifying resins would improve heat resistance of the adhesive.

24. Thermoplastic polymers are linear or branched polymers that soften upon heating and harden upon cooling, and this softening/cooling cycle is repeatable. (*See, e.g.,* Young (Ex. 1010) at 10.) The choice of the thermoplastic polymeric component was based on a number of factors and by June 1998, was a routine aspect of designing a hot melt adhesive. For example, copolymers and terpolymers of ethylene were one well-known type of thermoplastic polymer. (*See* '404 patent (Ex. 1001), col. 6, l. 61.) Ethylene-vinyl acetate (EVA) polymers are copolymers of ethylene and vinyl acetate that were known to be low in cost and readily available in the market as polymers for hot melt adhesives. (*See* '404 patent (Ex. 1001), col. 7, ll. 16-17.) The stable ethylene portion of EVA polymers provides crystallization, and the vinyl acetate portion provides interaction with substrates.

25. Amorphous polyalphaolefin polymers ('404 patent (Ex. 1001), col. 7, l. 61) and homogeneous ethylene/alpha-olefin interpolymers ('404 patent (Ex. 1001), col. 9, l. 24) are other thermoplastic polymeric components that were well-known by June 1998. The terms "amorphous polyolefins" and "amorphous polyalphaolefins" are often used interchangeably, and this was also true in June 1998. ('404 patent (Ex. 1001), col. 7, ll. 61-63; U.S. Patent 5,397,843 (issued Mar. 14, 1995) ("the '843 patent") (Ex. 1011), col. 1, ll. 45-48.) Amorphous polyalphaolefin was readily available and low in cost. The polymer is amorphous in its characteristic. EVA is more susceptible than amorphous polyalphaolefin to degradation at higher temperatures. Thus, one advantage of amorphous polyalphaolefin over EVA is that amorphous polyalphaolefin is more stable. Amorphous polyalphaolefin and homogenous

ethylene/alpha-olefin interpolymers have higher stability at higher temperatures, and therefore, adhesives made with these polymers were known to have higher stability at higher temperature.

26. It was also well known in the art and a routine matter to add other plasticizers, such as solid benzoate plasticizers, to hot melt adhesives. (*See, e.g.*, U.S. Patent No. 5,256,717 (issued Oct. 26, 1993) (“the ’717 patent”) (Ex. 1004), col. 1, ll. 59-64.) Additional ingredients or additives such as waxes, oils, terpenes, and resins were also commonly used. (*See, e.g.*, ’717 patent (Ex. 1004), col. 1, ll. 27-41.)

## **V. The ’404 Patent**

### **A. Person of Ordinary Skill in the Art**

27. A person of ordinary skill in the art to whom the ’404 patent is directed would have a graduate-level degree in polymer science, engineering, chemistry, physics, or a related field, as well as at least two years of experience in the field of polymer science and engineering. In making this determination, I have considered the education level of active workers in the field, the types of problems encountered in the art, the prior art solutions to these problems, the rapidity with which innovations are made, and the sophistication of the technology. These are also the qualifications that a person of ordinary skill in the art would have had as of June 30, 1998 and April 27, 1999.

28. As reflected in my qualifications set forth above and in my attached curriculum vitae (Ex. 1016), I am qualified to provide an opinion as to what a person of ordinary skill in the art would have understood, known, or concluded as of June 30, 1998, which I understand is the filing date of Provisional Application No. 60/091,231 (the ’404 patent’s provisional application), and as of April 27, 1999, which I understand is the filing date of U.S. Patent Application

No. 09/300,544 (the application that issued as the '404 patent). My opinions set forth herein are from the perspective of a person of ordinary skill in the art.

**B. The Claims**

29. The '404 patent relates to hot melt adhesives comprising a tackifying resin with a high glass transition temperature. ('404 patent (Ex. 1001), col. 1, ll. 12-15.)

30. The '404 patent contains five independent claims (claims 1, 20, 22, 28, and 30), and twenty-seven dependent claims (claims 2-19 and 29, which depend from claim 1; claim 21, which depends from claim 20; claims 23-27 and 31, which depend from claim 22; and claim 32, which depends from claim 28).

31. Claim 22 recites: "A hot melt adhesive composition comprising: a) about 10% by weight to about 50% by weight of at least one hydrocarbon tackifying resin derived, at least in part, from dicyclopentadiene and having a glass transition temperature of greater than about 65 °C; b) about 10% by weight to about 80% by weight of at least one thermoplastic base polymer selected from the group consisting of copolymers and terpolymers of ethylene; amorphous polyalphaolefins, homogenous ethylene/ $\alpha$ -olefin interpolymers, and mixtures thereof." ('404 patent (Ex. 1001), col. 21, ll. 4-14.)

32. Claim 23 depends from claim 22 and recites that "said tackifying resin has a T<sub>g</sub> of greater than about 68 °C (about 155 °F)." ('404 patent (Ex. 1001), col. 21, ll. 15-16.)

33. Claim 24 depends from claim 22 and recites that "greater than about 80 wt-% of the total resin unit is derived from dicyclopentadiene." ('404 patent (Ex. 1001), col. 21, ll. 17-19.)

34. Claim 25 depends from claim 22 and recites that "the tackifying resin is hydrogenated." ('404 patent (Ex. 1001), col. 21, ll. 20-21.)

35. Claim 26 depends from claim 22 and recites “further comprising up to about 40% by weight of a solid benzoate plasticizer.” (’404 patent (Ex. 1001), col. 21, ll. 22-23.)

36. Claim 27 depends from claim 22 and recites that “the peel values are greater than about 70 °C.” (’404 patent (Ex. 1001), col. 21, ll. 24-25.)

37. Claim 28 recites: “A hot melt adhesive comprising: a) from about 10% by weight to about 80% by weight of at least one aliphatic tackifying resin having a glass transition temperature (T<sub>g</sub>) of greater than about 65 °C; and b) from about 10% by weight to about 80% by weight of at least one thermoplastic base polymer selected from the group consisting of copolymers and terpolymers of ethylene; amorphous polyalphaolefins, homogenous ethylene/ $\alpha$ -olefin interpolymer, and mixtures thereof.” (’404 patent (Ex. 1001), col. 21, l. 26 to col. 22, l. 5.)

38. Claim 31 depends from claim 22 and recites that “said tackifying resin concentration is less than said thermoplastic base polymer concentration.” (’404 patent (Ex. 1001), col. 22, ll. 22-24.)

39. Claim 32 depends from claim 28 and recites that “said tackifying resin concentration is less than said thermoplastic base polymer concentration.” (’404 patent (Ex. 1001), col. 22, ll. 25-27.)

## **VI. Prior Art References**

### **A. The Eastotac Brochure (Ex. 1002)**

40. The Eastotac Brochure is a brochure from the Eastman Company, dated August 1992, that provides information about Eastotac® hydrocarbon resins. (Eastotac Brochure (Ex. 1002) at 8.)



41. The Eastotac Brochure provides the following three specific examples of general composition ranges for Eastotac® resins in hot melt adhesives (Eastotac Brochure (Ex. 1002), Table 3):

Materials	Compositions, % by Weight		
	PE Base	APP Base	EVA Base
Eastotac® resin	10-40	30-50	30-60
Low-molecular-weight polyethylene wax	60-90	0-20	—
Amorphous polyolefin	—	50-70	—
Ethylene-vinyl acetate copolymer	—	—	30-50
Petroleum wax or Fischer-Tropsch wax	—	—	0-20
Antioxidant	0.25-0.5	0.25-0.5	0.25-0.5

42. The Eastotac Brochure lists the following specific examples of Eastotac® hydrocarbon resins: H-100E, H-100R, H-100L, H-100W, H-115E, H-115R, H-115L, H-115W, H-130E, H-130R, H-130L, H-130W, and H-142R. (Eastotac Brochure (Ex. 1002), Table 1.) Because the last letter in the name of the Eastotac® hydrocarbon resins refers to the color of the resin, the Eastotac Brochure effectively lists only four examples of Eastotac® hydrocarbon resins, one of which is H-142. (Eastotac Brochure (Ex. 1002), Table 1.)

43. Eastotac® H-142 was available from Eastman Chemical Co. ('404 patent (Ex. 1001), col. 5, ll. 22-25) and was known to be “a substantially aliphatic (i.e., cycloaliphatic) hydrocarbon resin having a Tg at onset of about 82 °C” ('404 patent (Ex. 1001), col. 6, ll. 27-29). This resin contains a high weight percent of components derived from dicyclopentadiene. ('404 patent (Ex. 1001), col. 5, ll. 16-26.) While the Eastotac Brochure does not affirmatively state that Eastotac® H-142 is hydrogenated, its corresponding molten Gardner Color (Molten - 2+), acid number, density, and/or bromine number indicates that Eastotac® H-142 is hydrogenated. (See, e.g., '404 patent (Ex. 1001), col. 5, ll. 22-25.) The indication that Eastotac® H-142 is hydrogenated based on its low bromine number and low molten color is

explained in the '404 patent, in the last paragraph of column 5: "As the bromine number decreases, the level of hydrogenation increases and the tackifying resin becomes lighter in color as measured on the Molten Gardner Scale. . . . The resins preferred in the present inventions are light amber to water white in color, having a bromine number of preferably less than about 15 grams/100 grams . . . The Gardner color of the resin is preferably less than 3 . . . ." ('404 patent (Ex. 1001), col. 5, ll. 54-67.)

**B. The Exxon Reference (Ex. 1003)**

44. The Exxon Reference is a brochure from Exxon Chemical Company, dated October 1990, that provides information about specialty polymers for adhesives and sealants. (Exxon Reference (Ex. 1003) at 1.)

45. The Exxon Reference provides tables with typical properties of certain polymers, including viscosity and tensile strength. (Exxon Reference (Ex. 1003) at 2-4.)

46. The Exxon Reference provides a table with properties for Escorez® tackifiers, including their glass transition temperature at the midpoint (Tg(midpoint)) as measured by differential scanning calorimetry (DSC). (Exxon Reference (Ex. 1003) at 2.) The list of Escorez® tackifiers in the Exxon Reference includes Escorez® 5340, with a listed Tg(midpoint) of 85 °C. (Exxon Reference (Ex. 1003) at 2.)

47. The Exxon Reference provides as a specific example, a composition containing 40% tackifier (e.g., Escorez® 5340), 20% Escorene® UL7750, and 40% 158 °F MP paraffin wax. (Exxon Reference (Ex. 1003) at 2, FN 1.)

48. Escorez® 5340 was available from Exxon Chemical Co. and was known to be "a substantially aliphatic hydrocarbon resin having a Tg at onset of about 76 °C." ('404 patent (Ex. 1001), col. 6, ll. 21-24.) The Escorez® series of tackifying resins is "formed by the

polymerization of dicyclopentadiene followed by hydrogenation.” (U.S. Patent No. 5,171,628 (issued Dec. 15, 1992) (“the ’628 patent”) (Ex. 1012), col. 3, l. 67 to col. 4, l. 2.) Escorez® 5340 is a dicyclopentadiene based hydrocarbon tackifying resin with greater than 80 wt-% of its total unit derived from dicyclopentadiene. (’404 patent (Ex. 1001), col. 9, ll. 3-9.) The low molten Gardner Color (<<1) (Exxon Reference (Ex. 1003) at 2) indicates that Escorez® 5340 is hydrogenated. (See ’404 patent (Ex. 1001), col. 5, ll. 54-67.)

**C. The ’717 patent (Ex. 1004)**

49. The ’717 patent, which issued on October 26, 1993, discloses a hot melt adhesive composition comprising about 5 to 50% by weight of a thermoplastic base polymer; about 3 to 65% by weight of a solid benzoate plasticizer; about 10 to 90% by weight of a tackifier; and about 0 to 2% by weight of an antioxidant. (’717 patent (Ex. 1004), col. 1, l. 65 to col. 2, l. 9.) A number of examples of hot melt adhesives provided in Tables 1 and 3 of the ’717 patent contain up to about 40% by weight of the solid benzoate plasticizer, including Benzoflex® 352, which is the solid benzoate plasticizer used in examples of the ’404 patent. (’404 patent (Ex. 1001), col. 17, Tables III, IV.) The ’717 patent lists the Escorez® 5000 series and Eastotac® H-130 series as tackifiers for use in the disclosed compositions. (’717 patent (Ex. 1004), col. 3, ll. 19-21, 42-45.)

**D. Litz (Ex. 1005)**

50. Litz, R.J., *Developments in Ethylene-Based Hot Melt Adhesives*, Adhesives Age 17(8):35-38 (1974) (“Litz”) (Ex. 1005) is a review article published in 1974 that discusses developments in ethylene-based hot melt adhesives. (Litz (Ex. 1005) at 35-38.) Litz explains that “one of the most important reasons for the impressive growth of hot melts has been the ability of the formulators to meet the demanding requirements of diverse adhesive applications.”

(Litz (Ex. 1005) at 36, 2<sup>nd</sup> column.) One of these requirements is Rule 41 of the Uniform Freight Classification Committee, “which governs the packaging requirements of all materials shipped by rail.” (Litz (Ex. 1005) at 36, 2<sup>nd</sup> column.) Rule 41 requires that the hot melts maintain a bond (i.e., peel value) in temperatures between -20 °F and +165 °F (-29 °C and 74 °C). (Litz (Ex. 1005) at 36, 2<sup>nd</sup> column.)

**VII. The Prior Art Discloses or Suggests All of the Elements of Claims 22-28, 31, and 32.**

**E. The Eastotac Brochure discloses each and every element of claims 22, 23, 25, 28, 31, and 32.**

51. Each and every element of claims 22, 23, 25, 28, 31, and 32 is disclosed in the Eastotac Brochure such that one of ordinary skill in the art could have made and used the claimed inventions without undue experimentation in light of the general knowledge available in the art.

**1. Claim 22**

52. The Eastotac Brochure discloses “[a] hot melt adhesive composition comprising: a) about 10% by weight to about 50% by weight of at least one hydrocarbon tackifying resin derived, at least in part, from dicyclopentadiene and having a glass transition temperature of greater than about 65 °C; b) about 10% by weight to about 80% by weight of at least one thermoplastic base polymer selected from the group consisting of copolymers and terpolymers of ethylene; amorphous polyalphaolefins, homogenous ethylene/ $\alpha$ -olefin interpolymers, and mixtures thereof” (referred to herein as “the Claim 22 Composition”). (See ’404 patent (Ex. 1001), col. 21, ll. 4-14.)

53. Specifically, the Eastotac Brochure discloses a hot melt adhesive composition comprising 30 to 50% by weight of Eastotac® hydrocarbon tackifying resin and 50 to 70% by

weight of amorphous polyolefin or amorphous polyalphaolefin (referred to herein as “the Amorphous Polyolefin Composition”). (Eastotac Brochure (Ex. 1002), Table 3.) The Eastotac Brochure also discloses a hot melt adhesive composition comprising 30 to 60% by weight of Eastotac® hydrocarbon tackifying resin and 30 to 50% by weight of ethylene-vinyl acetate copolymer (referred to herein as “the EVA Composition”). (Eastotac Brochure (Ex. 1002), Table 3.) The ethylene-vinyl acetate copolymer in the EVA Composition is a random copolymer of ethylene and vinyl acetate. The amorphous polyolefin or amorphous polyalphaolefin and the ethylene-vinyl acetate copolymer are thermoplastic base polymers, as recited in the claims of the ’404 patent.

54. The Eastotac Brochure lists Eastotac® H-142 as one of four specific examples of the Eastotac® hydrocarbon tackifying resin. (Eastotac Brochure (Ex. 1002), Table 1.) Eastotac® H-142 is listed in the ’404 patent as an example of a tackifying resin for use in the invention. (’404 patent (Ex. 1001), col. 6, ll. 14-29.) The ’404 patent states that Eastotac® H-142 is a hydrocarbon resin having an onset glass transition temperature ( $T_g(\text{onset})$ ) of about 82 °C. (’404 patent (Ex. 1001), col. 6, ll. 27-29.) A  $T_g$  of about 82 °C is greater than a  $T_g$  of about 65 °C. The ’404 patent also states that Eastotac® H-142 is derived, at least in part, from dicyclopentadiene. (’404 patent (Ex. 1001), col. 5, ll. 25-28). Therefore, the Eastotac Brochure’s Amorphous Polyolefin Composition comprises 30-50% by weight of at least one hydrocarbon tackifying resin derived, at least in part, from dicyclopentadiene and having a glass transition temperature of greater than about 65 °C, as recited by claim 22, and its EVA Composition comprises 30-60% by weight of at least one hydrocarbon tackifying resin derived, at least in part, from dicyclopentadiene and having a glass transition temperature of greater than about 65 °C, as recited by claim 22. One of skill in the art would have been motivated to choose

the Eastotac Brochure compositions containing Eastotac® H-142 resin for use in many applications, such as those requiring a high peel value and heat resistance, because Eastotac® H-142 has the highest Tg of the Eastotac® resins in the Eastotac Brochure. (Eastotac Brochure (Ex. 1002).) The use of higher Tg tackifiers in a hot melt adhesive was known to increase the heat resistance and peel strength of the adhesive, which would have been desirable in certain applications, as discussed above, for example, in paragraphs 22-23.

55. Therefore, the Amorphous Polyolefin Composition disclosed in the Eastotac Brochure is a hot melt adhesive composition comprising: a) 30-50% by weight of a hydrocarbon tackifying resin derived, at least in part, from dicyclopentadiene and having a glass transition temperature of greater than about 65 °C; and b) 50-70% by weight of amorphous polyalphaolefin as a thermoplastic base polymer. The EVA Composition disclosed in the Eastotac Brochure is a hot melt adhesive composition comprising: a) 30-60% by weight of a hydrocarbon tackifying resin derived, at least in part, from dicyclopentadiene and having a glass transition temperature of greater than about 65 °C; and b) 30-50% by weight of a copolymer of ethylene as a thermoplastic base polymer.

## **2. Claims 23, 25, and 31**

56. As discussed above in paragraphs 52-55, the Eastotac Brochure discloses the Claim 22 Composition.

57. Regarding claim 23, the Eastotac Brochure discloses the Claim 22 Composition “wherein said tackifying resin has a Tg of greater than about 68 °C (about 155 °F).” (See ’404 patent (Ex. 1001), col. 21, ll. 15-16.) Specifically, the ’404 patent states that Eastotac® H-142 is a hydrocarbon tackifying resin having an onset glass transition temperature (Tg(onset)) of about 82 °C. (’404 patent (Ex. 1001), col. 6, ll. 27-29.) A Tg of about 82 °C is greater than a Tg of

about 68 °C. Therefore, the Eastotac Brochure discloses a hot melt adhesive composition comprising: a) about 10% by weight to about 50% by weight of at least one hydrocarbon tackifying resin derived, at least in part, from dicyclopentadiene and having a glass transition temperature of greater than about 65 °C; b) about 10% by weight to about 80% by weight of at least one thermoplastic base polymer selected from the group consisting of copolymers and terpolymers of ethylene; amorphous polyalphaolefins, homogenous ethylene/ $\alpha$ -olefin interpolymers, and mixtures thereof, wherein said tackifying resin has a T<sub>g</sub> of greater than about 68 °C. Moreover, for the reasons described above, for example, in paragraphs 22-23, one of skill in the art would be motivated to choose a tackifying resin with a higher T<sub>g</sub> and reasonably expected it to provide suitable properties.

58. Regarding claim 25, the Eastotac Brochure discloses the Claim 22 Composition “wherein the tackifying resin is hydrogenated.” (See ’404 patent (Ex. 1001), col. 21, ll. 20-21.) Specifically, as discussed above in paragraph 43, the low bromine number and low molten Gardner Color of Eastotac® H-142 (the hydrocarbon tackifying resin used in the Eastotac Brochure’s Amorphous Polyolefin Composition and its EVA Composition) indicate that it is hydrogenated. (See ’404 patent (Ex. 1001), col. 5, ll. 54-67.) Therefore, the Eastotac Brochure discloses a hot melt adhesive composition comprising: a) about 10% by weight to about 50% by weight of at least one hydrocarbon tackifying resin derived, at least in part, from dicyclopentadiene and having a glass transition temperature of greater than about 65 °C; b) about 10% by weight to about 80% by weight of at least one thermoplastic base polymer selected from the group consisting of copolymers and terpolymers of ethylene; amorphous polyalphaolefins, homogenous ethylene/ $\alpha$ -olefin interpolymers, and mixtures thereof, wherein the tackifying resin is hydrogenated.

59. Regarding claim 31, the Eastotac Brochure discloses the Claim 22 Composition “wherein said tackifying resin concentration is less than said thermoplastic base polymer concentration.” (*See* ’404 patent (Ex. 1001), col. 22, ll. 22-24.) Specifically, as discussed above in paragraph 51, the Eastotac Brochure’s Amorphous Polyolefin Composition is a hot melt adhesive composition comprising: a) 30-50% by weight of a hydrocarbon tackifying resin derived, at least in part, from dicyclopentadiene and having a glass transition temperature of greater than about 65 °C; and b) 50-70% of amorphous polyalphaolefin as a thermoplastic base polymer. The tackifying resin concentration of 30-50% is less than the thermoplastic base polymer concentration of 50-70%. Therefore, the Eastotac Brochure discloses a hot melt adhesive composition comprising: a) about 10% by weight to about 50% by weight of at least one hydrocarbon tackifying resin derived, at least in part, from dicyclopentadiene and having a glass transition temperature of greater than about 65 °C; b) about 10% by weight to about 80% by weight of at least one thermoplastic base polymer selected from the group consisting of copolymers and terpolymers of ethylene; amorphous polyalphaolefins, homogenous ethylene/ $\alpha$ -olefin interpolymer, and mixtures thereof, wherein said tackifying resin concentration is less than said thermoplastic base polymer concentration. High molecular weight thermoplastic base polymers are used to provide the mechanical properties needed for performance. They can be either homopolymers or copolymers with various functional groups specific to application needs. Low molecular weight resins or tackifiers are used in order to alter the viscosity of the formulation and to enhance adhesive property. Because of the relative cost of the two components and to enhance the overall adhesive strength, it is more cost effective to maintain a range of composition with the thermoplastic base polymer being the majority component..



### 3. Claim 28

60. Regarding claim 28, the Eastotac Brochure discloses “[a] hot melt adhesive comprising: a) from about 10% by weight to about 80% by weight of at least one aliphatic tackifying resin having a glass transition temperature ( $T_g$ ) of greater than about 65 °C; and b) from about 10% by weight to about 80% by weight of at least one thermoplastic base polymer selected from the group consisting of copolymers and terpolymers of ethylene; amorphous polyalphaolefins, homogenous ethylene/ $\alpha$ -olefin interpolymer, and mixtures thereof” (referred to herein as “the Claim 28 Composition”). (See ’404 patent (Ex. 1001), col. 21, l. 27 to col. 22, l. 5.)

61. Specifically, as discussed above in paragraph 53, the Eastotac Brochure discloses the Amorphous Polyolefin Composition, which is a hot melt adhesive composition comprising 30 to 50% by weight of Eastotac® aliphatic tackifying resin and 50 to 70% by weight of amorphous polyolefin or amorphous polyalphaolefin as a thermoplastic base polymer. (Eastotac Brochure (Ex. 1002), Table 3.) The Eastotac Brochure also discloses the EVA Composition, which is a hot melt adhesive composition comprising 30 to 60% by weight of Eastotac® aliphatic tackifying resin and 30 to 50% by weight of ethylene-vinyl acetate copolymer as a thermoplastic base polymer. (Eastotac Brochure (Ex. 1002), Table 3.)

62. As discussed above in paragraph 54, the Eastotac Brochure lists Eastotac® H-142 as one of four specific examples of the Eastotac® hydrocarbon resin. (Eastotac Brochure (Ex. 1002), Table 1.) Eastotac® H-142 is listed in the ’404 patent as an example of a tackifying resin for use in the invention. (’404 patent (Ex. 1001), col. 6, ll. 14-29.) The ’404 patent states that Eastotac® H-142 is an aliphatic resin having an onset glass transition temperature ( $T_g(\text{onset})$ ) of about 82 °C. (’404 patent (Ex. 1001), col. 6, ll. 27-29.) A  $T_g$  of about 82 °C is

greater than a Tg of about 65 °C. Therefore, the Eastotac Brochure's Amorphous Polyolefin Composition comprises 30-50% by weight of at least one aliphatic tackifying resin having a glass transition temperature (Tg) of greater than about 65 °C, as recited by claim 28, and its EVA Composition comprises 30-60% by weight of at least one aliphatic tackifying resin having a glass transition temperature (Tg) of greater than about 65 °C, as recited by claim 28. One of skill in the art would have been motivated to choose the Eastotac Brochure compositions containing Eastotac® H-142 resin for use in many applications, such as those requiring a high peel value and heat resistance, because Eastotac® H-142 has the highest Tg of the Eastotac® resins in the Eastotac Brochure. (Eastotac Brochure (Ex. 1002).) The use of higher Tg tackifiers in a hot melt adhesive was known to increase the heat resistance and peel strength of the adhesive, which would have been desirable in certain applications, as discussed above, for example, in paragraphs 22-23.

63. Therefore, the Amorphous Polyolefin Composition disclosed in the Eastotac Brochure is a hot melt adhesive composition comprising: a) 30-50% by weight of an aliphatic tackifying resin having a glass transition temperature (Tg) of greater than about 65 °C; and b) 50-70% by weight of amorphous polyalphaolefin as a thermoplastic base polymer. The EVA Composition disclosed in the Eastotac Brochure is a hot melt adhesive composition comprising: a) 30-60% by weight of an aliphatic tackifying resin having a glass transition temperature (Tg) of greater than about 65 °C; and b) 30-50% by weight of a copolymer of ethylene as a thermoplastic base polymer.

#### **4. Claim 32**

64. As discussed above in paragraphs 59-62, the Eastotac Brochure discloses the Claim 28 Composition.

65. Regarding claim 32, the Eastotac Brochure discloses the Claim 28 Composition “wherein said tackifying resin concentration is less than said thermoplastic base polymer concentration.” (See ’404 patent (Ex. 1001), col. 22, ll. 25-27.) Specifically, as discussed above, the Eastotac’s Amorphous Polyolefin Composition is a hot melt adhesive composition comprising: a) 30-50% by weight of an aliphatic tackifying resin having a glass transition temperature (T<sub>g</sub>) of greater than about 65 °C; and b) 50-70% of amorphous polyalphaolefin as a thermoplastic base polymer. The tackifying resin concentration of 30-50% is less than the thermoplastic base polymer concentration of 50-70%. Therefore, the Eastotac Brochure discloses a hot melt adhesive comprising: a) from about 10% by weight to about 80% by weight of at least one aliphatic tackifying resin having a glass transition temperature (T<sub>g</sub>) of greater than about 65 °C; and b) from about 10% by weight to about 80% by weight of at least one thermoplastic base polymer selected from the group consisting of copolymers and terpolymers of ethylene; amorphous polyalphaolefins, homogenous ethylene/α-olefin interpolymers, and mixtures thereof wherein said tackifying resin concentration is less than said thermoplastic base polymer concentration. High molecular weight thermoplastic base polymers are used to provide the mechanical properties needed for performance. They can be either homopolymers or copolymers with various functional groups specific to application needs. Low molecular weight resins or tackifiers are used in order to alter the viscosity of the formulation and to enhance adhesive property. Because of the relative cost of the two components and to enhance the overall adhesive strength, it is more cost effective to maintain a range of composition with the thermoplastic base polymer being the majority component.

**F. The Exxon Reference discloses each and every element of claims 22-25 and 28.**

66. Each and every element of claims 22-25 and 28 are disclosed in the Exxon Reference such that one of ordinary skill in the art could have made and used the claimed inventions without undue experimentation in light of the general knowledge available in the art.

**1. Claim 22**

67. With respect to claim 22, the Exxon Reference discloses “[a] hot melt adhesive composition comprising: a) about 10% by weight to about 50% by weight of at least one hydrocarbon tackifying resin derived, at least in part, from dicyclopentadiene and having a glass transition temperature of greater than about 65 °C; b) about 10% by weight to about 80% by weight of at least one thermoplastic base polymer selected from the group consisting of copolymers and terpolymers of ethylene; amorphous polyalphaolefins, homogenous ethylene/ $\alpha$ -olefin interpolymer, and mixtures thereof” (i.e., the Claim 22 Composition). (See ’404 patent (Ex. 1001), col. 21, ll. 4-14.)

68. Specifically, the Exxon Reference discloses a hot melt composition comprising 40% by weight of a hydrocarbon tackifying resin, 20% by weight of Escorene UL 7750 as a thermoplastic base polymer, and 40% by weight of 158 °F MP paraffin wax. (Exxon Reference (Ex. 1003) at 2, FN 1.)

69. The Exxon Reference lists Escorez® 5340 as one of four specific examples of the 5000-series of Escorez® tackifier resin. (Exxon Reference (Ex. 1003) at 2.) Escorez® 5340 is listed in the ’404 patent as an example of a resin for use in the invention. (’404 patent (Ex. 1001), col. 6, ll. 14-29.) The ’404 patent states that Escorez® 5340 is a hydrocarbon resin having an onset glass transition temperature ( $T_g(\text{onset})$ ) of about 76 °C. (’404 patent (Ex. 1001), col. 6, ll. 21-22.) A  $T_g$  of about 76 °C is greater than a  $T_g$  of about 65 °C. The ’404 patent also

states that Escorez® 5340 is derived, at least in part, from dicyclopentadiene. ('404 patent (Ex. 1001), col. 9, ll. 6-9). Therefore, the Exxon Reference discloses a composition comprising 40% by weight of at least one hydrocarbon tackifying resin derived, at least in part, from dicyclopentadiene and having a glass transition temperature of greater than about 65 °C, as recited by claim 22. One of skill in the art would have been motivated to choose the Exxon Reference compositions containing Escorez® 5340 resin for use in many applications, such as those requiring a high peel value and heat resistance, because Escorez® 5340 has the highest Tg of the Escorez® resins in the Exxon Reference. (Exxon Reference (Ex. 1003).) The use of higher Tg tackifiers in a hot melt adhesive was known to increase the heat resistance and peel strength of the adhesive, which would have been desirable in certain applications, as discussed above, for example, in paragraph 22-23.

70. The Escorene UL 7750 in the composition disclosed in the Exxon Reference is an ethylene vinyl acetate copolymer, which means that it is a copolymer of ethylene as recited in claim 22. (*See, e.g.*, Publication No. WO 97/09393 (published Mar. 13, 1997) (“the ’393 publication”) (Ex. 1013) at 15.)

71. Therefore, the composition disclosed in the Exxon Reference is a hot melt adhesive composition comprising: a) 40% by weight of a hydrocarbon tackifying resin derived, at least in part, from dicyclopentadiene and having a glass transition temperature of greater than about 65 °C; and b) 20% of ethylene vinyl acetate as a thermoplastic base polymer.

## **2. Claims 23-25**

72. As discussed above in paragraphs 67-71, the Exxon Reference discloses the Claim 22 Composition.

73. Regarding claim 23, the Exxon Reference discloses the Claim 22 Composition “wherein said tackifying resin has a Tg of greater than about 68 °C (about 155 °F).” (See ’404 patent (Ex. 1001), col. 21, ll. 15-16.) Specifically, the ’404 patent states that Escorez® 5340 is a hydrocarbon resin having an onset glass transition temperature (Tg(onset)) of about 76 °C. (’404 patent (Ex. 1001), col. 6, ll. 21-22; col. 9, ll. 6-9.) A Tg of about 76 °C is greater than a Tg of about 68 °C. Therefore, the Exxon Reference discloses a hot melt adhesive composition comprising: a) about 10% by weight to about 50% by weight of at least one hydrocarbon tackifying resin derived, at least in part, from dicyclopentadiene and having a glass transition temperature of greater than about 65 °C; b) about 10% by weight to about 80% by weight of at least one thermoplastic base polymer selected from the group consisting of copolymers and terpolymers of ethylene; amorphous polyalphaolefins, homogenous ethylene/α-olefin interpolymer, and mixtures thereof, wherein said tackifying resin has a Tg of greater than about 68 °C.

74. Regarding claim 24, the Exxon Reference discloses the Claim 22 Composition “wherein greater than about 80 wt-% of the total resin unit is derived from dicyclopentadiene.” (See ’404 patent (Ex. 1001), col. 21, ll. 17-19.) Specifically, the Escorez® series of resins is “formed by the polymerization of dicyclopentadiene followed by hydrogenation.” (’628 patent (Ex. 1012), col. 3, l. 67 to col. 4, l. 2.) The ’404 patent teaches that Escorez® 5340 is a dicyclopentadiene based hydrocarbon tackifying resin with greater than 80 wt-% of its total unit derived from dicyclopentadiene. (’404 patent (Ex. 1001), col. 9, ll. 3-9.) Therefore, the Exxon Reference discloses a hot melt adhesive composition comprising: a) about 10% by weight to about 50% by weight of at least one hydrocarbon tackifying resin derived, at least in part, from dicyclopentadiene and having a glass transition temperature of greater than about 65 °C; b) about

10% by weight to about 80% by weight of at least one thermoplastic base polymer selected from the group consisting of copolymers and terpolymers of ethylene; amorphous polyalphaolefins, homogenous ethylene/ $\alpha$ -olefin interpolymer, and mixtures thereof, wherein greater than about 80 wt-% of the total resin unit is derived from dicyclopentadiene.

75. Regarding claim 25, the Exxon Reference discloses the Claim 22 Composition “wherein the tackifying resin is hydrogenated.” (*See* ’404 patent (Ex. 1001), col. 21, ll. 20-21.) Specifically, the low molten Gardner Color ( $<<1$ ) (Exxon Reference (Ex. 1003) at 2) indicates that Escorez® 5340 is hydrogenated, as discussed in paragraph 48. (*See* ’404 patent (Ex. 1001), col. 5, ll. 54-67.) Therefore, the Exxon Reference discloses a hot melt adhesive composition comprising: a) about 10% by weight to about 50% by weight of at least one hydrocarbon tackifying resin derived, at least in part, from dicyclopentadiene and having a glass transition temperature of greater than about 65 °C; b) about 10% by weight to about 80% by weight of at least one thermoplastic base polymer selected from the group consisting of copolymers and terpolymers of ethylene; amorphous polyalphaolefins, homogenous ethylene/ $\alpha$ -olefin interpolymer, and mixtures thereof, wherein the tackifying resin is hydrogenated.

### **3. Claim 28**

76. Regarding claim 28, the Exxon Reference discloses “[a] hot melt adhesive comprising: a) from about 10% by weight to about 80% by weight of at least one aliphatic tackifying resin having a glass transition temperature ( $T_g$ ) of greater than about 65 °C; and b) from about 10% by weight to about 80% by weight of at least one thermoplastic base polymer selected from the group consisting of copolymers and terpolymers of ethylene; amorphous polyalphaolefins, homogenous ethylene/ $\alpha$ -olefin interpolymer, and mixtures thereof” (i.e., the Claim 28 Composition). (*See* ’404 patent, (Ex. 1001), col. 21, l. 27 to col. 22, l. 5.)

77. Specifically, the Exxon Reference discloses a hot melt composition comprising 40% by weight of an aliphatic tackifying resin, 20% by weight of Escorene UL 7750 as a thermoplastic base polymer, and 40% by weight of 158 °F MP paraffin wax. (Exxon Reference (Ex. 1003) at 2, FN 1.)

78. The Exxon Reference lists Escorez® 5340 as one of four specific examples of the 5000-series of Escorez® tackifier resin. (Exxon Reference (Ex. 1003) at 2.) Escorez® 5340 is listed in the '404 patent as an example of a resin for use in the invention. ('404 patent (Ex. 1001), col. 6, ll. 14-29.) The '404 patent states that Escorez® 5340 is an aliphatic tackifying resin having an onset glass transition temperature (Tg(onset)) of about 76 °C. ('404 patent (Ex. 1001), col. 6, ll. 21-22.) A Tg of about 76 °C is greater than a Tg of about 65 °C. Therefore, the Exxon Reference discloses a composition comprising 40% by weight of at least one aliphatic tackifying resin having a glass transition temperature (Tg) of greater than about 65 °C, as recited by claim 28. One of skill in the art would have been motivated to choose the Exxon Reference compositions containing Escorez® 5340 resin for use in many applications, such as those requiring a high peel value and heat resistance, because Escorez® 5340 has the highest Tg of the Escorez® resins in the Exxon Reference. (Exxon Reference (Ex. 1003).) The use of higher Tg tackifiers in a hot melt adhesive was known to increase the peel strength of the adhesive, which would have been desirable in certain applications, as discussed above, for example, in paragraphs 22-23.

79. The Escorene UL 7750 in the composition disclosed in the Exxon Reference is an ethylene vinyl acetate copolymer, which means that it is a copolymer of ethylene as recited claim 28. (See '393 publication (Ex. 1013) at 15, ll. 12-16.)



80. Therefore, the composition disclosed in Exxon Reference is a hot melt adhesive composition comprising: a) 40% by weight of an aliphatic tackifying resin having a glass transition temperature (T<sub>g</sub>) of greater than about 65 °C; and b) 20% of ethylene vinyl acetate as a thermoplastic base polymer.

**G. Each and every element of claim 26 is disclosed or suggested by the Eastotac Brochure or the Exxon Reference and the '717 patent.**

81. Claim 26 depends from claim 22 and “further compris[es] up to about 40% by weight of a solid benzoate plasticizer.” ('404 patent (Ex. 1001), col. 21, ll. 22-23.) As discussed above in paragraphs 52-55 and 67-71, respectively, the Eastotac Brochure and the Exxon Reference each disclose the Claim 22 Composition. And there was nothing nonobvious or new about the additional claim limitation of claim 26. The use of a solid benzoate plasticizer as an additional ingredient in hot melt adhesives was well known and routine for one of skill in the art, as was using such a plasticizer at up to about 40% by weight, as discussed above, for example, in paragraphs 26 and 49. (*See, e.g.*, '717 patent.)

82. The '717 patent discloses a hot melt adhesive composition comprising about 5 to 50% by weight of a thermoplastic base polymer; about 3 to 65% by weight of a solid benzoate plasticizer; about 10 to 90% by weight of a tackifier; and about 0 to 2% by weight of an antioxidant. ('717 patent (Ex. 1004), col. 1, l. 65 to col. 2, l. 9.) The motivation to use a benzoate plasticizer was because it helped to increase the open time while maintaining high crystallinity. ('717 patent (Ex. 1004), col. 3, ll. 1-4.) One of ordinary skill in the art would have routinely taken the hot melt compositions of the Eastotac Brochure and the Exxon Reference and added an additional solid benzoate plasticizer with an expectation of success since the benzoate plasticizers were compatible with hot melt adhesive compositions. (*See, e.g.*, '717 patent (Ex. 1004), col. 2, ll. 67-68.) This is shown from the examples of the '717 patent. A number of

example hot melt adhesives provided in Tables 1 and 3 of the '717 patent combine an aliphatic hydrocarbon tackifier (with the Escorez® 5000 series and Eastotac® H-100 series of tackifiers being listed as examples ('717 patent (Ex. 1004), col. 3, ll. 40-49)), a polybutylene thermoplastic polymer (which is a copolymer of polybutene-1 and ethylene and which is very similar to copolymers of ethylene used as thermoplastic base polymers in the '404 patent), and up to about 40% by weight of a solid benzoate plasticizer, including Benzoflex® 352, which is a solid benzoate plasticizer used in examples of the '404 patent ('404 patent (Ex. 1001), col. 17, Tables III, IV). ('717 patent (Ex. 1004), col. 5, l. 1 to col. 6, l. 32.)

**H. Each and every element of claim 27 is disclosed or suggested by Eastotac Brochure or the Exxon Reference and Litz.**

83. Claim 27 depends from claim 22 and further requires “peel values . . . greater than about 70 °C.” ('404 patent (Ex. 1001), col. 21, ll. 25-26.) As discussed above paragraphs 52-55 and 67-71, respectively, the Eastotac Brochure and the Exxon Reference each disclose the Claim 22 Composition. And obtaining such a composition wherein the peel values are greater than about 70 °C would have been obvious and routine for one of skill in the art. (*See, e.g.*, Litz (Ex. 1005) at 36, 2<sup>nd</sup> column.)

84. The '404 patent states that “[t]he tackifying resin [was] known to provide specific adhesion and to increase peel values which translates into heat resistance.” ('404 patent (Ex. 1001), col. 1, ll. 25-30.) Specifically, by June 1998, it was known that the use of a higher Tg tackifier in a hot melt adhesive would increase the overall mechanical strength of the adhesive, and therefore increase the peel value and heat resistance of the adhesive, as discussed above, for example, in paragraphs 22-23. This meant that an adhesive with a higher Tg tackifier would deform at higher temperature, which was preferable in certain applications. In addition to increasing peel value by using a high Tg tackifier, it was routine in the art to increase peel value

by varying the thermoplastic polymer and adding wax. (*See, e.g., Handbook of Adhesives* (ed. Irving Skeist 1977) (“Skeist”) (Ex. 1014).)

85. One of skill in the art would have been motivated to prepare a hot melt adhesive with a peel value of are greater than about 70 °C, and there would have been a reasonable expectation of success based on what was known in the art at the time regarding tackifying resins. Litz, for example, is a review article published in 1974 that discusses developments in ethylene-based hot melt adhesives. (Litz (Ex. 1005) at 35-38.) Litz explains that “one of the most important reasons for the impressive growth of hot melts has been the ability of the formulators to meet the demanding requirements of diverse adhesive applications.” (Litz (Ex. 1005) at 36, 2<sup>nd</sup> column.) One of these requirements is Rule 41 of the Uniform Freight Classification Committee, “which governs the packaging requirements of all materials shipped by rail.” (Litz (Ex. 1005) at 36, 2<sup>nd</sup> column.) Rule 41 requires that the hot melts maintain a bond (i.e., peel value) in temperatures between -20 °F and +165 °F (-29 °C and 74 °C). (Litz (Ex. 1005) at 36, 2<sup>nd</sup> column.) Therefore, Litz suggested the routine modification of the compositions of the Eastotac Brochure and the Exxon Reference to obtain a peel value of greater than about 70 °C, as recited in claim 27 of the ’404 patent.

86. Moreover, as explained above, for example, in paragraphs 22-23, based on what was known in the art at the time, a skilled artisan would be motivated to use tackifying resins with a high softening point and thus higher T<sub>g</sub> to improve heat resistance at elevated temperature. And there was an expectation that using higher softening point and therefore higher T<sub>g</sub> petroleum hydrocarbon tackifying resins would improve heat resistance of the adhesive.

### **VIII. Conclusion**

87. As discussed herein, each and every elements of claims 22-28, 31, and 32 is disclosed or suggested in the prior art.

88. In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place in the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

89. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Respectfully Submitted,



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Shaw Ling Hsu, Ph.D.

April 9, 2014  
Date: \_\_\_\_\_