

# Clarke, Modet & C<sup>o</sup>

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SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO



No. 12-040971- -00008-0000

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P-3267

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO  
DIVISION DE NUEVAS CREACIONES

E. S. D.

Re: Expediente No. 12-040.971

Solicitud de patente a nombre de **CREATIVE NAIL DESIGN, INC.**

Yo, **SILVANA MARIA LÓPEZ DÍAZ** identificada como aparece al pie de mi firma, domiciliada en la Carrera 11 No. 86-53, piso 6, obrando como apoderada sustituta de la sociedad **CREATIVE NAIL DESIGN, INC.**, domiciliada en California, Estados Unidos de América, solicitante de la patente de la referencia, en respuesta al oficio No. 13520 notificado por fijación en lista el 30 de julio de 2013, y de acuerdo a la solicitud de prórroga de treinta días presentada el 18 de octubre de 2013, me permito manifestar:

## 1. Nivel Inventivo de la Presente Solicitud

El Examinador establece en su concepto técnico que la reivindicación 1 de la presente solicitud, y reivindicaciones dependientes, carecen de nivel inventivo a la luz de las enseñanzas del documento D1 (US 5,407,666: *Removable, hard, durable, nail coating*), ya que la persona del oficio normalmente versada en la materia, incluiría las características de la composición divulgada en el documento D1 para llegar así al objeto de la presente solicitud.

A este respecto, me permito indicar que el artículo 18 de la Decisión 486 establece que *“Se considerará que una invención tiene nivel inventivo, si para una persona del oficio normalmente versada en la materia técnica correspondiente, esa invención no hubiese resultado obvia ni se hubiese derivado de manera evidente del estado de la técnica”*.

Por lo tanto, una invención se considerará inventiva si la misma no hubiese resultado obvia a partir del arte previo, para una persona del oficio normalmente versada en la materia. Esto a su vez implica que el examinador a cargo de esta evaluación debe colocarse en el momento exacto en el que el inventor buscaba resolver el problema

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técnico contemplado en la solicitud y para el cual poseía la literatura y el conocimiento disponibles en dicho momento.

Siguiendo entonces los lineamientos de la jurisprudencia aplicable al análisis de nivel inventivo de una solicitud de patente, se considera que una anterioridad puede afectar dicho requerimiento de patentabilidad, si una persona medianamente versada en la materia encuentra enseñanzas o sugerencias clara que le indiquen cómo llegar a la invención reivindicada.

Frente a lo anterior, deseamos poner de presente que la presente solicitud se refiere a una composición para el revestimiento de uñas, la cual proporciona una mayor adhesión y características superiores frente al desgaste, de manera que esta puede ser usada por un período de tiempo más largo sin que la misma se salte o se desportille, y siendo a su vez fácil de remover. Previo a la presentación de la presente solicitud, las composiciones para el recubrimiento de uñas conocidas, caracterizadas por una mayor resistencia al desgaste, como lo son las uñas artificiales, resultaban difíciles de remover. Incluso, requerían a menudo de medios mecánicos como el limado para lograr dicha remoción (llamamos la atención de su Despacho a la página 2, líneas 6 a 12 de la memoria descriptiva de la solicitud). Por el contrario, los esmaltes de uñas conocidos en ese entonces de fácil remoción, presentaban una mala adherencia y se desgastaban con facilidad (como es mencionado en el cuarto párrafo de la página 1 de la presente solicitud). Precisamente, la invención tal y como es reivindicada en esta solicitud permite superar estos inconvenientes.

Ahora bien, con relación al documento D1 citado por su Despacho, deseamos aclarar que este se refiere en términos generales a composiciones curables para el revestimiento de uñas (como es indicado en la col. 1, líneas 5-10 de dicho documento); sin embargo, no se hace referencia alguna a composiciones que se curan mediante un proceso de termoendurecido reticulado con vacíos definidos en su estructura. Como se menciona en la memoria descriptiva de la solicitud:

*“En ciertas realizaciones de la invención, el compuesto reticulado termoendurecido 3-D, está interpenetrado por una red de espacios vacíos dejados por la elución de un solvente...”*

(Líneas 20 y 21, página 7 de la memoria descriptiva)

Aún más, vale la pena mencionar que D1 no hace referencia alguna a un proceso de termoendurecimiento como tal.

Por otro lado, su Despacho afirma en la acción oficial que el al menos un copolímero de metacrilato de polimetilo (PMMA)-ácido polimetacrílico (PMAA) corresponde a los

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polímeros acrílicos seleccionados de: polimetilmetaacrilato, polietilmetacrilato, polibutylmetaacrilato y mezclas de los mismos de acuerdo a la línea 8, de la página 3 de la anterioridad citada. No obstante, no nos encontramos de acuerdo con la anterior apreciación, en la medida que el al menos un copolímero de metacrilato de polimetilo (PMMA)-ácido polimetacrílico (PMAA) de las reivindicaciones 1, 2 y 27 es un copolímero formado a partir de un polimetilmetacrilato (PMMA) y un ácido polimetacrílico (PMAA). En otras palabras, se trata de un *polímero copolimerizado a partir del metacrilato de metilo (MMA) y ácido metacrílico (MAA) para formar un polímero compuesto de metacrilato de polimetilo (PMMA) y ácido polimetacrílico (PMAA)*.

A diferencia de lo anterior, D1 indica en la columna 3, líneas 8 a 14 que:

*“Los polímeros acrílicos se seleccionan del grupo que consiste esencialmente de polímeros y copolímeros de ésteres de ácido metacrílico que incluyen polimetilmetacrilato, polietilmetacrilato, polibutylmetacrilato, polimetilmetacrilato-co-polietilmetacrilato, y polimetilmetacrilato-co-polibutylmetacrilato”*

(subrayado por fuera del texto)

Como es del conocimiento de una persona versada en la materia, el metacrilato de polimetilo (PMMA) es un éster, mientras que el ácido polimetacrílico (PMAA) no lo es. Por el contrario, las enseñanzas de D1 se limitan exclusivamente a la combinación de ésteres de ácido metacrílico y copolímeros de los mismos, sin hacer referencia alguna de los efectos que puede tener la adición de un copolímeros que incluye ácido polimetacrílico (PMAA). Igualmente, D1 falla en sugerir el uso de un ácido metacrílico en un copolímero, ofreciendo únicamente información relacionada con ésteres de ácido metacrílico.

Por el contrario, los inventores de la invención bajo estudio encontraron que las composiciones que incluyen un copolímero de PMMA-PMAA mejoran significativamente la durabilidad y los tiempos de remoción de la composición para el revestimiento de uñas. Como sustento de lo anterior, presentamos adjunto al presente memorial copia de la declaración hecha por Thong Vu ante la USPTO para la solicitud de patente equivalente en los Estados Unidos. En dicha declaración se discuten las pruebas experimentales que demuestran que las formulaciones que incluye un copolímero de PMMA-PMAA mejoran la duración del recubrimiento en las uñas en alrededor un 83%, simultáneamente demostrando una reducción del tiempo de remoción de aproximadamente un 45 % en comparación con la formulación sin el copolímero de PMMA-PMAA.

Asimismo, adjuntamos la declaración del inventor Chad Conger también ante la USPTO, en donde se compara una formulación (fórmula 1) que comprende un

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copolímero de PMMA-PMAA con una formulación utilizando metacrilato de etilo (fórmula 2), similar a las composiciones descritas en D1. Dichos estudios permiten concluir que la adición de un copolímero de PMMA-PMAA produce resultados superiores en comparación con los polímeros y copolímeros de ésteres de ácido metacrílico descritos en D1, lo cual no podía ser inferido a partir del estado del arte. En particular, no era posible anticipar que la incorporación de un ácido polimetacrílico (PMAA) en el copolímero de la composición implicaría una mejor adhesión y facilitaría la remoción de las composiciones para el revestimiento de uñas.

Por último, se desea traer a colación el hecho que D1 no enseña la incorporación de al menos un monómero de (met)acrilato de polipropilenglicol o un monómero de (met)acrilato de polietilenglicol, contrario a lo afirmado por el Señor Examinador en su concepto técnico.

Lo anterior, por cuanto los polímeros acrílicos enseñados en D1 se limitan a polímeros y copolímeros de ésteres de ácido metacrílico que incluyen polimetilmetacrilato, polietilmetacrilato, polibutilmetacrilato, polimetilmetacrilato-co-polietilmetacrilato, y polimetilmetacrilato-co-polibutilmetacrilato, como se demostró con anterioridad. Estos polímeros acrílicos se forman como resultado de una reacción de polimerización, y no son reactivos en la medida en que la polimerización ya tuvo lugar.

D1 también describe en su columna 3, líneas 15-18, el uso de monómeros fotorreactivos seleccionados del grupo que consiste esencialmente de metacrilato de etilo, metacrilato de ciclohexilo, metacrilato de etilhexilo, metacrilato de butilo y metacrilato de isobornilo. Como una persona en el área técnica lo puede reconocer, ninguno de estos monómeros fotorreactivos puede ser considerado como un mono(met)acrilato de polipropilenglicol reactivo o un mono(met)acrilato de polietilenglicol reactivo. Lo mismo ocurre con los diésteres del ácido metacrílico seleccionados del grupo que consiste esencialmente de di(met)acrilato de dietilenglicol, di(met)acrilato de trietilenglicol y di(met)acrilato de 1,4- butanodiol definidos en la columna 3, líneas 19 a 22 de la anterioridad citada. Ninguno de estos diésteres es un mono(met)acrilato de polipropilenglicol reactivo o un mono(met)acrilato de polietilenglicol de reactivo.

En vista de lo anterior, se puede concluir que no existe enseñanza alguna en esta D1 que enseñe o sugiera la incorporación de al menos un mono(met)acrilato de polipropilenglicol reactivo o un mono(met)acrilato de polietilenglicol reactivo, con el fin de “*abrir*” y facilitar la remoción de la composición de las uñas (como es indicado en la página 3, líneas 20-24 ; página 6, línea 28 a la página 7, línea 4) . Esta propiedad no es sugerida por las composiciones de D1 e inesperado en vista sus enseñanzas.

Con base en lo anterior, resulta evidente que D1 no es una anterioridad válida capaz de afectar el nivel inventivo de la presente solicitud, en la medida que no enseña todas las características técnicas de la invención, y no permiten derivar la misma a partir de sus enseñanzas, particularmente porque no divulga composiciones que se curan mediante un proceso de termoendurecido reticulado con vacíos definidos, y que incluyen al menos un monómero de (met)acrilato de polipropilenglicol o un monómero de (met)acrilato de polietilenglicol, y al menos un copolímero de (met)acrilato de polimetilo (PMMA)-ácido polimetacrílico (PMAA). Por lo tanto, queda demostrado que la presente solicitud es inventiva a la luz de las enseñanzas de la anterioridad D1.

Por último, y aunque reconocemos la soberanía de su Despacho frente al estudio de las solicitudes de patentes, deseamos poner de presente que las solicitudes equivalentes en los Estados Unidos a la solicitud bajo estudio ya han sido concedidas bajo los No. US 8,263,677 y US 8,399,537. Las reivindicaciones actuales de la presente solicitud presentan la siguiente equivalencia con relación a estas patentes estadounidenses:

| Reivindicaciones actuales | Reivindicación correspondiente en US 8,263,677 | Reivindicación correspondiente en US 8,399,537 |
|---------------------------|------------------------------------------------|------------------------------------------------|
| 2                         | 1                                              |                                                |
| 3                         |                                                | 1                                              |
| 4-22                      | 2-20                                           |                                                |
| 24                        |                                                | 5                                              |
| 25                        | 21                                             | 7                                              |
| 26                        | 22                                             |                                                |

Habiendo atendido cabalmente las objeciones presentadas por ese despacho, atentamente solicitamos se conceda el privilegio de patente de invención a la solicitud en estudio o si el señor examinador considera que subsisten razones para objetar la presente invención, rogamos expedir otro examen de fondo con los debidos motivos y razones que sustenten su objeción con el fin de que nuestro mandante tenga la posibilidad de exponer sus argumentos con base en la interpretación de los artículos 45 de la Decisión 486 -el cual otorga la facultad al examinador para emitir los exámenes de fondo-, 35 y 59 del Código Contencioso Administrativo que señala que: *“habiéndose dado oportunidad a los interesados para expresar sus opiniones, y con base en las pruebas e informes disponibles, se tomará la decisión que será motivada al menos en forma sumaria si afecta a particulares”* y *“(.) deberá proferirse la decisión definitiva. Esta se motivará en sus aspectos de hecho y de derecho, y en los de conveniencia si es el caso”*, respectivamente (subrayado por fuera del

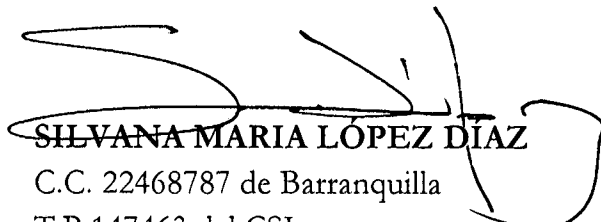
## **Clarke, Modet & Cº**

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texto).

En consecuencia, solicitamos a ese despacho pronunciarse en relación con todos los argumentos presentados en este memorial dando estricta aplicación al principio del debido proceso consagrado en el artículo 29 de la Constitución Nacional.

Señor Superintendente,



**SILVANA MARIA LÓPEZ DÍAZ**  
C.C. 22468787 de Barranquilla  
T.P 147463 del CSJ  
[notificaciones@clarkemodet.com.co](mailto:notificaciones@clarkemodet.com.co)

Vis EFS

Attorney Docket No. 017535-0376694

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

|                |                   |                  |               |
|----------------|-------------------|------------------|---------------|
| Applicants :   | <i>Vu et al.</i>  | Confirmation No: | 1801          |
| Serial Number: | 12/555,571        | Examiner:        | Kara Negrelli |
| Filing Date :  | September 8, 2009 | Art Unit:        | 1766          |

For : REMOVABLE COLOR GEL BASECOAT FOR ARTIFICIAL NAIL  
COATINGS AND METHODS THEREFORE

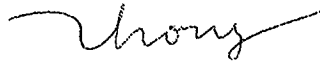
Via EFS  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

**DECLARATION OF THONG VU**

I, Thong Vu, declare under penalty of perjury by the laws of the United States of America, as follows:

1. I am an inventor named in the present application and a Research Chemist at Creative Nail Design, Inc. ("CND"), the assignee of the present application.
2. In 2007, several tests were conducted in order to identify a base coat nail covering composition with improved wear and removal properties. As a result of these tests, it was concluded that the presence of PMMA:PMAA copolymer in the base coat formulations improved both wear and removal properties. For example, CND formulation #185-39-3, formulated *without* PMMA:PMAA copolymer, showed 5.75 average days of wear on the natural nail and took an average of 16.5 minutes to remove using CND's standard removal method. However, CND formulation #185-93-3, formulated *with* PMMA:PMAA copolymer, exhibited 10.5 average days of wear on the natural nail and took an average of 9 minutes to remove, using the same standard removal method. Comparing the above results, the formulation containing PMMA:PMAA copolymer increased wear time by about 83% and reduced removal time by about 45%.
3. I further declare that all statements made herein of our 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 18 U.S.C. § 1001 and that willful false statements may jeopardize the validity of this application and any patent issuing therefrom.



Thong Vu

Signed this 22<sup>nd</sup> day of September, 2011

Vis EFS

Attorney Docket No. 017535-0376694

**IN THE UNITED STATES PATENT AND TRADE MARK OFFICE**

|                |                   |                  |               |
|----------------|-------------------|------------------|---------------|
| Applicants :   | Vu <i>et al.</i>  | Confirmation No: | 1801          |
| Serial Number: | 12/555,571        | Examiner:        | Kara Negrelli |
| Filing Date :  | September 8, 2009 | Art Unit:        | 1766          |

For : REMOVABLE COLOR GEL BASECOAT FOR ARTIFICIAL NAIL  
COATINGS AND METHODS THEREFORE

**Via EFS**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

**DECLARATION OF CHAD CONGER**

I, Chad Conger, declare under penalty of perjury by the laws of the United States of America, as follows:

1. I am an inventor named in the present application and a Research Chemist at Creative Nail Design, Inc. ("CND"), the assignee of the present application.
2. I have read the *Final Office Action* of October 26, 2011 and the cited references of Cook (US 5,985,951), Sirdesai (US 5,785,958), Jia (U.S. 6,147,137) and Maeda (US 4,572,888). I have reviewed the present application in conjunction with each of the cited references. I understand that Maeda is relied on by the examiner in the *Final Office Action* for its disclosure that polymers such as polymethacrylic alkyl esters may be used as binders and thus may have adhesion properties. See *e.g.*, Maeda at column 9, lines 1 to 29.
3. In January 2012, I conducted a series of experiments to test the adhesion and removability properties of nail coatings of Formulas 1 and 2. The list of components of Formulas 1 and 2 are provided in the table below. As indicated in the following table, Formulas 1 and 2 are identical except that the PMMA-PMAA copolymer of Formula 1 is substituted for ethyl methacrylate polymer. Ethyl methacrylate polymer is a polymethacrylic alkyl ester, the genus of compounds referenced in Maeda. Formulas 1

and 2 contain 4.5 wt. % PMMA-PMAA copolymer and Ethyl Methacrylate Polymer, respectively.

| Formula 1                                       | Formula 2                                       |
|-------------------------------------------------|-------------------------------------------------|
| Tetrahydrofurfuryl Methacrylate                 | Tetrahydrofurfuryl Methacrylate                 |
| PPG-5 Methacrylate                              | PPG-5 Methacrylate                              |
| Cellulose Acetate Butyrate                      | Cellulose Acetate Butyrate                      |
| Acetone                                         | Acetone                                         |
| Bis-HEMA Poly(1,4-Butanediol)-22/IPDI Copolymer | Bis-HEMA Poly(1,4-Butanediol)-22/IPDI Copolymer |
| Alcohol Denat.                                  | Alcohol Denat.                                  |
| PMMA-PMAA Copolymer                             | Ethyl Methacrylate Polymer                      |
| Di-HEMA Trimethylhexyl Dicarbamate              | Di-HEMA Trimethylhexyl Dicarbamate              |
| Hydroxycyclohexyl Phenyl Ketone                 | Hydroxycyclohexyl Phenyl Ketone                 |
| Butyl Acetate                                   | Butyl Acetate                                   |
| Ethyl Trimethylbenzoyl Phenylphosphinate        | Ethyl Trimethylbenzoyl Phenylphosphinate        |
| Bis(Glyceryl Dimethacrylate) Pyromellitate      | Bis(Glyceryl Dimethacrylate) Pyromellitate      |
| Phenyldimethoxyacetophenone                     | Phenyldimethoxyacetophenone                     |
| Hydroxypropyl Methacrylate                      | Hydroxypropyl Methacrylate                      |

- Adhesion Testing: All formulas were tested utilizing ASTM Standard Test D3359. A full description of the ASTM Standard Test D3359 is attached herewith. Standard Test Methods for Measuring Adhesion by Tape Test – Test method B was used. For the test, all formulas were tested by applying a 15 mil coating onto a piece of clean artificial keratin. Each sample was then cured for 8 minutes in an UV lamp to ensure thorough cure was achieved. Each sample was then rested for a minimum of 2 hours before testing. A minimum of 3 tests were recorded for each formula. Test results are based on the ASTM method that correlates percent of area affected to a classification ranging from 5B to 0B, where 5B indicates superior adhesion (0% of the test area was affected), and where 0B indicates weak adhesion (an area greater than 65% of the test area was affected).
- Adhesion Testing Results: As shown in the table below, Formula 1 containing PMMA-PMAA copolymer displayed superior adhesion properties compared to Formula 2 containing a different copolymer.

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| Formula   | ASTM Test Result |
|-----------|------------------|
| Formula 1 | 3B               |
| Formula 2 | 1B               |

6. Removal or Soakability Testing: All formulas were tested for removability (or soakability) properties. This test measures the time it takes for a thin film of a material to detach from a glass slide while being soaked in acetone. Removal time is a good indicator that the material has the relative ability to be removed from the natural finger nail when used as a nail coating. For the "Soakability" test method, a 15 mil coating is applied to a slide. Slides are cured for 8 minutes in an UV lamp and then rested for at least 1 hour. To test, 25 ml of acetone is placed into a 50 ml beaker, a slide is then placed in the beaker and the time it takes for the coating to completely detach from the slide is recorded. Each formula was tested 3 times and the average soakability times were calculated.
7. Soakability test Results: As shown in the table below, Formula 1 containing PMMA-PMAA copolymer displayed superior removal properties (shorten time for removal) compared to Formula 2 containing a different copolymer.

| Formula   | Average Detachment Time (seconds) |
|-----------|-----------------------------------|
| Formula 1 | 205                               |
| Formula 2 | 292                               |

8. The adhesion and removability test were also performed on third formula, Formula A, which was made using the guidance of Example 8 of *Sirdesai* (U.S. Patent No. 5785958). Formula A contained the following components:

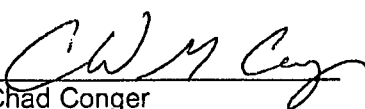
| Formula A                  |
|----------------------------|
| Ethyl Acetate              |
| Butyl Acetate              |
| Isopropyl Alcohol          |
| Cyclohexyl Methacrylate    |
| Hydroxypropyl Methacrylate |
| DiUrethane Dimethacrylate  |
| Benzoine Methyl Ether      |
| Esacure Tzt                |

|                            |
|----------------------------|
| Poly Ethyl Methacrylate    |
| Cellulose Acetate Butyrate |
| 381-0.5                    |
| 4-Methoxy Phenol           |

9. Results of Testing Formula A: The results of the Adhesion and Soakability test on Formula A are summarized in the table below. Formula A exhibited weak adhesion and a gel removal test could not be performed. Formula A could not be tested for soakability because an acrylic thermoset was not formed. If an acrylic thermoset was formed, there would be remnants of a film and the film would visually detach from the slide. In the case of Formula A, the coating was completely dissolved within 15 seconds. This behavior is indicative of the solvent evaporative coatings used for nail polish, which is what is described in *Sirdesai*.

| Test             | Result |
|------------------|--------|
| ASTM Test Result | 0B     |
| Soakability      | NA     |

10. I further declare that all statements made herein of our 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 18 U.S.C. § 1001 and that willful false statements may jeopardize the validity of this application and any patent issuing therefrom.

  
Chad Conger

Signed this 24 day of January 2012



Designation: D3359 – 09<sup>e2</sup>

## Standard Test Methods for Measuring Adhesion by Tape Test<sup>1</sup>

This standard is issued under the fixed designation D3359; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense.*

<sup>e1</sup> *NOTE*—Footnote 5 and 5.2 were corrected editorially in June 2010.

<sup>e2</sup> *NOTE*—Footnote 5 and 5.2 were corrected editorially and moved into Note 4 in 5.3 in July 2010.

### 1. Scope\*

1.1 These test methods cover procedures for assessing the adhesion of coating films to metallic substrates by applying and removing pressure-sensitive tape over cuts made in the film.

*NOTE 1*—This test method has been reported being used to measure adhesion of organic coatings on soft substrates (for example, wood and plastic). Issues with plastic substrates are noted in Appendix X1. A similar test method, ISO 2409, permits tests on soft substrates (for example, wood and plaster). Precision and bias data on the latter is lacking. Test Methods D3359 was developed with metal as the substrate and, in the absence of supporting precision and bias data, is so limited.

1.2 Test Method A is primarily intended for use at job sites while Test Method B is more suitable for use in the laboratory. Also, Test Method B is not considered suitable for films thicker than 5 mils (125 $\mu$ m).

*NOTE 2*—Subject to agreement between the purchaser and the seller, Test Method B can be used for thicker films if wider spaced cuts are employed.

1.3 These test methods are used to establish whether the adhesion of a coating to a substrate is at a generally adequate level. They do not distinguish between higher levels of adhesion for which more sophisticated methods of measurement are required.

*NOTE 3*—It should be recognized that differences in adherability of the coating surface can affect the results obtained with coatings having the same inherent adhesion.

1.4 This test method is similar in content (but not technically equivalent) to ISO 2409.

1.5 In multicoat systems adhesion failure may occur between coats so that the adhesion of the coating system to the substrate is not determined.

1.6 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.7 *This standard does not purport to address the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:<sup>2</sup>

D609 Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products

D823 Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels

D1000 Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications

D1730 Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting

D2092 Guide for Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting<sup>3</sup>

D2370 Test Method for Tensile Properties of Organic Coatings

D3330/D3330M Test Method for Peel Adhesion of Pressure-Sensitive Tape

D3924 Specification for Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials

D4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser

<sup>1</sup> These test methods are under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and are the direct responsibility of Subcommittee D01.23 on Physical Properties of Applied Paint Films.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Withdrawn. The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

\*A Summary of Changes section appears at the end of this standard.

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## 2.2 Other Standard:

ISO 2409 Paint and Varnishes — Cross-cut test<sup>1</sup>

## 3. Summary of Test Methods

3.1 *Test Method A*—An X-cut is made through the film to the substrate, pressure-sensitive tape is applied over the cut and then removed, and adhesion is assessed qualitatively on the 0 to 5 scale.

3.2 *Test Method B*—A lattice pattern with either six or eleven cuts in each direction is made in the film to the substrate, pressure-sensitive tape is applied over the lattice and then removed, and adhesion is evaluated by comparison with descriptions and illustrations.

## 4. Significance and Use

4.1 If a coating is to fulfill its function of protecting or decorating a substrate, it must adhere to it for the expected service life. Because the substrate and its surface preparation (or lack of it) have a drastic effect on the adhesion of coatings, a method to evaluate adhesion of a coating to different substrates or surface treatments, or of different coatings to the same substrate and treatment, is of considerable usefulness in the industry.

4.2 The limitations of all adhesion methods and the specific limitation of this test method to lower levels of adhesion (see 1.3) should be recognized before using it. The intra- and inter-laboratory precision of this test method is similar to other widely-accepted tests for coated substrates (for example, Test Method D2370 and Test Method D4060), but this is partly the result of it being insensitive to all but large differences in adhesion. The limited scale of 0 to 5 was selected deliberately to avoid a false impression of being sensitive.

## TEST METHOD A—X-CUT TAPE TEST

## 5. Apparatus and Materials

5.1 *Cutting Tool*—Sharp razor blade, scalpel, knife or other cutting devices. It is of particular importance that the cutting edges be in good condition.

5.2 *Cutting Guide*—Steel or other hard metal straightedge to ensure straight cuts.

5.3 *Tape*—25-mm (1.0-in.) wide semitransparent pressure-sensitive tape with an adhesion strength agreed upon by the supplier and the user is needed. Because of the variability in adhesion strength from batch-to-batch and with time, it is essential that tape from the same batch be used when tests are to be run in different laboratories. If this is not possible the test method should be used only for ranking a series of test coatings.

NOTE 4—Permacel P99 tape, previously identified as suitable for this purpose, was withdrawn from manufacture in July 2009. Current supplies of Permacel 99 on the market at this time have a shelf life that runs out in July 2010. Subcommittee D01.23 is assessing alternative tapes and a new interlaboratory study is planned to take place in 2010. Alternative tapes with specifications similar to that of Permacel P99 tape are available. Users of alternative tapes should check whether the alternative tapes give

comparable results to the Permacel P99 tape. If more information is required about the tapes being evaluated in the D01.23 interlaboratory study, please contact the Committee D01 staff manager.

5.4 *Rubber Eraser*, on the end of a pencil.

5.5 *Illumination*—A light source is helpful in determining whether the cuts have been made through the film to the substrate.

## 6. Test Specimens

6.1 When this test method is used in the field, the specimen is the coated structure or article on which the adhesion is to be evaluated.

6.2 For laboratory use apply the materials to be tested to panels of the composition and surface conditions on which it is desired to determine the adhesion.

NOTE 5—Applicable test panel description and surface preparation methods are given in Practice D609 and Practices D1730 and D2092.

NOTE 6—Coatings should be applied in accordance with Practice D823, or as agreed upon between the purchaser and the seller.

NOTE 7—If desired or specified, the coated test panels may be subjected to a preliminary exposure such as water immersion, salt spray, or high humidity before conducting the tape test. The conditions and time of exposure will be governed by ultimate coating use or shall be agreed upon between the purchaser and seller.

## 7. Procedure

7.1 Select an area free of blemishes and minor surface imperfections. For tests in the field, ensure that the surface is clean and dry. Extremes in temperature or relative humidity may affect the adhesion of the tape or the coating.

7.1.1 For specimens which have been immersed: After immersion, clean and wipe the surface with an appropriate solvent which will not harm the integrity of the coating. Then dry or prepare the surface, or both, as agreed upon between the purchaser and the seller.

7.2 Make two cuts in the film each about 40 mm (1.5 in.) long that intersect near their middle with a smaller angle of between 30 and 45°. When making the incisions, use the straightedge and cut through the coating to the substrate in one steady motion.

7.3 Inspect the incisions for reflection of light from the metal substrate to establish that the coating film has been penetrated. If the substrate has not been reached make another X in a different location. Do not attempt to deepen a previous cut as this may affect adhesion along the incision.

7.4 At each day of testing, before initiation of testing, remove two complete laps of the pressure-sensitive tape from the roll and discard. Remove an additional length at a steady (that is, not jerked) rate and cut a piece about 75 mm (3 in.) long.

7.5 Place the center of the tape at the intersection of the cuts with the tape running in the same direction as the smaller angles. Smooth the tape into place by finger in the area of the incisions and then rub firmly with the eraser on the end of a pencil. The color under the transparent tape is a useful indication of when good contact has been made.

7.6 Within  $90 \pm 30$  s of application, remove the tape by seizing the free end and pulling it off rapidly (not jerked) back upon itself at as close to an angle of 180° as possible.

<sup>1</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036. <http://www.ansi.org>.

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7.7 Inspect the X-cut area for removal of coating from the substrate or previous coating and rate the adhesion in accordance with the following scale:

- 5A No peeling or removal,
- 4A Trace peeling or removal along incisions or at their intersection,
- 3A Jagged removal along incisions up to 1.6 mm (1/16 in.) on either side,
- 2A Jagged removal along most of incisions up to 3.2 mm (1/8 in.) on either side,
- 1A Removal from most of the area of the X under the tape, and
- 0A Removal beyond the area of the X.

7.8 Repeat the test in two other locations on each test panel. For large structures make sufficient tests to ensure that the adhesion evaluation is representative of the whole surface.

7.9 After making several cuts examine the cutting edge and, if necessary, remove any flat spots or wire-edge by abrading lightly on a fine oil stone before using again. Discard cutting tools that develop nicks or other defects that tear the film.

## 8. Report

8.1 Report the number of tests, their mean and range, and for coating systems, where the failure occurred that is, between first coat and substrate, between first and second coat, etc.

8.2 For field tests report the structure or article tested, the location and the environmental conditions at the time of testing.

8.3 For test panels report the substrate employed, the type of coating, the method of cure, and the environmental conditions at the time of testing.

8.4 If the adhesion strength of the tape has been determined in accordance with Test Methods D1000 or D3330/D3330M, report the results with the adhesion rating(s). If the adhesion strength of the tape has not been determined, report the specific tape used and its manufacturer.

8.5 If the test is performed after immersion, report immersion conditions and method of sample preparation.

## 9. Precision and Bias <sup>5</sup>

9.1 In an interlaboratory study of this test method in which operators in six laboratories made one adhesion measurement on three panels each of three coatings covering a wide range of adhesion, the within-laboratories standard deviation was found to be 0.33 and the between-laboratories 0.44. Based on these standard deviations, the following criteria should be used for judging the acceptability of results at the 95 % confidence level:

9.1.1 *Repeatability*—Provided adhesion is uniform over a large surface, results obtained by the same operator should be considered suspect if they differ by more than 1 rating unit for two measurements.

9.1.2 *Reproducibility*—Two results, each the mean of triplicates, obtained by different operators should be considered suspect if they differ by more than 1.5 rating units.

9.2 Bias cannot be established for these test methods.

<sup>5</sup> Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D01-1008.

## TEST METHOD B—CROSS-CUT TAPE TEST

### 10. Apparatus and Materials

10.1 *Cutting Tool* <sup>6</sup>—Sharp razor blade, scalpel, knife or other cutting device having a cutting edge angle between 15 and 30° that will make either a single cut or several cuts at once. It is of particular importance that the cutting edge or edges be in good condition.

10.2 *Cutting Guide*—If cuts are made manually (as opposed to a mechanical apparatus) a steel or other hard metal straight-edge or template to ensure straight cuts.

10.3 *Rule*—Tempered steel rule graduated in 0.5 mm for measuring individual cuts.

10.4 *Tape*, as described in 5.3.

10.5 *Rubber Eraser*, on the end of a pencil.

10.6 *Illumination*, as described in 5.5.

10.7 *Magnifying Glass*—An illuminated magnifier to be used while making individual cuts and examining the test area.

### 11. Test Specimens

11.1 Test specimens shall be as described in Section 6. It should be noted, however, that multitip cutters<sup>7</sup> provide good results only on test areas sufficiently plane that all cutting edges contact the substrate to the same degree. Check for flatness with a straight edge such as that of the tempered steel rule (10.3).

### 12. Procedure

12.1 Where required or when agreed upon, subject the specimens to a preliminary test before conducting the tape test (see Note 5). After drying or testing the coating, conduct the tape test at room temperature as defined in Specification D3924, unless D3924 standard temperature is required or agreed.

12.1.1 For specimens which have been immersed: After immersion, clean and wipe the surface with an appropriate solvent which will not harm the integrity of the coating. Then dry or prepare the surface, or both, as agreed upon between the purchaser and the seller.

12.2 Select an area free of blemishes and minor surface imperfections, place on a firm base, and under the illuminated magnifier, make parallel cuts as follows:

12.2.1 For coatings having a dry film thickness up to and including 2.0 mils (50 µm) space the cuts 1 mm apart and make eleven cuts unless otherwise agreed upon.

<sup>6</sup> Multiblade cutters are available from a few sources that specialize in testing equipment for the paint industry.

<sup>7</sup> The sole source of supply of the multitip cutter for coated pipe surfaces known to the committee at this time is Paul N. Gardner Co., 316 NE First St., Pompano Beach, FL 33060. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,<sup>1</sup> which you may attend.

12.2.2 For coatings having a dry film thickness between 2.0 mils (50  $\mu\text{m}$ ) and 5 mils (125  $\mu\text{m}$ ), space the cuts 2 mm apart and make six cuts. For films thicker than 5 mils (125  $\mu\text{m}$ ), use Test Method A.<sup>8</sup>

12.2.3 Make all cuts about 20 mm (3/4 in.) long. Cut through the film to the substrate in one steady motion using just sufficient pressure on the cutting tool to have the cutting edge reach the substrate. When making successive single cuts with the aid of a guide, place the guide on the uncut area.

12.3 After making the required cuts brush the film lightly with a soft brush or tissue to remove any detached flakes or ribbons of coatings.

12.4 Examine the cutting edge and, if necessary, remove any flat spots or wire-edge by abrading lightly on a fine oil stone. Make the additional number of cuts at 90° to and centered on the original cuts.

12.5 Brush the area as before and inspect the incisions for reflection of light from the substrate. If the metal has not been reached make another grid in a different location.

12.6 At each day of testing, before initiation of testing, remove two complete laps of tape and discard. Remove an additional length at a steady (that is, not jerked) rate and cut a piece about 75 mm (3 in.) long.

12.7 Place the center of the tape over the grid and in the area of the grid smooth into place by a finger. To ensure good contact with the film rub the tape firmly with the eraser on the end of a pencil. The color under the tape is a useful indication of when good contact has been made.

12.8 Within  $90 \pm 30$  s of application, remove the tape by seizing the free end and rapidly (not jerked) back upon itself at as close to an angle of 180° as possible.

12.9 Inspect the grid area for removal of coating from the substrate or from a previous coating using the illuminated magnifier. Rate the adhesion in accordance with the following scale illustrated in Fig. 1:

- 5B The edges of the cuts are completely smooth; none of the squares of the lattice is detached.
- 4B Small flakes of the coating are detached at intersections; less than 5 % of the area is affected.
- 3B Small flakes of the coating are detached along edges and at intersections of cuts. The area affected is 5 to 15 % of the lattice.
- 2B The coating has flaked along the edges and on parts of the squares. The area affected is 15 to 35 % of the lattice.
- 1B The coating has flaked along the edges of cuts in large ribbons and whole squares have detached. The area affected is 35 to 65 % of the lattice.
- 0B Flaking and detachment worse than Grade 1.

12.10 Repeat the test in two other locations on each test panel.

### 13. Report

13.1 Report the number of tests, their mean and range, and for coating systems, where the failure occurred, that is, between first coat and substrate, between first and second coat, etc.

<sup>8</sup> Test Method B has been used successfully by some people on coatings greater than 5 mils (0.13 mm) by spacing the cuts 5 mm apart. However, the precision values given in 1-4.1 do not apply as they are based on coatings less than 5 mils (0.13 mm) in thickness.

| CLASSIFICATION OF ADHESION TEST RESULTS |                      |                                                                                                               |
|-----------------------------------------|----------------------|---------------------------------------------------------------------------------------------------------------|
| CLASSIFICATION                          | PERCENT AREA REMOVED | SURFACE OF CROSS-CUT AREA FROM WHICH FLAKING HAS OCCURRED FOR SIX PARALLEL CUTS AND ADHESION RANGE BY PERCENT |
| 5B                                      | 0%<br>None           |                                                                                                               |
| 4B                                      | Less than 5%         |                                                                                                               |
| 3B                                      | 5 - 15%              |                                                                                                               |
| 2B                                      | 15 - 35%             |                                                                                                               |
| 1B                                      | 35 - 65%             |                                                                                                               |
| 0B                                      | Greater than 65%     |                                                                                                               |

FIG. 1 Classification of Adhesion Test Results

13.2 Report the substrate employed, the type of coating and the method of cure.

13.3 If the adhesion strength has been determined in accordance with Test Methods D1000 or D3330/D3330M, report the results with the adhesion rating(s). If the adhesion strength of the tape has not been determined, report the specific tape used and its manufacturer.

13.4 If the test is performed after immersion, report immersion conditions and method of sample preparation.

### 14. Precision and Bias<sup>5</sup>

14.1 On the basis of two interlaboratory tests of this test method in one of which operators in six laboratories made one adhesion measurement on three panels each of three coatings covering a wide range of adhesion and in the other operators in six laboratories made three measurements on two panels each of four different coatings applied over two other coatings, the pooled standard deviations for within- and between-laboratories were found to be 0.37 and 0.7. Based on these standard deviations, the following criteria should be used for judging the acceptability of results at the 95 % confidence level:

14.1.1 *Repeatability*—Provided adhesion is uniform over a large surface, results obtained by the same operator should be

considered suspect if they differ by more than one rating unit for two measurements.

14.1.2 *Reproducibility*—Two results, each the mean of duplicates or triplicates, obtained by different operators should be considered suspect if they differ by more than two rating units.

14.2 Bias cannot be established for these test methods.

## 15. Keywords

15.1 adhesion; crosscut adhesion test method; tape; tape adhesion test method; X-cut adhesion test method

## APPENDIX

### (Nonmandatory Information)

## X1. COMMENTARY

### X1.1 Introduction

X1.1.1 Given the complexities of the adhesion process, can adhesion be measured? As Mittal (1)<sup>9</sup> has pointed out, the answer is both yes and no. It is reasonable to state that at the present time no test exists that can precisely assess the actual physical strength of an adhesive bond. But it can also be said that it is possible to obtain an indication of relative adhesion performance.

X1.1.2 Practical adhesion test methods are generally of two types: “*implied*” and “*direct*.” “*Implied*” tests include indentation or scribe techniques, rub testing, and wear testing. Criticism of these tests arises when they are used to quantify the strength of adhesive bonding. But this, in fact, is not their purpose. An “*implied*” test should be used to assess coating performance under actual service conditions. “*Direct*” measurements, on the other hand, are intended expressly to measure adhesion. Meaningful tests of this type are highly sought after, primarily because the results are expressed by a single discrete quantity, the force required to rupture the coating/substrate bond under prescribed conditions. Direct tests include the Hesiometer and the Adherometer (2). Common methods which approach the direct tests are peel, lap-shear, and tensile tests.

### X1.2 Test Methods

X1.2.1 In practice, numerous types of tests have been used to attempt to evaluate adhesion by inducing bond rupture by different modes. Criteria deemed essential for a test to warrant large-scale acceptance are: use of a straightforward and unambiguous procedure; relevance to its intended application; repeatability and reproducibility; and quantifiability, including a meaningful rating scale for assessing performance.

X1.2.2 Test methods used for coatings on metals are: peel adhesion or “tape testing;” Gardner impact flexibility testing; and adhesive joint testing including shear (lap joint) and direct tensile (butt joint) testing. These tests do not strictly meet all the criteria listed, but an appealing aspect of these tests is that in most cases the equipment/instrumentation is readily available or can be obtained at reasonable cost.

X1.2.3 A wide diversity of tests methods have been developed over the years that measure aspects of adhesion (1-5).

There generally is difficulty, however, in relating these tests to basic adhesion phenomena.

### X1.3 The Tape Test

X1.3.1 By far the most prevalent test for evaluating coating “adhesion” is the tape-and-peel test, which has been used since the 1930’s. In its simplest version a piece of adhesive tape is pressed against the paint film and the resistance to and degree of film removal observed when the tape is pulled off. Since an intact film with appreciable adhesion is frequently not removed at all, the severity of the test is usually enhanced by cutting into the film a figure X or a cross hatched pattern, before applying and removing the tape. Adhesion is then rated by comparing film removed against an established rating scale. If an intact film is peeled cleanly by the tape, or if it debonds just by cutting into it without applying tape, then the adhesion is rated simply as poor or very poor, a more precise evaluation of such films not being within the capability of this test.

X1.3.2 The current widely-used version was first published in 1974; two test methods are covered in this standard. Both test methods are used to establish whether the adhesion of a coating to a substrate is at an adequate level; however they do not distinguish between higher levels of adhesion for which more sophisticated methods of measurement are required. Major limitations of the tape test are its low sensitivity, applicability only to coatings of relatively low bond strengths, and non-determination of adhesion to the substrate where failure occurs within a single coat, as when testing primers alone, or within or between coats in multicoat systems. For multicoat systems where adhesion failure may occur between or within coats, the adhesion of the coating system to the substrate is not determined.

X1.3.3 Repeatability within one rating unit is generally observed for coatings on metals for both methods, with reproducibility of one to two units. The tape test enjoys widespread popularity and is viewed as “simple” as well as low in cost. Applied to metals, it is economical to perform, lends itself to job site application, and most importantly, after decades of use, people feel comfortable with it.

X1.3.4 When a flexible adhesive tape is applied to a coated rigid substrate surface and then removed, the removal process has been described in terms of the “peel phenomenon,” as illustrated in Fig. X1.1.

X1.3.5 Peeling begins at the “toothed” leading edge (at the right) and proceeds along the coating adhesive/interface or the

<sup>9</sup> The boldface numbers in parentheses refer to the list of references at the end of this test method.

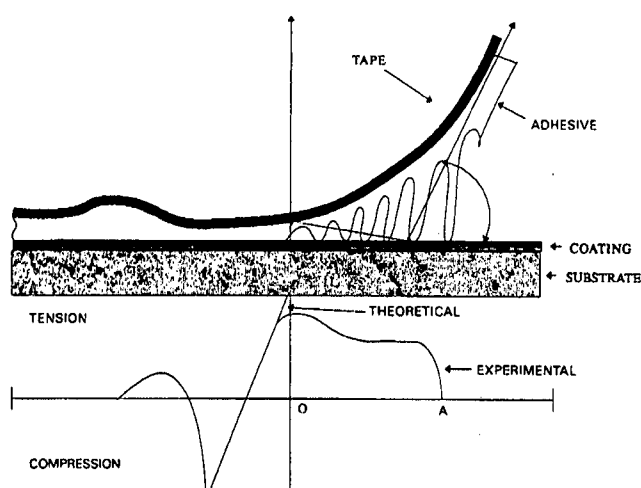


FIG. X1.1 Peel Profile (6)

coating/substrate interface, depending on the relative bond strengths. It is assumed that coating removal occurs when the tensile force generated along the latter interface, which is a function of the rheological properties of the backing and adhesive layer materials, is greater than the bond strength at the coating-substrate interface (or cohesive strength of the coating). In actuality, however, this force is distributed over a discrete distance (O-A) in Fig. X1.1, which relates directly to the properties described, not concentrated at a point (O) in Fig. X1.1 as in the theoretical case—though the tensile force is greatest at the origin for both. A significant compressive force arises from the response of the tape backing material to being stretched. Thus both tensile and compressive forces are involved in adhesion tape testing.

X1.3.6 Close scrutiny of the tape test with respect to the nature of the tape employed and certain aspects of the procedure itself reveal several factors, each or any combination of which can dramatically affect the results of the test as discussed (6).

#### X1.4 Peel Adhesion Testing on Plastic Substrates

X1.4.1 Tape tests have been criticized when used for substrates other than metal, such as plastics. The central issues are that the test on plastics lacks reproducibility and does not relate to the intended application. Both concerns are well founded: poor precision is a direct result of several factors intrinsic to the materials employed and the procedure itself. More importantly, in this instance the test is being applied beyond its intended scope. These test methods were designed for relatively ductile coatings applied to metal substrates, not for coatings (often brittle) applied to plastic parts (7). The unique functional requirements of coatings on plastic substrates cause the usual tape tests to be unsatisfactory for measuring adhesion performance in practice.

#### X1.5 The Tape Controversy

X1.5.1 With the withdrawal from commerce of the tape specified originally, 3M No. 710, current test methods no longer identify a specific tape. Differences in tapes used can

lead to different results as small changes in backing stiffness and adhesive rheology cause large changes in the tension area. Some commercial tapes are manufactured to meet minimum standards. A given lot may surpass these standards and thus be suitable for general market distribution; however, such a lot may be a source of serious and unexpected error in assessing adhesion. One commercially available tape test kit had included a tape with adhesion strength variations of up to 50 % claimed by the manufacturer. Also, because tapes change on storage, bond strengths of the tape may change over time (7, 8).

X1.5.2 While there are tapes available that appear to deliver consistent performance, a given tape does not adhere equally well to all coatings. For example, when the peel removal force of the tape (from the coating) used earlier by Task Group D01.23.10 to establish precision of the method, by 3M No. 710 was examined with seven different electromagnetic interference/radio frequency interference (EMI/RFI) coatings, it was found that, while peel was indeed consistent for a given coating, the value varied by 25 % between the highest and lowest ratings among coatings. Several factors that contribute to these differences include coating composition and topology: as a result, no single tape is likely to be suitable for testing all coatings. Further, the tape test does not give an absolute value for the force required for bond rupture, but serves only as an indicator that some minimum value for bond strength was met or exceeded (7, 8).

#### X1.6 Procedural Problems

X1.6.1 The tape test is operator intensive. By design it was made as simple as possible to perform, and requires a minimum of specialized equipment and materials that must meet certain specifications. The accuracy and precision depend largely upon the skill of the operator and the operator's ability to perform the test in a consistent manner. Key steps that directly reflect the importance of operator skill include the angle and rate of tape removal and the visual assessment of the tested sample. It is not unexpected that different operators might obtain different results (7, 8).

##### X1.6.2 Peel Angle and Rate:

The standard requires that the free end of the tape be removed rapidly at as close to a 180° angle as possible. If the peel angle and rate vary, the force required to remove the tape can change dramatically. Nearly linear increases were observed in peel force approaching 100 % as peel angle was changed from 135 to 180, and similar large differences can be expected in peel force as peel rate varies. These effects are related as they reflect certain rheological properties of the backing and adhesive that are molecular in origin. Variation in pull rate and peel angle can effect large differences in test values and must be minimized to assure reproducibility (9).

##### X1.6.3 Visual Assessment:

The final step in the test is visual assessment of the coating removed from the specimen, which is subjective in nature, so that the coatings can vary among individuals evaluating the same specimen (9).

X1.6.3.1 Performance in the tape test is based on the amount of coating removed compared to a descriptive scale. The exposure of the substrate can be due to factors other than coating adhesion, including that arising from the requirement

that the coating be cut (hence the synonym "cross-hatch adhesion test"). Justification for the cutting step is reasonable as cutting provides a free edge from which peeling can begin without having to overcome the cohesive strength of the coating layer.

X1.6.3.2 Cutting might be suitable for coatings applied to metal substrates, but for coatings applied to plastics or wood, the process can lead to a misleading indication of poor adhesion due to the unique interfacial zone. For coatings on soft substrates, issues include how deep should this cut penetrate, and is it possible to cut only to the interface?

X1.6.3.3 In general, if adhesion test panels are examined microscopically, it is often clearly evident that the coating removal results from substrate failure at or below the interface, and not from the adhesive failure between the coating and the substrate. Cohesive failure within the coating film is also frequently observed. However, with the tape test, failures within the substrate or coating layers are rare because the tape adhesive is not usually strong enough to exceed the cohesive strengths of normal substrates and organic coatings. Although some rather brittle coatings may exhibit cohesive failure, the tape test adhesion method does not make provision for giving failure locality (7, 8).

X1.6.4 Use of the test method in the field can lead to variation in test results due to temperature and humidity changes and their effect upon tape, coating and substrate.

X1.6.5 Test Method B has been used successfully, without affecting adhesion test results, by some coil coating users on coatings up to and including 2.0 mils (50  $\mu\text{m}$ ) by spacing the cuts 2 mm apart. While this may be an agreement between purchaser and seller, the precision values given in 14.1 do not apply, as they are based on cuts 1 mm apart.

X1.6.6 Some have found that the use of a suitable mechanical device is helpful in minimizing some of the variables in placing the tape onto the coatings (see 7.5 and 12.7) and removing the tape from the coatings (see 7.6 and 12.8) which maintains consistent pressure on the tape during application and ensures a 180° pull off.<sup>10</sup>

## X1.7 Conclusion

X1.7.1 All the issues aside, if these test methods are used within the Scope Section and are performed carefully, some insight into the approximate, relative level of adhesion can be gained.

<sup>10</sup> The sole source of supply of a suitable mechanical device for laying down and removal of tape known to the committee at this time is ReliaPull, a registered trademark of Random Logic LLC, manufactured by Random Logic LLC, Cincinnati, OH 45245. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,<sup>1</sup> which you may attend.

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## SUMMARY OF CHANGES

Committee D01 has identified the location of selected changes to this standard since the last issue (D3359 - 08) that may impact the use of this standard. (Approved June 1, 2009.)

(1) X1.6.6 was added to Appendix X1.

(2) Footnote 11 was added to identify a source of equipment.

Committee D01 has identified the location of selected changes to this standard since the last issue (D3359 - 07) that may impact the use of this standard. (Approved February 1, 2008.)

(1) X1.6.5 was added to Appendix X1.

 D3359 – 09<sup>e2</sup>

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