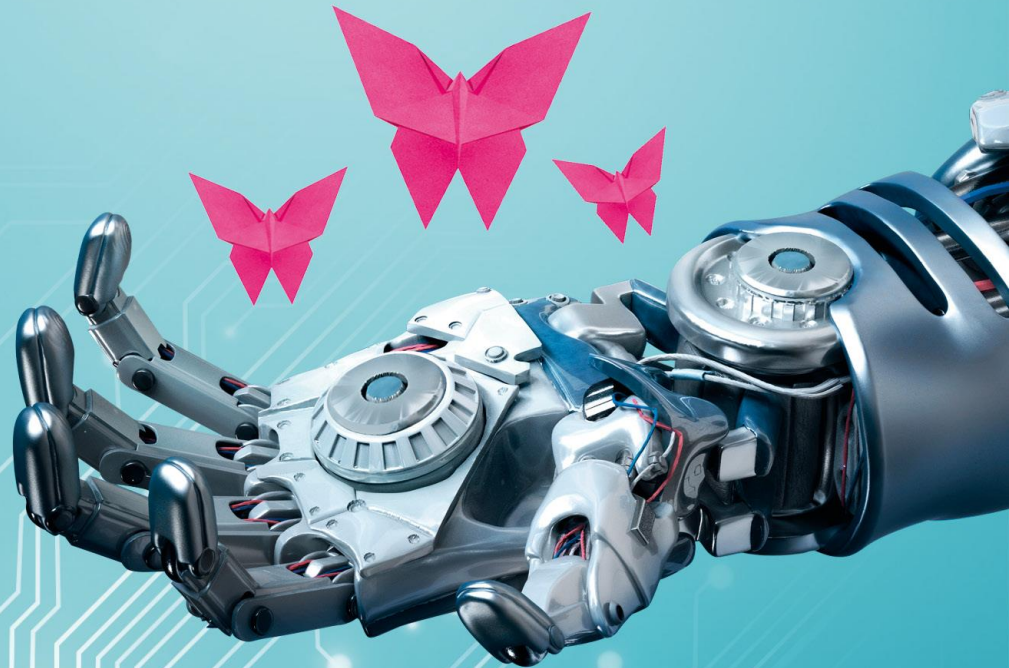


UL 746 + IPC 4101E „Was ist NEU?“



**SPITZENLAMINATE UND PREPREGS –
AUF JEDE ANFORDERUNG ZUGESCHNITTEN**

Technology and Service belong together but

It's service that makes the difference! reliable, available, responsible and competent

TECHNOLAM leads the way....

Founded 1994 general distributor of Nan Ya

Employees 30

Production capacity:

Thin multilayer laminate + Rigid 7.000.000 m²/year

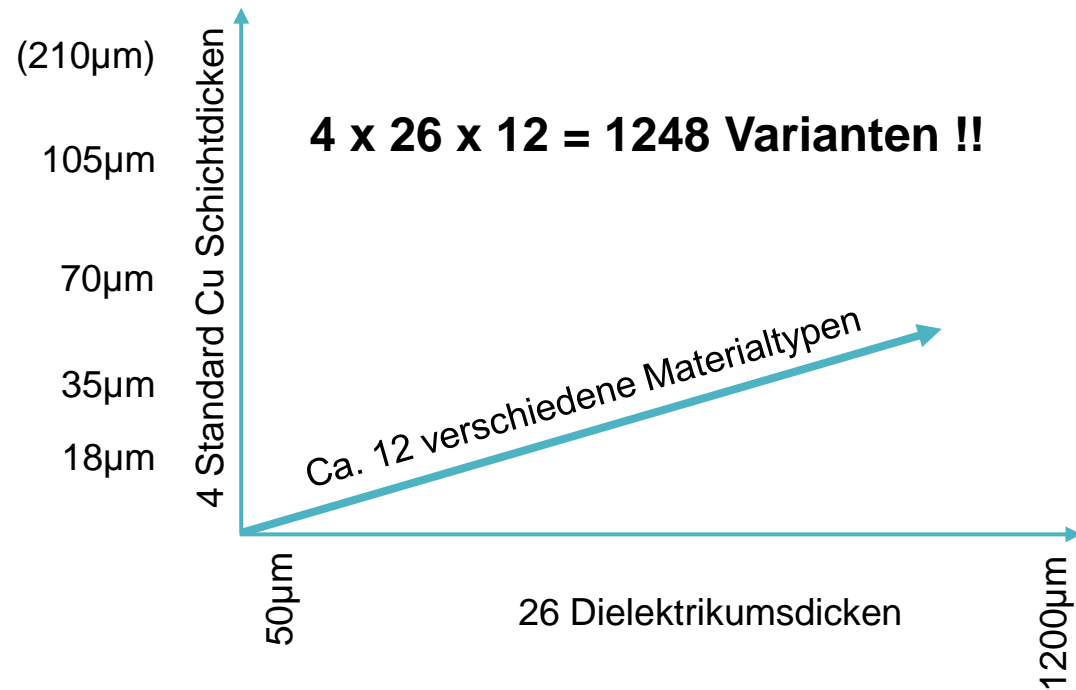
Prepreg 14.000.000 m²/year

20 high-bay warehouse racks for 600.000 m²

2 prepreg cold store buildings for 400.000 m²

to FUTURE





**Mehr als 900 Artikel sind am Lager
und kurzfristig verfügbar!**



- + Harzsysteme
- + Thermische Alterung
- + Brandverhalten



- + Produktüberwachung
- + Feuchteeinfluss
- + Mechanische Kennwerte

UL 746E

STANDARD FOR SAFETY

Polymeric Materials – Industrial Laminates,
Filament Wound Tubing, Vulcanized Fibre, and
Materials Used In Printed-Wiring Boards

UL/ANSI type	Resin	Reinforcement material
FR-4.0 ^a FR-4.1 ^{a, b} FR-5	Brominated Epoxy Non-Halogenated Epoxy Epoxy	Continuous filament woven glass fabric Continuous filament woven glass fabric Continuous filament woven glass fabric
NEU! FR-15.0 FR-15.1	Brominated Epoxy Non-Haogenated Epoxy	Continuous filament woven glass fabric MOT150 Continuous filament woven glass fabric MOT150
CEM-1	Epoxy	Continuous filament woven glass fabric surfaces, cellulose paper core
CEM-3	Epoxy	Continuous filament woven glass fabric surfaces, nonwoven glass core

UL 746E

UL Recognition for Industrial Laminates

Relevant standards for Polymeric Materials of the **UL 746** series:

- *UL 746A* Short Term Property Evaluations
Wide range of individual tests, e.g. Flammability, IR
- *UL 746B* Long Term Property Evaluations
Thermal aging at four elevated temperatures
Minimum duration of time: 5.000 hours
- *UL 746E* Industrial Laminates, Filament Wound Tubing, Vulcanized Fibre, and Materials Used in Printed-Wiring Boards
Bond strength delamination and blistering test, MCIL

UL 746E

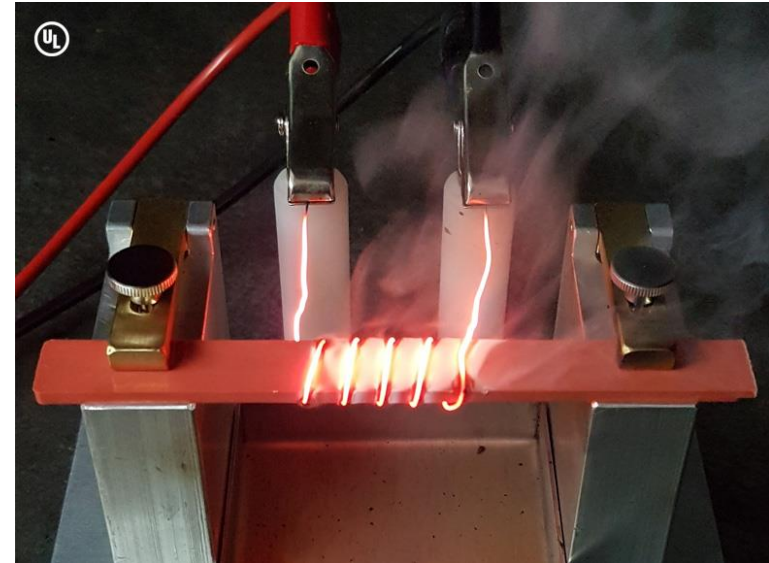
Standard for Polymeric Materials - Short Term Property Evaluations

Elektrische Zündquelle HWI (Hot Wire Ignition)

Vorbehandlung:

> 48h / 23°C / 50 % rel. Luftfeuchte

Ignition range (s)	PLC-Klasse
> 120	0
> 60 to ≤ 120	1
> 30 to ≤ 60	2
> 15 to ≤ 30	3
> 7 to ≤ 15	4
0 to ≤ 7	5



- mit diesem Prüfverfahren werden Entzündungszeiten elektrischer Isoliermaterialien ermittelt
- es wird hierbei die Zeit ermittelt, die benötigt wird, um eine Probe zu entzünden, die mit einem Draht umwickelt ist
- anhand der Entzündungszeit wird das Material in PLC-Klassen eingeteilt
- FR-4.0 und FR-4.1 müssen PLC 0 erreichen – über 300 s

<https://www.ulffc.com/de/leistungen/pruefverfahren/brand/elektrische-zuendquelle/hwi.html>

UL 746E

- Voraussetzung für eine UL Listung unter „Metal clad industrial laminats“
 - für das Basislaminat muss einen RTI (rel. Temperaturindex) zugrunde liegen
 - Alterungsbeständigkeit von Kunststoffen

- der Multilayeraufbau für den MOT

Test sollte die dünnsten und dicksten Prepregs sowie die größte Cu – Stärke in den Innenlagen beinhalten

- Vorbehandlung der Proben:

- 1,5 h Trocknung im Ofen bei 121°C
- ≥ 4 h Abkühlung im Exsikkator
- Bestimmung der Cu Haftfestigkeit > 0,525 N/mm
- Lötsimulation (z.B. Tauchlöten bei 20s / 288°C oder IR Löten)

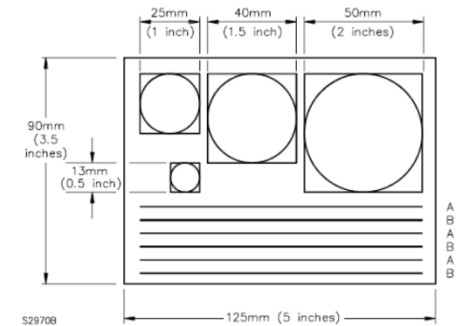
- MOT Test - Lagerung im Ofen

die Ofentemperatur ergibt sich aus folgenden Formeln:

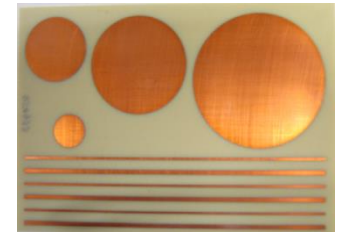
t_1 = angestrebtes MOT rating

$t_2 = 1,076 \quad (t_1+288)-273$ für 10 Tage oder

$t_3 = 1,02 \quad (t_1+288)-273$ für 56 Tage



UL 746E Layout



9/70 µm Copper-foil

1 x 1080 Prepreg

1 x 7628 Prepreg

18 µm Copper-foil

1 x 106 Prepreg

105 µm Copper-foil

2 x 2116 Prepreg

9/70 µm Copper-foil

Innerlayer

typischer Lagenaufbau

UL 746E

- FR4 wurde bis vor Kurzem nur bis max. MOT 130°C von UL gelistet!
- MOT 130°C erfordert:
 - 10-tägige Lagerung bei 177°C bzw.
 - 56-tägige Lagerung bei 154°C
- Cu Abzugfestigkeit $\geq 0,175$ N/mm (nach 56 Tagen) 0,35 N/mm (nach 10 Tagen)
- Ausfallkriterien
keine Knitter, Risse, Blasenbildung, Auflockerung des Layouts, Delaminationen
- MOT 150°C Materialien werden als FR4-15 gelistet.
 - 10-tägige Lagerung bei 199°C bzw.
 - 56-tägige Lagerung bei 174°C.
- MOT kann nicht höher sein als der niedrigste RTI eines bestimmten Aufbaus

 UL 746E

Einführung von FR-4.1 (Non-Halogen FR-4) durch UL
Übernahme in die IPC-4101 Rev. D

FR-4 History and UL746E Standard Revision

Summary of IPC UL 746E Proposal for STP Ballot: Two New UL/ANSI Types Replacing FR-4

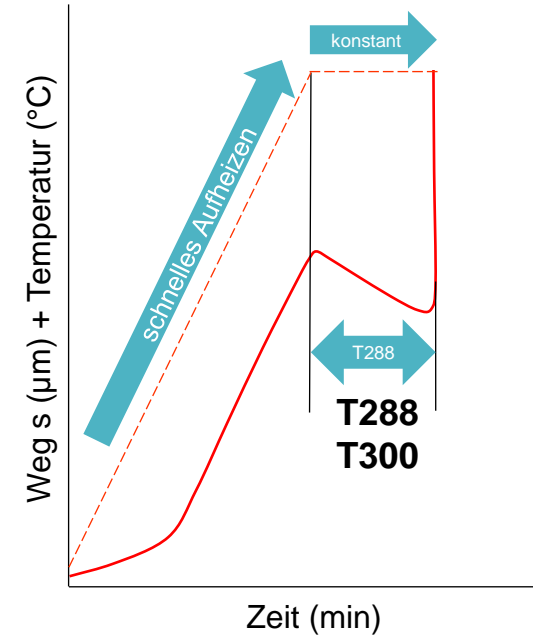
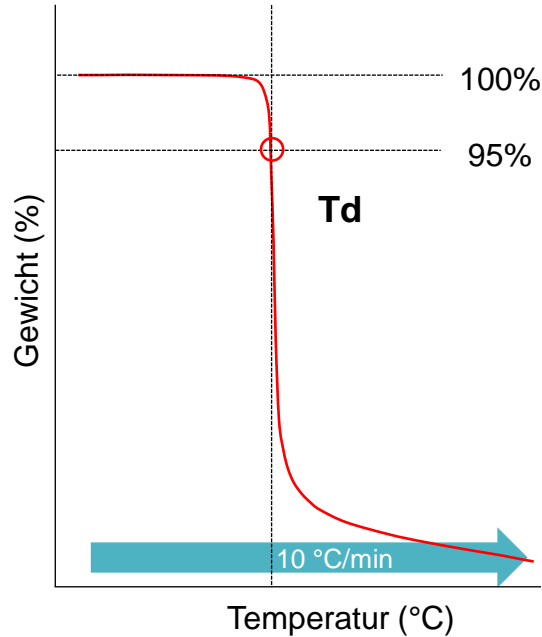
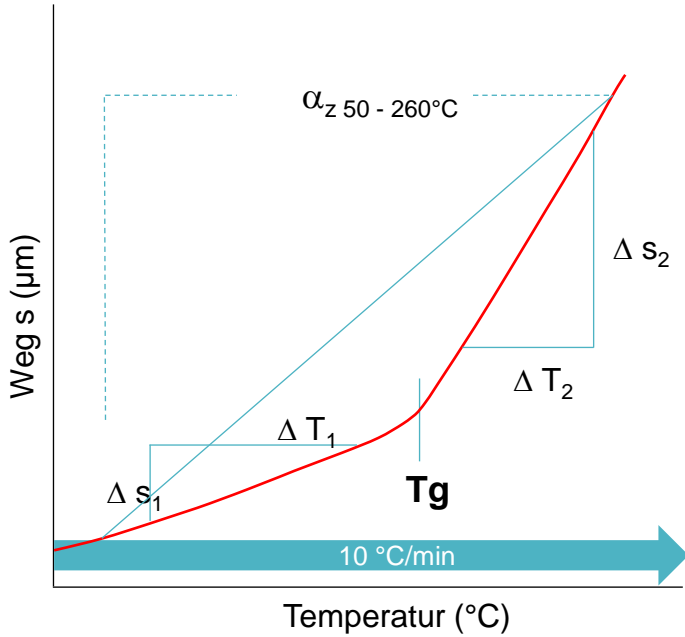
UL/ANSI Type	Primary Resin	Secondary Resin(s)	Filler ¹	Flame Retardant	Reinforcement
FR-4.0 (Proposed Brominated FR-4)	Epoxy ²	Any	Inorganic Max 45%	Bromine	Woven Glass
FR-4.1 (Proposed Non-Halogen FR-4)	Epoxy ²	Any	Inorganic Max 45%	Non-Halogen	Woven Glass

¹ Examples of inorganic fillers include, but are not limited to: Silica, Clay, Talc, Ceramic, Calcium Carbonate, Aluminum Hydroxide, Fumed Silica and Titanium Oxide.

² Epoxy functionality, minimum 50% by weight of organic resin.

FR-4.0 / FR-4.1 max.
45% Füllstoff

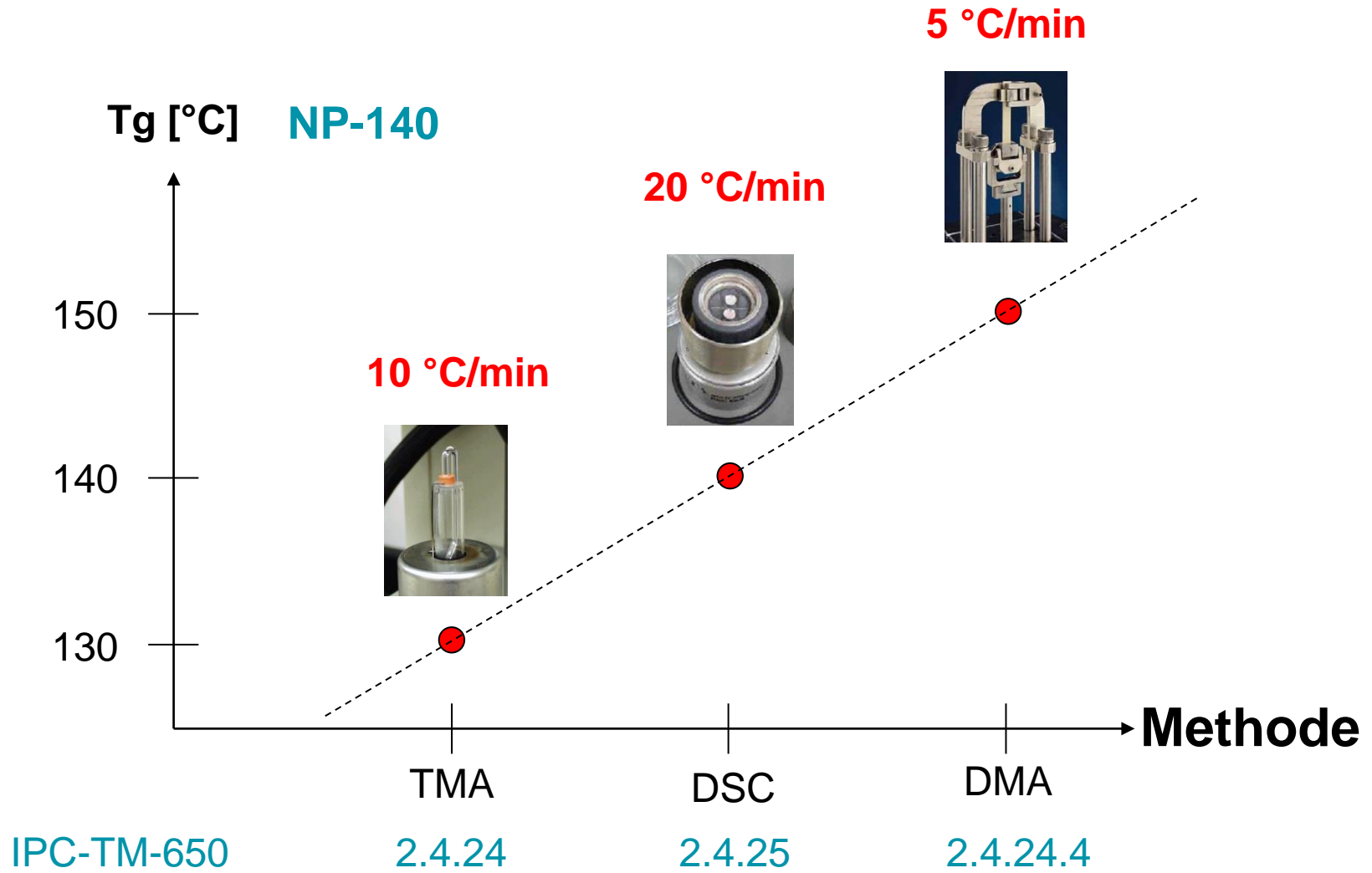
Source: UL JPCA 2013





	Tg (DSC)	Td (TGA)	T288 (TMA)	T300 (TMA)
NP-155F	150°C	350°C	>20'	>3'
NP-175FBH	170°C	352°C	>30'	>10'
NPG-180BH	190°C	370°C	>30'	>40'

(14.) Glasübergangstemperatur

14. Glass Transition Temperature, minimum	-	170	°C	2.4.24 2.4.24.4 2.4.25	3.10.1.6
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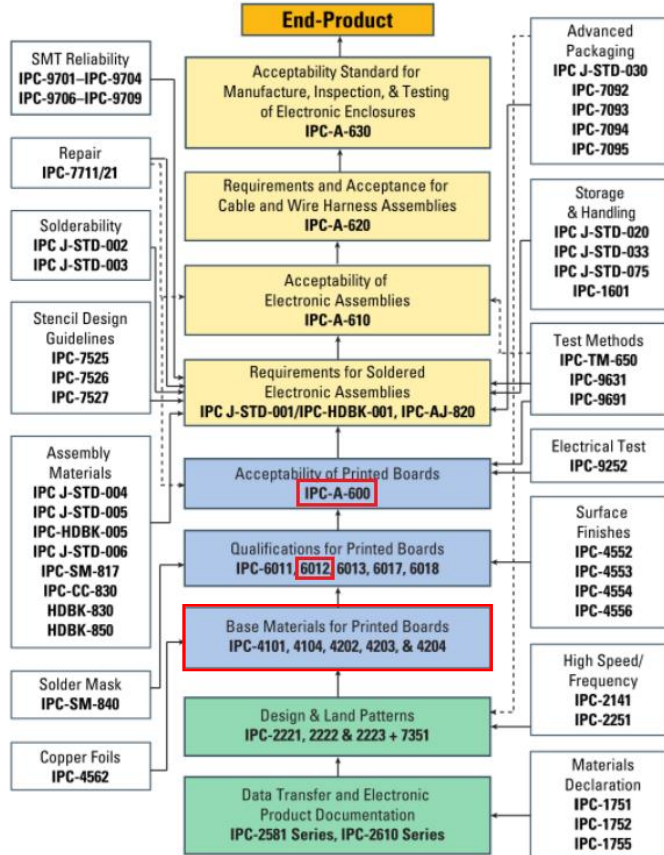


FR-4.0/FR-4.1		
Primäres Harzsystem	Epoxy, mindestens 50% Gewichtsanteil der Organik	Epoxy, 95 %
Sekundäres Harzsystem	beliebig	5 % modifiziertes oder Nicht-Epoxy
Füllstoffe	anorganisch, maximal 45 %	je nach Typ, Grenzwert UL
FR-4.0 bromiert	✓	✓
FR-4.1 halogenfrei	✓	✓

Association Connecting Electronics Industries



IPC STANDARDS — EVERYTHING YOU NEED FROM START TO FINISH



Learn about IPC standards at www.ipc.org/standards

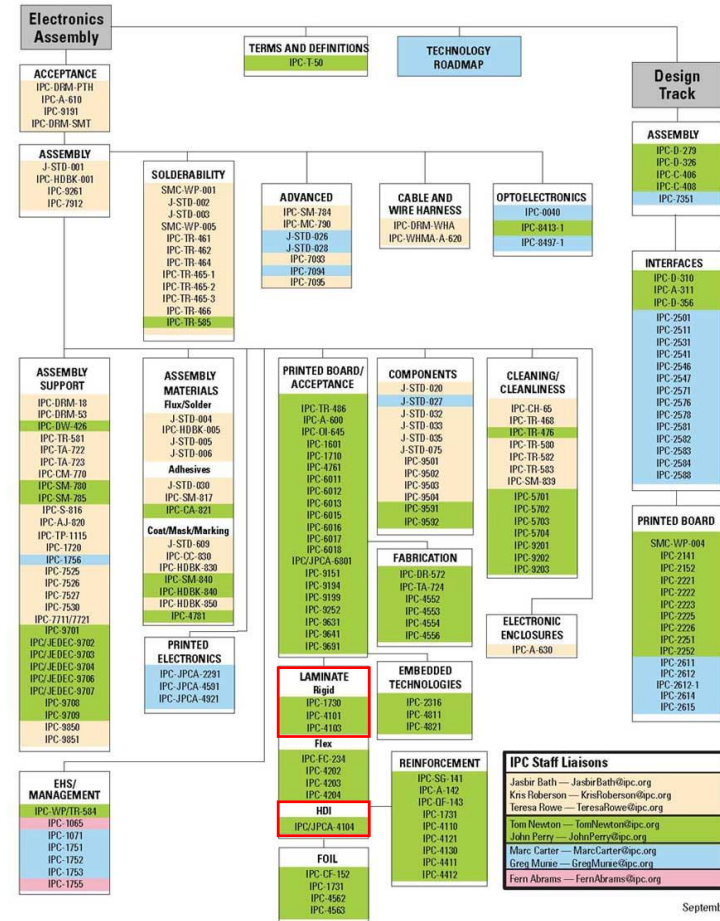
DECEMBER 2014

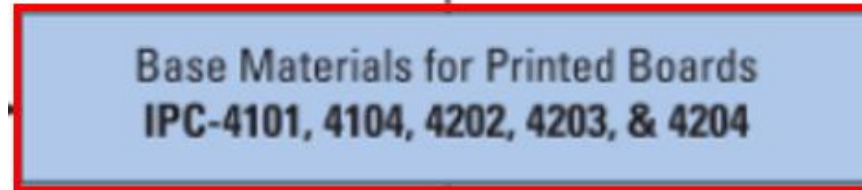
Association Connecting Electronics Industries



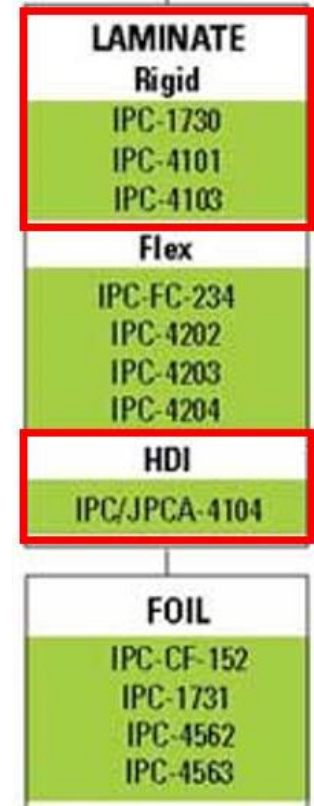
IPC Standards Tree

[For questions about IPC standards, please email: answers@ipc.org]





- **IPC-4101 E** **Specification for Base Materials for Rigid and Multilayer Printed Boards**
- IPC-4103 B Specification for Base Materials for High Speed/ High Frequency Applications
- IPC-4104 Specification for High Density Interconnect (HDI) and Microvia Materials
- **IPC-4562 A** **Metal Foil for Printed Board Applications**
- IPC-4563 Resin Coated Copper Foil for Printed Boards Guideline



Erster Abschnitt

IPC-4101E 2017 - March Specification for Base Materials for Rigid and Multilayer Printed Boards

Klassifizierung

Supersedes IPC-4101D-WAM1
July 2015

An international standard developed by IPC

Zweiter Abschnitt

Laminateigenschaften

Dritter Abschnitt

Prepregeigenschaften

Association Connecting Electronics Industries



IPC-4101E March 2017

Revision Date: March 2017

SPECIFICATION SHEET

SPECIFICATION SHEET #:	IPC-4101E	IPC-4101E
REINFORCEMENT:	1: Woven E-glass	2: NONE
RESIN SYSTEM:	Primary: D	Secondary 1: NONE
FLAME RETARDANT MECHANISM:	RoHS Compliant Bromine	Secondary 2: NONE
FILLERS:	<5%	Minimum UL94 Requirement: V-0
ID REFERENCE:	UL/ANSI: FR-4.0/21	ML-S-13948 /04
GLASS TRANSITION (T _g):	110 °C minimum	- GF, GFN, GFK, GFF, GFM

IPC-4101/21
1: Woven E-glass
Primary: Difunctional ep
Secondary 1: Multifunct
RoHS Compliant Bromine
<5%
UL/ANSI: FR-4.0/21
110 °C minimum

LAMINATE REQUIREMENTS

Laminate Requirement	Specification <0.50 mm [0.0197 in]	Specification >0.50 mm [0.0197 in]	Units	Test Method	Ref. Para.
1. Peel Strength, minimum A. Low profile copper foil and very low profile copper foil – all copper foil >17 µm [0.669 mil]. B. Standard profile copper foil 1. After thermal stress 2. At 125 °C [257 °F] 3. After process solutions C. All other foil – composite	0.70 [4.00] 0.80 [4.57] 0.70 [4.00] 0.55 [3.14] AABUS	0.70 [4.00] 1.05 [18.00] 0.70 [4.00] 0.80 [4.57] AABUS	N/mm [lb/in]	2.4.8 2.4.8.2 2.4.8.3	3.9.1.1 3.9.1.1.1 3.9.1.1.2 3.9.1.1.3
2. Volume Resistivity, minimum A. 96/35/90 B. After moisture resistance C. At elevated temperature E-24/125	10 ⁹ – 10 ⁹	– 10 ⁹ 10 ⁹	MΩ-cm	2.5.17.1	3.11.1.3
3. Surface Resistivity, minimum A. 96/35/90 B. After moisture resistance C. At elevated temperature E-24/125	10 ⁴ – 10 ⁹	– 10 ⁴ 10 ⁹	MΩ	2.5.17.1	3.11.1.4
4. Moisture Absorption, maximum	–	0.80	%	2.6.2.1	3.12.1.1
5. Dielectric Breakdown, minimum	–	40	kV	2.5.6	3.11.1.6
6. Permittivity at 1 MHz, maximum (Laminate & laminated prepreg)*	5.4	5.4	–	2.5.5.2 2.5.5.3 2.5.5.9	3.11.1.1 3.11.1.1 3.11.2.1
7. Loss Tangent at 1 MHz, maximum (Laminate & laminated prepreg)*	0.035	0.035	–	2.5.5.2 2.5.5.3 2.5.5.9	3.11.1.2 3.11.2.2
8. Flexural Strength, minimum A. Length direction B. Cross direction	–	415 [60,190] 345 [50,040]	N/mm ² [lb/in ²]	2.4.4	3.9.1.3
9. Flexural Strength at Elevated Temperature, length direction, minimum	–	–	N/mm ² [lb/in ²]	2.4.4.1	3.9.1.4
10. Arc Resistance, minimum	60	60	s	2.5.1	3.11.1.5
11. Thermal Stress 10 s at 288 °C [550.4 °F], minimum A. Unetched B. Etched	Pass Visual Pass Visual	Pass Visual Pass Visual	rating	2.4.13.1	3.10.1.2
12. Electric Strength, minimum (Laminate & laminated prepreg)	30	–	kV/mm	2.5.6.2	3.11.1.7 3.11.2.3
13. Flammability, minimum (Laminate & laminated prepreg)	V-0	V-0	rating	UL94	3.10.2.1 3.10.1.1
14. Glass Transition Temperature, minimum	–	110	°C	2.4.24 2.4.25	3.10.1.6
15. Other	–	–	–	–	–

*See Slash Sheet 2 in IPC-4121.

March 2017

IPC-4101E

PREPREG REQUIREMENTS

Prepreg Requirement	Specification	Units	Test Method	Ref. Para.
1. Shelf Life, minimum (Condition 1/Condition 2)	180/90	Days	AABUS	3.17
2. Reinforcement	As per IPC-4412 or AABUS.			
3. Volatile content maximum	0.75	%	2.3.19	3.9.2.2.8
4. Prepreg Parameters	–	AABUS	AABUS	1.1.7
5. Flammability, minimum (as laminated)	V-0	rating	UL94	3.10.2.1
6. Other	–	–	–	–

IPC-Spezifikationsblatt

TECHNOLAM-Datenblatt

Performance List / Leistungsspektrum 1/2

IPC-4101E

March 2017

Revision Date: March 2017

SPECIFICATION SHEET					
Specification Sheet #:	IPC-4101/21				
REINFORCEMENT:	1: Woven E-glass	2: NONE			
RESIN SYSTEM:	Primary: Difunctional epoxy	Secondary 1: Multifunctional epoxy	Secondary 2: NONE		
FLAME RETARDANT MECHANISM:	RoHS Compliant Bromine	Minimum UL94 Requirement: V-0			
FILLERS:	<5%				
ID REFERENCE:	UL/ANSI: FR-4.0/21	MIL-S-13949: /04			
GLASS TRANSITION (T _g):	110 °C minimum	- GF, GFN, GFK, GFR, GFM			
LAMINATE REQUIREMENTS					
Laminate Requirement	Specification <0.50 mm [0.0197 in]	Specification ≥0.50 mm [0.0197 in]	Units	Test Method	Ref. Para.
1. Peel Strength, minimum					3.9.1.1
A. Low profile copper foil and very low profile copper foil – all copper foil >17 µm [0.669 mil].	0.70 [4.00]	0.70 [4.00]	N/mm [lb/in]	2.4.8	3.9.1.1.1
B. Standard profile copper foil				2.4.8.2	
1. After thermal stress	0.80 [4.57]	1.05 [6.00]		2.4.8.3	
2. At 125 °C [257 °F]	0.70 [4.00]	0.70 [4.00]			
3. After process solutions	0.55 [3.14]	0.80 [4.57]			3.9.1.1.3
C. All other foil – composite	AABUS	AABUS			
2. Volume Resistivity, minimum			MΩ-cm	2.5.17.1	3.11.1.3
A. 96/35/90	10 ⁶	–			
B. After moisture resistance	–	10 ⁶			
C. At elevated temperature E-24/125	10 ³	10 ³			
3. Surface Resistivity, minimum			MΩ	2.5.17.1	3.11.1.4
A. 96/35/90	10 ⁴	–			
B. After moisture resistance	–	10 ⁴			
C. At elevated temperature E-24/125	10 ³	10 ³			
4. Moisture Absorption, maximum	–	0.80	%	2.6.2.1	3.12.1.1
5. Dielectric Breakdown, minimum	–	40	kV	2.5.6	3.11.1.6
6. Permittivity at 1 MHz, maximum (Laminate & laminated prepreg)*	5.4	5.4	–	2.5.5.2 2.5.5.3 2.5.5.9	3.11.1.1 3.11.2.1
7. Loss Tangent at 1 MHz, maximum (Laminate & laminated prepreg)*	0.035	0.035	–	2.5.5.2 2.5.5.3 2.5.5.9	3.11.1.2 3.11.2.2
8. Flexural Strength, minimum			N/mm ² [lb/in ²]	2.4.4	3.9.1.3
A. Length direction	–	415 [60,190]			
B. Cross direction	–	345 [50,040]			
9. Flexural Strength at Elevated Temperature, length direction, minimum	–	–	N/mm ² [lb/in ²]	2.4.4.1	3.9.1.4
10. Arc Resistance, minimum	60	60	s	2.5.1	3.11.1.5
11. Thermal Stress 10 s at 288 °C [550.4 °F], minimum			rating	2.4.13.1	3.10.1.2
A. Unetched	Pass Visual	Pass Visual			
B. Etched	Pass Visual	Pass Visual			
12. Electric Strength, minimum (Laminate & laminated prepreg)	30	–	kV/mm	2.5.6.2	3.11.1.7 3.11.2.3
13. Flammability, minimum (Laminate & laminated prepreg)	V-0	V-0	rating	UL94	3.10.2.1 3.10.1.1
14. Glass Transition Temperature, minimum	–	110	°C	2.4.24 2.4.25	3.10.1.6
15. Other	–	–			

*See Slash Sheet 2 in IPC-4121.

Revision Date: February 2018		SPECIFICATION SHEET	
SPECIFICATION SHEET #:		NP-140 TL, NP-140B	
REINFORCEMENT:		IPC-4101/21	
RESIN SYSTEM:		1: Woven E-glass Primary: Difunctional epoxy Secondary 1: Multifunctional epoxy Secondary 2: NONE	
FLAME RETARDANT MECHANISM:		RoHS Compliant Bromine <5% Minimum UL94 Requirement: V-0	
FILLERS:			
ID REFERENCE:		UL/ANSI: FR-4.0/21 MIL-S-13949: NO ATTENTION	
GLASS TRANSITION (T _g):		110 °C minimum	

LAMINATE REQUIREMENTS / ANFORDERUNGEN AN DAS LAMINAT							
Laminate Requirement	Specification < 0.50 mm [0.0197 in]		Specification ≥ 0.50 mm [0.0197 in]		Units	Test Method (IPC-IM-650)	Ref. Para.
	Specification	Property	Specification	Property			
1. Peel Strength, minimum							3.9.1.1
A. Low profile copper foil and very low profile copper foil – all copper foil >17µm [0.669 mil]	0.70 [4.00]	0.88 [5.00]	0.70 [4.00]	0.96 [5.50]	N/mm [lb/in]	2.4.8	3.9.1.1.1
B. Standard profile copper foil						2.4.8.2	
1. After thermal stress (35 µm)	0.80 [4.57]	1.75 [10.00]	1.05 [6.00]	1.75 [10.00]		2.4.8.3	
2. At 125 °C [257 °F]	0.70 [4.00]	1.22 [7.00]	0.70 [4.00]	1.22 [7.00]			
3. After process solutions	0.55 [3.14]	1.13 [6.50]	0.80 [4.57]	1.13 [6.50]			3.9.1.1.3
C. All other foil – composite	AABUS	-	AABUS	-			
2. Volume Resistivity, minimum					MΩcm	2.5.17.1	3.11.1.3
A. C-96/35/90	10 ⁶	5.0*10 ⁹	-	5.0*10 ⁹			
B. After moisture resistance	-	-	10 ⁴	10 ⁹			
C. At elevated temperature E-24/125	10 ³	10 ⁹	10 ³	10 ⁹			
3. Surface Resistivity, minimum					MΩ	2.5.17.1	3.11.1.4
A. C-96/35/90	10 ⁴	5.0*10 ⁷	-	5.0*10 ⁷			
B. After moisture resistance	-	-	10 ⁴	10 ⁷			
C. At elevated temperature E-24/125	10 ³	10 ⁷	10 ³	10 ⁷			
4. Moisture Absorption, maximum	-	0.30	0.80	0.10	%	2.6.2.1	3.12.1.1
5. Dielectric Breakdown, minimum	-	60	40	60	kV	2.5.6	3.11.1.6
6. Permittivity at 1 MHz, maximum (Laminate & laminated prepreg)	5.4	4.3	5.4	4.4	-	2.5.5.2 2.5.5.3 2.5.5.9	3.11.1.1 3.11.2.1
7. Loss Tangent at 1 MHz, maximum (Laminate & laminated prepreg)	0.035	0.012	0.035	0.013	-	2.5.5.2 2.5.5.3 2.5.5.9	3.11.1.2 3.11.2.2
8. Flexural Strength, minimum					N/mm ² [lb/in ²]	2.4.4	3.9.1.3
A. Length direction	-	-	415 [60190]	500 [72519]			
B. Cross direction	-	-	345 [50040]	400 [58015]			
9. Flexural Strength at Elevated Temperature, length direction, minimum	-	-	-	-	N/mm ² [lb/in ²]	2.4.4.1	3.9.1.4
10. Arc Resistance, minimum	60	120	60	120	s	2.5.1	3.11.1.5
11. Thermal Stress 10 s at 288 °C [550.4 °F], minimum					rating	2.4.13.1	3.10.1.2
A. Unetched	ungeätzt	Pass Visual	20 x 10 s	Pass Visual			
B. Etched	abgeätzt	Pass Visual	20 x 10 s	Pass Visual			
12. Electric Strength, minimum (Laminate & laminated prepreg)	30	40	-	40	kV/mm	2.5.6.2	3.11.1.7 3.11.2.3
13. Flammability, minimum (Laminate & laminated prepreg)	V-0	V-0	V-0	V-0	rating	UL94	3.10.2.1 3.10.1.1
14. Glass Transition Temperature, minimum					°C	2.4.24 2.4.25	3.10.1.6
	IMA	130	110	130			
	DSC	135	135	135			

AABUS = As Agreed Between User and Supplier

We zwischen Kunde und Lieferant vereinbart

		< 0,5 mm	≥ 0,5mm	Laminate
1. Peel Strength minimum	A. Low profile copper foil and very low profile copper foil – all copper foil >17 µm [0.669 mil].	0.70 [4.00]	0.70 [4.00]	N/mm [lb/in]
	B. Standard profile copper foil			
	1. After thermal stress	0.80 [4.57]	1.05 [6.00]	N/mm [lb/in]
	2. At 125 °C [257 °F]	0.70 [4.00]	0.70 [4.00]	N/mm [lb/in]
	3. After process solutions	0.55 [3.14]	0.80 [4.57]	N/mm [lb/in]
	C. All other foil – composite	AABUS	AABUS	N/mm [lb/in]
2. Volume Resistivity minimum	A. 96/35/90	10 ⁶	–	MΩ/cm
	B. After moisture resistance	–	10 ⁶	MΩ/cm
	C. At elevated temperature E-24/125	10 ³	10 ³	MΩ/cm
3. Surface Resistivity minimum	A. 96/35/90	10 ⁴	–	MΩ/cm
	B. After moisture resistance	–	10 ⁴	MΩ/cm
	C. At elevated temperature E-24/125	10 ³	10 ³	MΩ/cm
4. Moisture Absorption	maximum	–	0.80	%
5. Dielectric Breakdown	minimum	–	40	kV
6. Permittivity at 1 MHz	maximum (Laminate & laminated prepreg)*	5,4	5,4	
7. Loss Tangent at 1 MHz	maximum (Laminate & laminated prepreg)*	0.035	0.035	
8. Flexural Strength	minimum			
	A. Length direction	–	415 [60,190]	N/mm ² [lb/in ²]
	B. Cross direction	–	345 [50,040]	N/mm ² [lb/in ²]
9. Flexural Strength at Elevated Temperature	length direction, minimum	–	–	
10. Arc Resistance	minimum	60	60	s
11. Thermal Stress	10 s at 288 °C [550.4 °F], minimum			
	A. Unetched	Pass Visual	Pass Visual	rating
	B. Etched	Pass Visual	Pass Visual	rating
12. Electric Strength	minimum (Laminate & laminated prepreg)	30	–	kV/mm
13. Flammability	minimum (Laminate & laminated prepreg)	V-0	V-0	rating UL94
14. Glass Transition Temperature	minimum	–	110	°C
15. Other		–	–	

March 2017

IPC-4101E

PREPREG REQUIREMENTS				
Prepreg Requirement	Specification	Units	Test Method	Ref. Para.
1. Shelf Life, minimum (Condition 1/Condition 2)	180/90	Days	AABUS	3.17
2. Reinforcement	As per IPC-4412 or AABUS.			
3. Volatile content maximum	0.75	%	2.3.19	3.9.2.2.8
4. Prepreg Parameters	–	AABUS	AABUS	1.1.7
5. Flammability, minimum (as laminated)	V-0	rating	UL94	3.10.2.1
6. Other	–			

1. Shelf Life	minimum (Condition 1/Condition 2)	180/90 Days
2. Reinforcement		As per IPC-4412 or AABUS
3. Volatile content	maximum	0,75 %
4. Prepreg Parameters		AABUS
5. Flammability	minimum (as laminated)	V-0 rating UL94
6. Other –		

Spezifikationsblatt Nr.	20 G-10 ¹⁾	22 G-11 ¹⁾	23 FR-5 ¹⁾	27 None ¹⁾
Flammschutzmittel	None	None	Br ²⁾	Br ²⁾
Füllstoff	None	None	None	None
UL	HB	HB	V-1	V-1
Tg	None	135 - 175°C	135 - 185°C	>110°C
	↳ 21 FR-4.0 ¹⁾	24 FR-4.0 ¹⁾	26 FR-4.0 ¹⁾	
Flammschutzmittel	Br _{RoHS} ³⁾	Br _{RoHS} ³⁾	Br _{RoHS} ³⁾	
Füllstoffe	< 5%	< 5%	< 5%	
Harz-System	Epoxy ⁴⁾ Multi ⁵⁾ /None	Epoxy ⁴⁾ Multi ⁵⁾ /None	Epoxy ⁴⁾ Multi ⁵⁾ /None	
UL	V-0	V-0	V-0	
Tg	>110°C	>150°C	>170°C	

- 1) Bezeichnung nach UL / ANSI
- 2) Flammschutzmittel Brom:
Br = **nicht** RoHS konform!!
- 3) Br_{RoHS} = RoHS konform
(TBBPA ist chemisch gebunden)
- 4) Primary Resin System
 - Epoxy
 - Difunctional Epoxy
- 5) Secondary 1
 - Multifunctional Epoxy
 - Cyanate Ester
- 6) Secondary 2
 - Modified Epoxy or Non Epoxy (max. wt 5%)
 - Non Epoxy
- 7) halogenfrei:
Definition nach IPC 4101:
max. 900 ppm Cl
max. 900 ppm Br
Σ Cl + Br = max. 1500 ppm

Spezifikationsblatt Nr. **21_{FR-4.0¹⁾}**

Tg	>110°C				
	→	97_{FR-4.0¹⁾}	82_{FR4}	92_{halogenfrei}	93_{halogenfrei}
Füllstoffe		Br _{RoHS} ³⁾ Contains inorganic filler	Br _{RoHS} Kaolin	P n/a	Al(OH) ₃ n/a
Harz-System		Difu-Epoxy ⁴⁾ Multi ⁵⁾			
UL		V-0	V-1	V-1	V-1
Tg	>110°C				

Ersatzlos gestrichen
Rev. C nach Rev. D

7) halogenfrei:
Definition nach IPC 4101:
max. 900 ppm Cl
max. 900 ppm Br
Σ Cl + Br = max. 1500 ppm

Gemeinsame Merkmale:
(für Laminat ≥ 0,50 mm)

T _D 5%	310°C
CTEz α1	60 ppm/K
CTEz α2	300 ppm/K
CTE _{50-260°C}	4%
T ₂₆₀	30 min
T ₂₈₈	5 min
T ₃₀₀	AABUS

	→	101_{FR-4.0¹⁾}	121_{FR-4.0¹⁾}	122_{FR-4.1⁷⁾}	127_{FR-4.1⁷⁾}
Flammschutzmittel		Br _{RoHS} ³⁾	Br _{RoHS} ³⁾	Phosphorus, Nitrogen and/or Inorganic compound	Phosphorus, Nitrogen and/or Inorganic compound
Füllstoffe		Contains inorganic filler	< 5%	< 5%	Contains inorganic filler
Harz-System		Difu-Epoxy ⁴⁾ Multi ⁵⁾ /Modi ⁶⁾	Difu-Epoxy ⁴⁾ Multi ⁵⁾ /Modi ⁶⁾	Difu-Epoxy ⁴⁾ Multi ⁵⁾ /Modi ⁶⁾	Difu-Epoxy ⁴⁾ Multi ⁵⁾ /Modi ⁶⁾
UL		V-0	V-0	V-0	V-0
Tg		>110°C	>110°C	>110°C	>110°C

Spezifikationsblatt Nr. **24_{FR-4 .0¹⁾}**

Tg	>150°C				
	→	98 FR-4.0 ¹⁾	83 FR4	94 halogenfrei	95 halogenfrei
Füllstoffe		Br _{RoHS} ³⁾ Contains inorganic filler	Br _{RoHS} Kaolin	P n/a	Al(OH) ₃ n/a
Harz-System		Difu-Epoxy ⁴⁾ Multi ⁵⁾			
UL		V-0	V-1	V-1	V-1
Tg	>150°C				

Ersatzlos gestrichen
Rev. C nach Rev. D

7) halogenfrei:
Definition nach IPC 4101:
max. 900 ppm Cl
max. 900 ppm Br
Σ Cl + Br = max. 1500 ppm

Gemeinsame Merkmale:
(für Laminat ≥ 0,50 mm)

T _D 5%	325°C
CTEz α1	60 ppm/K
CTEz α2	300 ppm/K
CTE _{50-260°C}	3,5%
T ₂₆₀	30 min
T ₂₈₈	5 min
T ₃₀₀	AABUS

	→	99 FR-4 .0 ¹⁾	124 FR-4.0 ¹⁾	125 FR-4.1 ⁷⁾	128 FR-4.1 ⁷⁾
Flammschutzmittel		Br _{RoHS} ³⁾	Br _{RoHS} ³⁾	Phosphorus, Nitrogen and/or Inorganic compound	Phosphorus, Nitrogen and/or Inorganic compound
Füllstoffe		Contains inorganic filler	< 5%	< 5%	Contains inorganic filler
Harz-System		Difu-Epoxy ⁴⁾ Multi ⁵⁾ /Modi ⁶⁾	Difu-Epoxy ⁴⁾ Multi ⁵⁾ /Modi ⁶⁾	Difu-Epoxy ⁴⁾ Multi ⁵⁾ /Modi ⁶⁾	Difu-Epoxy ⁴⁾ Multi ⁵⁾ /Modi ⁶⁾
UL		V-0	V-0	V-0	V-0
Tg		>150°C	>150°C	>150°C	>150°C



Spezifikationsblatt Nr. **26_{FR-4.0}¹⁾** - - - - ->

Tg **>170°C**

Füllstoffe

Harz-System

Permittivity

UL

Tg

72_{FR-4.0}¹⁾

Br_{RoHS}³⁾
≥ 5%

Epoxy⁴⁾
Cyanate Ester⁵⁾
Non Epoxy⁶⁾

4.1 (1 MHz)
4.0 (1 GHz)
3.9 (10 GHz)

V-0

>170°C

73_{FR-4.0}¹⁾

Br_{RoHS}³⁾
≥ 5%

Epoxy⁴⁾
Cyanate Ester⁵⁾
Modi or Non Epoxy⁶⁾

4.2 (1 MHz)
4.1 (1 GHz)
4.0 (10 GHz)

V-0

>170°C

- 4) Primary Resin System
 - Epoxy
 - Difunctional Epoxy
- 5) Secondary 1
 - Multifunctional Epoxy
 - Cyanate Ester
- 6) Secondary 2
 - Modified Epoxy or Non Epoxi (max. wt 5%)
 - Non Epoxy
- 7) halogenfrei:
Definition nach IPC 4101:
max. 900 ppm Cl
max. 900 ppm Br
Σ Cl + Br = max. 1500 ppm

Gemeinsame Merkmale:
(für Laminat ≥ 0,50 mm)

T _D 5%	340°C
CTEz α1	60 ppm/K
CTEz α2	300 ppm/K
CTE _{50-260°C}	3%
	(3,5%, < 5% Füllstoff)
T ₂₆₀	30 min
T ₂₈₈	15 min
T ₃₀₀	2 min

Flammschutzmittel

Füllstoffe

Harz-System

UL

Tg

126_{FR-4.0}¹⁾

Br_{RoHS}³⁾

Contains inorganic filler

Epoxy⁴⁾
Multi⁵⁾/Modi⁶⁾

V-0

>170°C

129_{FR-4.0}¹⁾

Br_{RoHS}³⁾

< 5%

Epoxy⁴⁾
Multi⁵⁾/Modi⁶⁾

V-0

>170°C

130_{FR-4.1}⁷⁾

Phosphorus,
Nitrogen and/or
Inorganic compound

Contains inorganic filler

Epoxy⁴⁾
Multi⁵⁾/Modi⁶⁾

V-0

>170°C

131_{FR-4.1}⁷⁾

Phosphorus,
Nitrogen and/or
Inorganic compound

< 5%

Epoxy⁴⁾
Multi⁵⁾/Modi⁶⁾

V-0

>170°C

August 2009

IPC-4101C

Revision Date: August 2009

Revision Date: August 2009

SPECIFICATION SHEET	
SPECIFICATION SHEET #:	IPC-4101/21
REINFORCEMENT:	1: Woven E-glass
RESIN SYSTEM:	Primary: Difunctional epoxy Secondary 1: Multifunctional epoxy Secondary 2: N/A
FLAME RETARDANT MECHANISM:	RoHS Compliant Bromine
FILLERS:	N/A
ID REFERENCE:	UL/ANSI: FR-4/21
GLASS TRANSITION (T _g):	110 °C minimum
UL MAX. OPERATING TEMP:	N/A

SPECIFICATION SHEET	
SPECIFICATION SHEET #:	IPC-4101/101
REINFORCEMENT:	1: Woven E-glass
RESIN SYSTEM:	Primary: Difunctional Epoxy Secondary 1: Multifunctional epoxy
FLAME RETARDANT MECHANISM:	RoHS Compliant Bromine
FILLERS (≥5%):	Contains inorganic fillers
ID REFERENCE:	UL/ANSI: FR-4/101
GLASS TRANSITION (T _g):	110 °C minimum
UL MAX. OPERATING TEMP:	AABUS

Revision Date: August 2009

SPECIFICATION SHEET	
SPECIFICATION SHEET #:	IPC-4101/126
REINFORCEMENT:	1: Woven E-glass
RESIN SYSTEM:	Primary: Epoxy Secondary 1: Multifunctional epoxy
FLAME RETARDANT MECHANISM:	RoHS Compliant Bromine
FILLERS (≥5%):	Contains inorganic fillers
ID REFERENCE:	UL/ANSI: FR-4/126
GLASS TRANSITION (T _g):	126 °C minimum
UL MAX. OPERATING TEMP:	130 °C

**N/A = not applicable - nicht anzuwenden -
wird ersetzt durch NONE und eine Obergrenze**

IPC-4101D-WAM1

July 2015

Revision Date: July 2015

SPECIFICATION SHEET	
SPECIFICATION SHEET #:	IPC-4101/21
REINFORCEMENT:	1: Woven E-glass
RESIN SYSTEM:	Primary: Difunctional epoxy Secondary 1: Multifunctional epoxy Secondary 2: NONE
FLAME RETARDANT MECHANISM:	RoHS Compliant Bromine
FILLERS:	<5%
ID REFERENCE:	UL/ANSI: FR-4.0/21
GLASS TRANSITION (T _g):	110 °C minimum

3.13.1 Permissible Substitutions of Specification Sheet Materials For purposes of use, the following base material substitutions in Table 3-10 shall be allowed:

Table 3-10 Permissible Material Substitutions

Original Drawings Released Before December 31, 2016	Permissible Substitutions from Other IPC-4101 Current Revision Specification Sheets
/21	/24, /26, /97, /98, /99, /101, /121, /124, /126, /129
/24	/26, /98, /99, /124, /126, /129
/26	/126, /129
/30	/135
/129	/98, /99, /101, /126

Contains inorganic filler

Wenn:
Zeichnung bzw. Daten vor dem
31.12.2016

Dann:
Zulässige Substitution von anderen aktuellen
Spezifikationsblättern aus anderen IPC-4101 Revisionen

Substitutability (= Ersetzbarkeit)

Flamm-schutz	Filler	Slash Sheet	21	24	26	72	73	97	98	99	101	121	122	124	125	126	127	128	129	130	131	Tg
Br _{RoHS}	< 5%	21	21	X	X							X		X					X			>110
Br _{RoHS}	< 5%	24		24	X									X					X			>150
Br _{RoHS}	< 5%	26			26														X			>170
Br _{RoHS}	Filler	72				72																>170
Br _{RoHS}	Filler	73					73															>170
Br _{RoHS}	Filler	97						97	X	X	X					X						>110
Br _{RoHS}	Filler	98							98	X						X						>150
Br _{RoHS}	Filler	99								99						X						>150
Br _{RoHS}	Filler	101									X	101				X						>110
Br _{RoHS}	< 5%	121										121		X					X			>110
Halogenfrei	< 5%	122											122		X						X	>110
Br _{RoHS}	< 5%	124												124					X			>150
Halogenfrei	< 5%	125													125						X	>150
Br _{RoHS}	Filler	126														126						>170
Halogenfrei	Filler	127															127	X		X		>110
Halogenfrei	Filler	128																128		X		>150
Br _{RoHS}	< 5%	129																	129			>170
Halogenfrei	Filler	130																		130		>170
Halogenfrei	< 5%	131																			131	>170

Kann ersetzt werden durch Material mit Slash Sheet Nummer....

Nan Ya Typen vs. IPC-Spezifikationsblättern

IPC Spezifikationsblatt	21	97	101	121	122	127	24	98	99	124	125	128	26	126	129	130	131	
Tg [°C]	≥ 110						≥ 150						≥ 170					
Td 5% [°C]	---	---	310	310	310	310	---	---	325	325	325	325		340	340	340	340	
Füllstoffe ≥ 5 Gew. %	< 5%	ja	ja	< 5%	< 5%	ja	< 5%	ja	ja	< 5%	< 5%	Ja	< 5%	ja	< 5%	ja	< 5%	
UL	FR-4.0	FR-4.0	FR-4.0	FR-4.0	FR-4.1	FR-4.1	FR-4.0	FR-4.0	FR-4.0	FR-4.0	FR-4.1	FR-4.1	FR-4.0	FR-4.0	FR-4.0	FR-4.1	FR-4.1	
CTE z α₁ [ppm/K]	---	---	60	60	60	60		---	60	60	60	60		60	60	60	60	
CTE z α₂ [ppm/K]	---	---	300	300	300	300		---	300	300	300	300		300	300	300	300	
TE 50-260 °C [%]	---	---	4,0	4,0	4,0	4,0		---	3,5	3,5	3,5	3,5		3,0	3,0	3,0	3,0	
T260 [min]	---	---	30	30	30	30		---	30	30	30	30		30	30	30	30	
T288 [min]	---	---	5	5	5	5		---	5	5	5	5		15	15	15	15	
T300 [min]	---	---	AABUS	AABUS	AABUS	AABUS		---	AABUS	AABUS	AABUS	AABUS		2	2	2	2	
UV Block FR-4-86	X																	
NP-140	X			(X)														
FR-4-11PY	(X)	X		(X)														
NP-155F		X	X					X	X									
NP-175F, NP-175FBH		X	X					X	X					X				
NPG-150N, NPG-151						X						X						
NPGN-150PY						X						X						
NPG-170						X						X				X		
NPG-170D						X						X				X		
NPG-180BH						X						X				X		

kein Abgleich mit der MIL 13949

(X) nicht uneingeschränkt anwendbar

IPC-4101E

March 2017

Revision Date: March 2017

UV Block FR-4-86, NP-140

SPECIFICATION SHEET		
SPECIFICATION SHEET #:	IPC-4101/21	
REINFORCEMENT:	1: Woven E-glass	2: NONE
RESIN SYSTEM:	Primary: Difunctional epoxy Secondary 1: Multifunctional epoxy	Secondary 2: NONE
FLAME RETARDANT MECHANISM:	RoHS Compliant Bromine	Minimum UL94 Requirement: V-0
FILLERS:	<5%	
ID REFERENCE:	UL/ANSI: FR-4.0/21	MIL-S-13949: /04
GLASS TRANSITION (T _g):	110 °C minimum	- GF, GFN, GFK, GFP, GFM

March 2017

IPC-4101E

Revision Date: March 2017

NP-155F

SPECIFICATION SHEET		
SPECIFICATION SHEET #:	IPC-4101/99	
REINFORCEMENT:	1: Woven E-glass	2: NONE
RESIN SYSTEM:	Primary: Epoxy Secondary 1: Multifunctional epoxy	Secondary 2: Modified Epoxy or Non-Epoxy (max. wt. 5%)
FLAME RETARDANT MECHANISM:	RoHS Compliant Bromine	Minimum UL94 Requirement: V-0
FILLERS:	Contains inorganic fillers	
ID REFERENCE:	UL/ANSI: FR-4.0/99	
GLASS TRANSITION (T _g):	150 °C minimum	

March 2017

IPC-4101E

Revision Date: March 2017

NPG-150N

SPECIFICATION SHEET		
SPECIFICATION SHEET #:	IPC-4101/128	
REINFORCEMENT:	1: Woven E-glass	2: NONE
RESIN SYSTEM:	Primary: Epoxy Secondary 1: Multifunctional epoxy	Secondary 2: Modified Epoxy or Non-Epoxy (max. wt. 5%)
FLAME RETARDANT MECHANISM:	Phosphorus, Nitrogen and/or inorganic compound†	Minimum UL94 Requirement: V-0
FILLERS:	Contains inorganic fillers	
ID REFERENCE:	UL/ANSI: FR-4.1/128	MIL-S-13949: NONE
GLASS TRANSITION (T _g):	150 °C minimum	†900 ppm max. Br or Cl and 1500 ppm max. Br + Cl

LAMINATE REQUIREMENTS									
Laminate Requirement Anforderung an das Laminat	Specification < 0,50 mm [0,0197 in]	Specification ≥ 0,50 mm [0,0197 in]	Units metric [English]	#21 FR-4-86UV NP-140	#99 NP-155F	#126 NP-175F NP-175FBH	#128 NPG-150N NPG-170	Test Method IPC-TM-650	IPC-4101 Ref. Para.
	Specification	Specification							
1. Peel Strength, minimum Kupferhaftfestigkeit A. Low profile copper foil and very low profile copper foil - all copper foil >17µm [0,669 mil] B. Standard profile copper foil 1. After thermal stress (35 µm) 2. At 125 °C [257 °F] 3. After process solutions C. All other foil - composite	0,70 [4,00]	0,70 [4,00]	N/mm [lb/in]					2.4.8 2.4.8.2 2.4.8.3	3.9.1.1 3.9.1.1.1 3.9.1.1.2 3.9.1.1.3
2. Volume Resistivity, minimum Durchgangswiderstand A. C-96/35/90 B. After moisture resistance C. At elevated temperature E-24/125	10 ⁶ - 10 ³	- 10 ⁴ 10 ³	MΩcm					2.5.17.1	3.11.1.3
3. Surface Resistivity, minimum Oberflächenwiderstand A. C-96/35/90 B. After moisture resistance C. At elevated temperature E-24/125	10 ⁴ - 10 ³	- 10 ⁴ 10 ³	MΩ					2.5.17.1	3.11.1.4
4. Moisture Absorption, maximum Feuchteaufnahme	-	0,5/0,8	%	0,8	0,5	0,5	0,8	2.6.2.1	3.12.1.1
5. Dielectric Breakdown, minimum Dielektrischer Durchschlag	-	40	kV					2.5.6	3.11.1.6
6. Permittivity at 1 MHz, maximum (Laminate & laminated prepreg) Dielektrizitätskonstante	5,4	5,4	-					2.5.5.2 2.5.5.3 2.5.5.9	3.11.1.1 3.11.2.1
7. Loss Tangent at 1 MHz, maximum (Laminate & laminated prepreg) Verlustfaktor	0,035	0,035	-					2.5.5.2 2.5.5.3 2.5.5.9	3.11.1.2 3.11.2.2
8. Flexural Strength, minimum Biegefestigkeit A. Length direction B. Cross direction	- -	415 [60190] 345 [50040]	N/mm ² [lb/in ²]					2.4.4	3.9.1.3
9. Flexural Strength at Elevated Temperature length direction, minimum	-	-	N/mm ² [lb/in ²]					2.4.4.1	3.9.1.4
10. Arc Resistance, minimum Lichtbogenbeständigkeit	60	60	s					2.5.1	3.11.1.5

geforderte Eigenschaften

nicht geforderte Eigenschaften

LAMINATE REQUIREMENTS									
Laminate Requirement Anforderung an das Laminat	Specification < 0,50 mm [0,0197 in]	Specification ≥ 0,50 mm [0,0197 in]	Units metric [English]	#21 FR-4-86UV NP-140	#99 NP-155F	#126 NP-175F NP-175FBH	#128 NPG-150N NPG-170	Test Method IPC-TM-650	IPC-4101 Ref. Para.
	Specification	Specification							
10. Arc Resistance, minimum Lichtbogenbeständigkeit	60	60	s					2.5.1	3.11.1.5
11. Thermal Stress 10 s at 288 °C [550,4 °F], minimum A. Unetched B. Etched Thermische Belastung	Pass Visual Pass Visual	Pass Visual Pass Visual	rating					2.4.13.1	3.10.1.2
12. Electric Strength, minimum (Laminate & laminated prepreg) Spannungsfestigkeit	30	-	kV/mm					2.5.6.2	3.11.1.7 3.11.2.3
13. Flammability, minimum (Laminate & laminated prepreg) Entflammbarkeit	V-0	V-0	rating					UL94	3.10.2.1 3.10.1.1
14. Glass Transition Temperature, minimum Glasübergangstemperatur TMA DMA DSC	-	110/150/170	°C	110	150	170	150	2.4.24 2.4.24.4 2.4.25	3.10.1.6
15. Decomposition Temperatur, minimum (5% wt loss) Zersetzungstemperatur	325/340	325/340	°C		325	340	325	2.4.24.6	3.10.1.8
16. Z-Axis CTE A. Alpha 1, maximum B. Alpha 2, maximum C. 50 to 260 °C, maximum (Total Expansion) Thermischer Ausdehnungskoeffizient Z-Richtung vor Tg nach Tg Gesamtausdehnung	- - -	60 300 3,5/3,0	ppm/°C ppm/°C %			3,5 3	3,5	2.4.24	3.9.1.7
17. Time to Delamination (TMA) (Copper removed) A. T260, minimum B. T288, minimum C. T300, minimum Zeit bis zur Delamination	- - -	30 5/15 AABUS/2	minutes		5	15 2	5	2.4.24.1	3.10.1.9
18. Halogen Content, maximum Halogengehalt -Chlorine -Bromine -Chlorine+Bromine	900 900 1500	900 900 1500	ppm					2.3.41	3.12.1.4
19. CAF Resistance CAF-Beständigkeit	-	AABUS	Pass/Fail			AABUS		2.6.25	3.12.1.5
20. Other									

geforderte Eigenschaften

nicht geforderte Eigenschaften

PREPREG REQUIREMENTS								
Prepreg Requirement Anforderung an das Prepreg	Specification	Unit	#21 NP-140	#99 NP-155F	#126 NP-175F NP-175FBH	#128 NPG-150N NPG-170	Test Method IPC-TM-650	IPC-4101 Ref. Para.
1. Shelf Life, minimum (Condition 1 / Condition 2) <i>Verarbeitbarkeit</i>	180/90	Days					AABUS	3.17
2. Reinforcement <i>Verstärkung</i>	As per IPC-4412 or AABUS							
3. Volatile content maximum <i>Flüchtige Bestandteile</i>	0,75/1,5	%	0,75	1,5	1,5	1,5	2.3.19	3.9.2.2.8
4. Prepreg Parameters <i>Prepregeigenschaften</i>	-	AABUS					AABUS	1.1.7
5. Flammability, minimum (as laminated) <i>Entflammbarkeit</i>	V-0	rating					UL94	3.10.2.1
6. Other	-							

Prepreg Eigenschaften AABUS = As Agreed Between User and Supplier

IPC-4101E – gültige Version seit März 2017



IPC-4101E

Specification for Base Materials for Rigid and Multilayer Printed Boards

Supersedes:

- IPC-4101D-WAM1 - July 2015
- IPC-4101D - April 2014
- IPC-4101C - August 2009
- IPC-4101B with
Amendments 1 & 2 - April 2007
- IPC-4101B with
Amendment 1 - February 2007
- IPC-4101B - June 2006
- IPC-4101A with
Amendment 1 - June 2002
- IPC-4101A - December 2001
- IPC-4101 - December 1997

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QMTS2.E98983
Polymeric Materials - Filament-wound Tubing, Industrial Laminates, Vulcanized Fiber, and Materials for Use in Fabricating Recognized Printed Wiring Boards - Component
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Polymeric Materials - Filament-wound Tubing, Industrial Laminates, Vulcanized Fiber, and Materials for Use in Fabricating Recognized Printed Wiring Boards - Component

[See General Information for Polymeric Materials - Filament-wound Tubing, Industrial Laminates, Vulcanized Fiber, and Materials for Use in Fabricating Recognized Printed Wiring Boards - Component](#)

NAN YA PLASTICS CORP CCL DEPT ELECTRONIC MATERIAL DIV
201 TUNG HWA N RD
TAIPEI, 10508 TAIWAN

Industrial laminates:

Mtl Dsg	ANSI Type	Color	Build up	Flame Class	R.T.I.		H W I	H A I	V T R	C T I	Meets 746E Non-HAL	Meets 746E DSR
					Elec (°C)	Mech (°C)						
Epoxy (EP) Industrial laminates, furnished as sheets.												
NP-175FBH-15												
	FR-15.0	NC	0.20	V-0	150	150	0	0	-	-	-	Yes
			0.38	V-0	150	150	0	0	-	-	-	Yes
			0.63	V-0	150	150	0	0	-	-	-	Yes
			1.40	V-0	150	150	0	0	-	3	-	Yes

Metal clad industrial laminates:

Metal Clad Dsg	Lam-inate Dsg	Pre-preg Dsg	ANSI Type	Bld up	Clad Cond Thk			Max Area Dia (mm)	Flame Class	Max Oper Temp (°C)	Solder Lts	
					Min Ext (mic)	Max Ext (mic)	Max Int (mic)				Temp (°C)	Time (sec)
Epoxy (EP) Metal clad industrial laminates for use in multilayer printed wiring boards with copper on one or both sides, furnished as sheets.												
NP-175FBH-15/NP-175FBH-15B												
	NP-175FBH-15	NP-175FBH-15B	FR-15.0	0.20	9	102	102	50.8	V-0	150	300	30
				0.38	9	102	102	50.8	V-0	150	300	30
				0.38	9	102	210	50.8	V-0	130	300	30

NP-175FBH
“next big step in thermal resistance”

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Materials for Use in Fabricating Recognized Printed Wiring Boards

E98983

Guide Information

NAN YA PLASTICS CORP CCL DEPT ELECTRONIC MATERIAL DIV

201 TUNG HWA N RD, TAIPEI 10508 TW

NPG-180BH-15

Industrial laminates furnished as sheets

<u>ANSI Type</u>	<u>Color</u>	<u>Min Build Up Thk(mm)</u>	<u>Flame Class</u>	<u>RTI Elec (°C)</u>	<u>RTI Mech (°C)</u>	<u>HWI</u>	<u>HAI</u>	<u>HVTR</u>	<u>CTI</u>	<u>Meets 746E Non-HAL</u>	<u>Meets 746E DSR</u>
FR-15.1	NC	0.63	V-0	150	150	0	0	-	-	Yes	Yes
		1.40	V-0	150	150	0	0	-	2	-	Yes

Report Date: 2020-03-03


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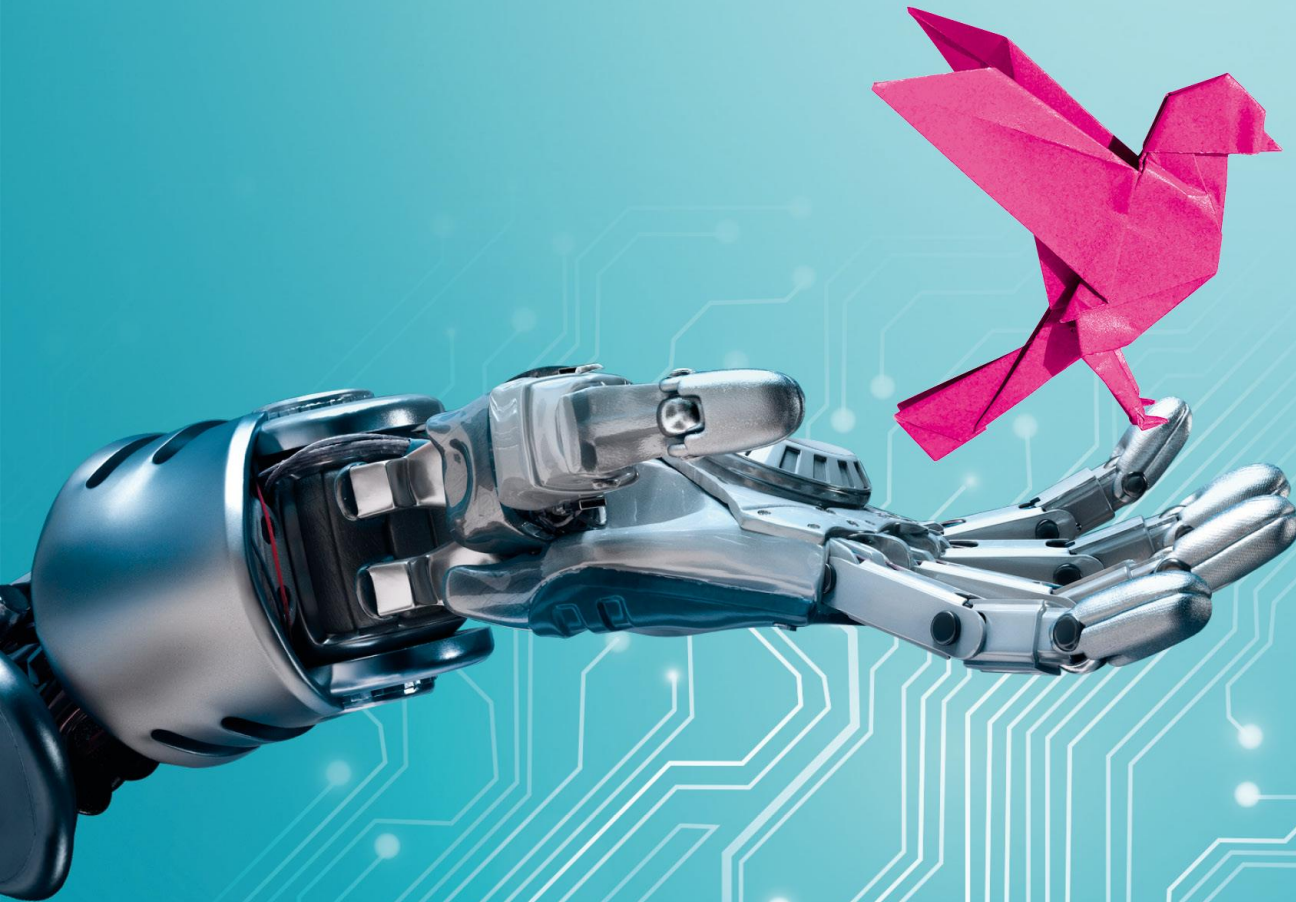


IEC and ISO Test Methods

Test Name	Test Method	Units	Thk (mm)	Value
Flammability	IEC 60695-11-10	Class (color)	0.63	V-0 (NC)
			1.40	V-0 (NC)
IEC Comparative Tracking Index	IEC 60112	Volts (Max)	-	-

Tradenames/Trademarks for File E98983:  NP

VIELEN DANK



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