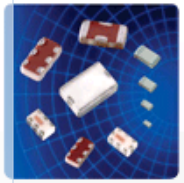
ÉTS
Le génie pour l'industrie

LTCC@ÉTS

LTCC@ÉTS PROCESS & CAPABILITIES



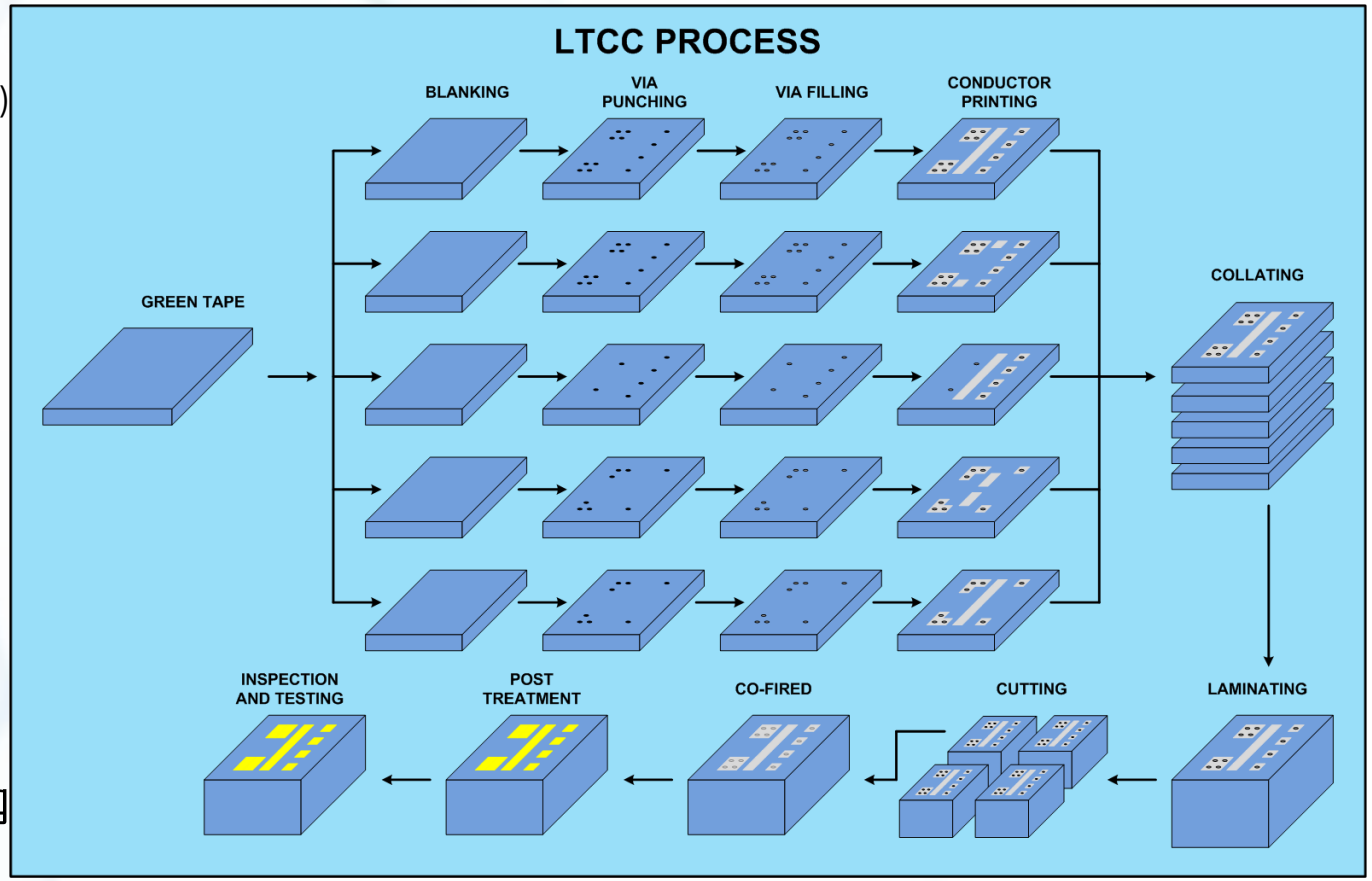
LTCC PROCESS OVERVIEW

Le génie pour l'industrie

LTCC PROCESS

Sheet size 120 x 120 mm (4.7x4.7 inch)

1) Blanking
2) Via Punching
3) Via Filling
4) Conductor Printing
5) Collating
6) Laminating
7) Cutting
8) Co-fired
9) Post Treatment
10) Inspection and Testing



LTCC@ÉTS INFRASTRUCTURE

Le génie pour l'industrie

LTCC Clean Room (Class 10000)

- LTCC Manufacturing: Industry grade – Small volume production
- LTCC Inspection: Confocal Microscope, Scanning Electron Microscope
- RF Probing Station: 67GHz - 4 port PNA-X with noise measurements
- Wire bonding
- Flipchip bonding

Available LTCC Systems

Le génie pour l'industrie

		GREEN TAPE			
		DUPONT		FERRO	
		951	9K7	L8	A6M
METAL	Gold	x	☑	☑	☑
	Silver	☑	☑	☑	☑
	Mixed	x	x	☑	☑
		@3GHz ε_r=7.8 - Tanδ = 0.006	@10GHz ε_r=7.1 - Tanδ = 0.001	@3GHz ε_r=7.2 - Tanδ = 0.002	@10GHz ε_r=5.7 - Tanδ = 0.001

LTCC Systems: Ferro

Le génie pour l'industrie

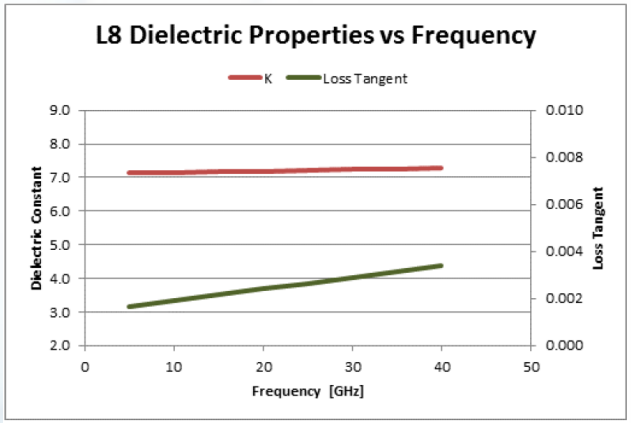
Ferro Green Tapes:

L8

Available thickness: 125 and 250 μm (5 and 10 mils)

Typical Fired Properties

Thermal Coefficient of Expansion	6.0	ppm/°C
Tape Shrinkage	13.2 ± 0.3	% X,Y
	30.0	% Z
Fired Density	> 3.1	gm/cc
Flexural Strength	275	MPa
Young's Modulus	92	Gpa
Thermal Conductivity	2	W/mK
Dielectric Constant	7.2 ± 0.2	@10 GHz
Loss Tangent	< 0.1	@10 GHz
Insulation resistance	> 10^{10}	Ω
Breakdown Voltage	> 900	V/mil
Electrolytic Leakage Current	< 1	μA/cm2

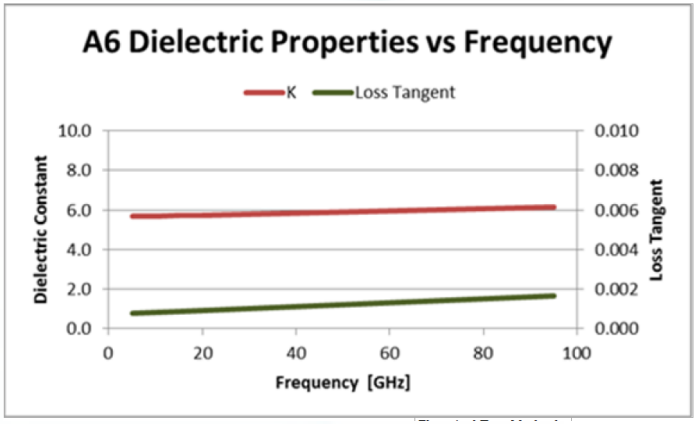


A6M

Available thickness: 50, 125 and 250 μm (2, 5 and 10 mils)

Typical Fired Properties

Thermal Coefficient of Expansion	7.0	ppm/°C
Tape Shrinkage	15.8 ± 0.3	% X,Y
	26.0	% Z
Fired Density	> 2.4	gm/cc
Flexural Strength	170	MPa
Young's Modulus	92	Gpa
Thermal Conductivity	2	W/mK
Dielectric Constant	5.7 ± 0.2	@10 GHz
Loss Tangent	< 0.1	@10 GHz
Insulation resistance	> 10^{10}	Ω
Breakdown Voltage	> 750	V/mil
Electrolytic Leakage Current	< 1	μA/cm2



LTCC Systems: Dupont

Le génie pour l'industrie

Dupont Green Tapes:

951

Test	Properties
Physical	
Unfired Thickness (µm)	50 ± 3 (951C2) 114 ± 8 (951PT) 165 ± 11 (951P2) 254 ± 13 (951PX)
X, Y Shrinkage (%) Z Shrinkage (%)	12.7 ± 0.3 (951 PT, P2, PX) 13.0 ± 0.2 (951C2) 15 ± 0.5
TCE(25 to 300°C), ppm/°C	5.8
Density (g/cm³)	3.1
Camber, inch/inch	Conforms to setter
Surface Roughness , µm	<0.34
Thermal Conductivity, W/m·K	3.3
Flexural Strength, MPa (1)	230
Young's Modulus, GPa	120
Electrical	
Dielectric constant @ 3 GHz (2)	7.8 ± 0.2
Dielectric constant @ 10 GHz (3)	7.5 ± 0.2
Loss Tangent @ 3 GHz	0.006
Insulation resistance at 100VDC,Ω	$>10^{12}$
Breakdown voltage, V/µm	> 1000/25

Notes:
(1) Four point bend
(2) T-resonator with gold conductor
(3) Split cavity measurement method

9K7

Physical Property	Value
Unfired thickness, (um)	127, +/- 9 (9K7)
	254, +/- 14 (9K7X)
X, Y, shrinkage, (%) [1]	9.1, +/- 0.3
Z shrinkage, (%) [1]	11.8, +/- 0.5
TCE, (23° - 300° C)	4.4
Density, (g/cm^3)	3.1
Camber, (um / 25 mm)	25
Surface roughness, (um)	0.52
Thermal conductivity, (W / m-K)	4.6
Flexural strength, (MPa)	230
Young's modulus, (GPa)	145
Poisson's ratio	0.25

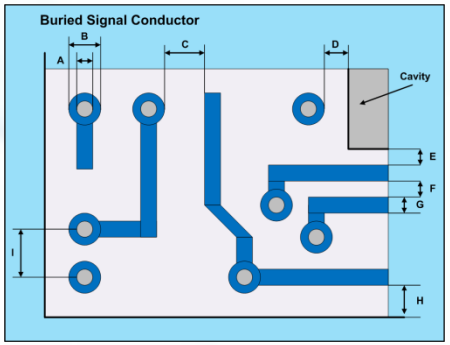
Electrical Property	Value
Dielectric constant, (10 GHz) [2]	7.1, +/- 0.2
Loss tangent, (10 GHz) [2]	0.0010
Insulation resistance, (Ohms)	$> 10^{12}$
Breakdown voltage, (kV / 25 um)	>/= 1100

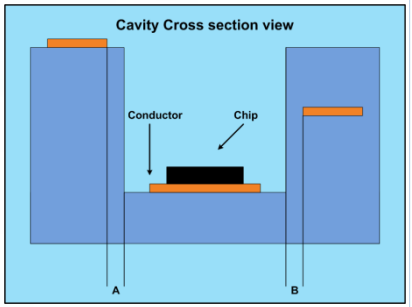
[1]: Isostatic lamination, 3000 psi, 70° C, 10 minutes
[2]: split cavity measurement method

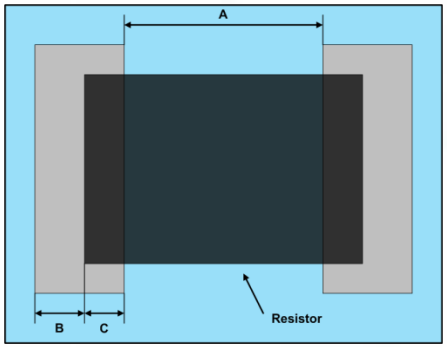
Design Rules Summary – Feature Sizes

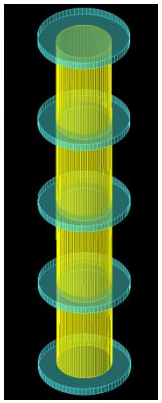
Le génie pour l'industrie

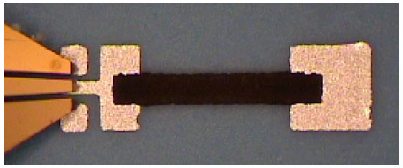
CONDUCTORS (Fired)	Standard	Accepted	Laser	Units
(F-G) Line Width and spacing - Minimum	125	105	**50**	um
(C) Line to Via Spacing – Minimum	205	170	**50**	um
Ground Plane Density	50%	75-100%		%
VIAS (Fired)				
(A) Via Size (unfired, see tape shrinking)	150	150	**>80**	um
(I) Via to Via Spacing (Center to Center)	450	375	**375**	um
(B) Via Catch Pad	210	210	Via size	um
RESISTORS (Fired)				
(A) Length – Minimum	1015	**635**		um
Width - Minimum	760	505		um
(C) Overlap onto Termination – Minimum	255	180		um
As Fired Tolerance - Tightest	± 40	± 30	TBD	%
LTCC PARTS				
Max. part size (unfired, see tape shrinking)	100x100			mm
Minimum part size	2 x 3			mm
CAVITIES				
Cavity Wall - Minimum Width	2.54	2.00		mm
Cavity to Wall Height Ratio - Maximum	1	1.5		
Cavity corner radius	100			um
CAPACITORS (Fired)				
Length Dielectric - Minimum	1.9	**1.27**		mm
Width Dielectric - Minimum	1.9	**1.27**		mm
As Fired Tolerance - Tightest	± 50	± 40		%

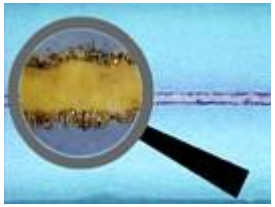












Resources

Le génie pour l'industrie

Website: ltcc.etsmtl.ca

Documents:

Ferro L8 green tape	https://www.etsmtl.ca/Unites-de-recherche/LTCC/Services-offerts/Ferro_L8.pdf
Ferro A6M geen tape	https://www.etsmtl.ca/Unites-de-recherche/LTCC/Services-offerts/Ferro_A6M.pdf
Dupont 951 geen tape	https://www.etsmtl.ca/Unites-de-recherche/LTCC/Services-offerts/Dupont_951.pdf
Dupont 9K7 geen tape	https://www.etsmtl.ca/Unites-de-recherche/LTCC/Services-offerts/Dupont_9K7.pdf
LTCC Process (this document)	https://www.etsmtl.ca/Unites-de-recherche/LTCC/Services-offerts/process.pdf
Layer Definition (ADS)	https://www.etsmtl.ca/Unites-de-recherche/LTCC/Services-offerts/ETS_LTCC_LAYERS_V3_lib.zip
Complete Design Rules	Available upon request

Contact information

Prof. Ammar Kouki
Director LTCC@ÉTS
École de technologie supérieure
Phone: +1 514-396-8554
ammar.kouki@etsmtl.ca

Normand Gravel
Lab managerLTCC@ÉTS
École de technologie supérieure
Phone: +1 514-396-8800 ext 7309
normand.gravelt@lacime.etsmtl.ca