BREAKDOWN TESTING OF WIRING INSULATION

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BACKGROUND

M81381 (Polyimide) is widely used for wiring insulation in aerospace applications

Advantages

- Light Weight
- High Service Temperature
- High Breakdown Strength
- Availability

Disadvantages

- Resistive Heating
- Lossy at High Temperature
- Absorbs Moisture
- Arc Tracking
- Fire Hazard

TYPICAL OPERATING VOLTAGES

- **28 Volts dc (Space Shuttle)**
- **120 Volts dc**
  (Currently Proposed for Space Station Freedom)
- **28-270 Volts dc**
  (Expendable Launch Vehicles)
- **115 V 3-ph 400 Hz (Aerospace Applications)**

TASK

To evaluate dielectric strength at high temperature of potential wiring insulation recommended by NASA LeRC to replace existing M81381 (Polyimide)

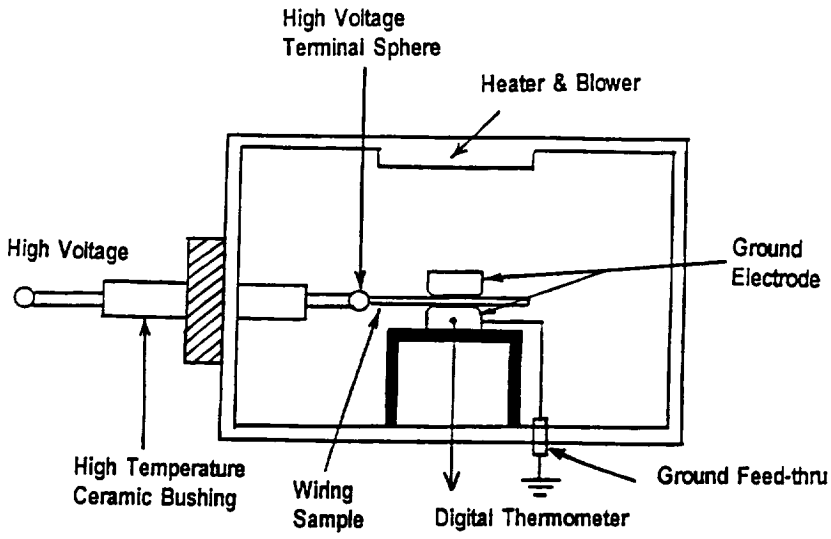
Top Candidates Recommended by NASA LeRC for Dielectric Testing at UB

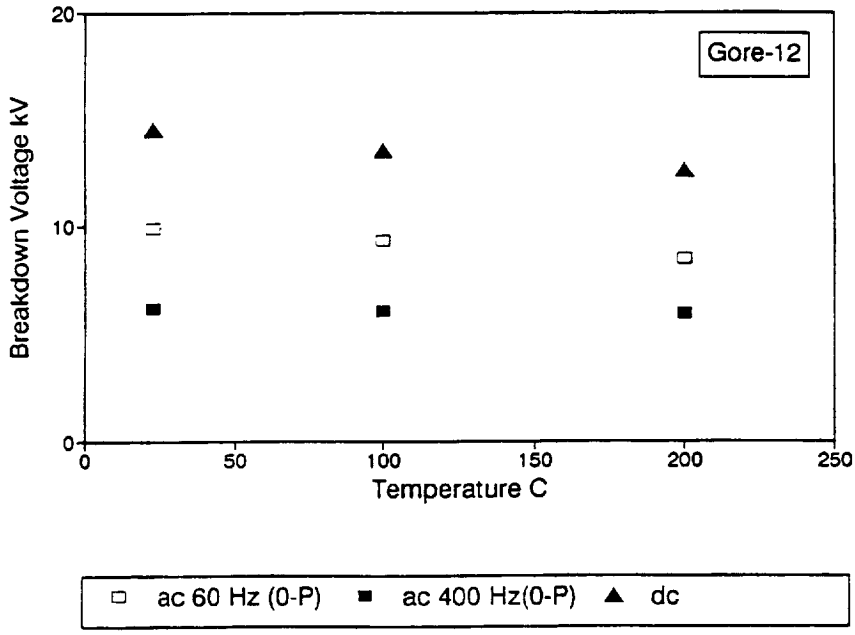
Gore	12 AWG
Gore	20 AWG
Tensolite	12 AWG
Tensolite	20 AWG
Filotex	12 AWG
Filotex	20 AWG
Kapton (M81381)	12 AWG
Kapton (M81381)	20 AWG
Teledyne	12 AWG
Teledyne	20 AWG
Barcel	20 AWG
Champlain	20 AWG

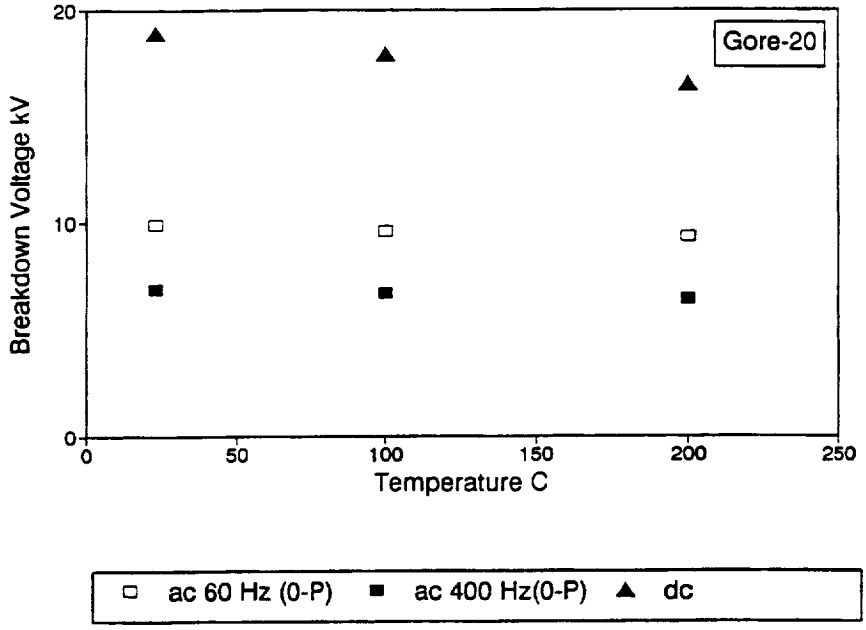
Wiring Cable Specifications

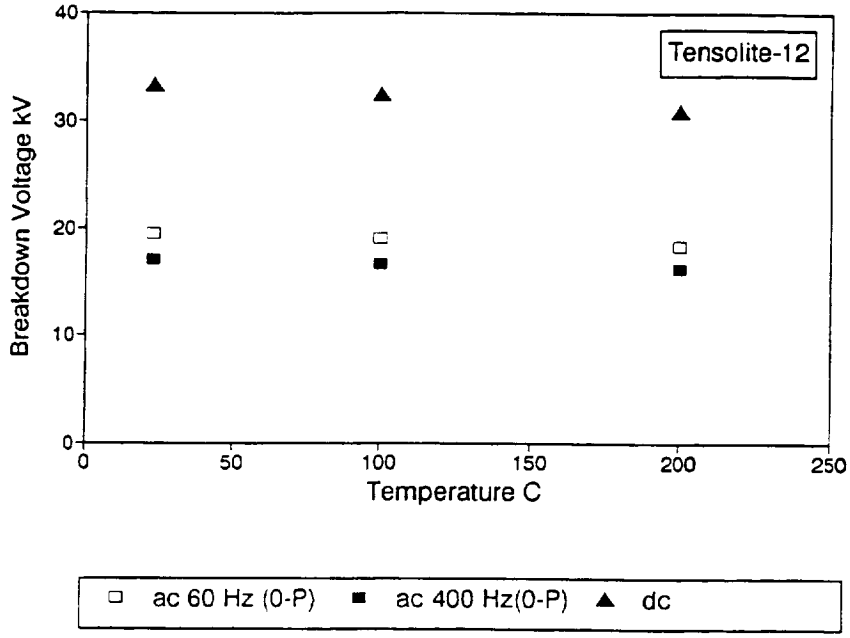
Sample	Insulation System	Insulation Thickness
Gore-12	PTFE/ High Strength PTFE/ PTFE	6 mil
Gore-20	PTFE/ High Strength PTFE/ PTFE	6 mil
Tensolite-12	PTFE/ Polyimide/ PTFE	7.15 mil
Tensolite -20	PTFE/ Polyimide/ PTFE	6.15 mil
Filotex -12	PTFE/ Polyimide/ FEP	6.9 mil
Filotex -20	PTFE/ Polyimide/ FEP	6.5 mil
M81381-12	Kapton with Polyimide top coat	8.6 mil
M81381-20	Kapton with Polyimide top coat	8.6 mil
Teledyne-12	PTFE/ Polyimide/ PTFE	~ 6 mil
Teledyne-20	PTFE/ Polyimide/ PTFE	~ 6 mil
Barcel-20	Kapton/ Unsintered PTFE, Buttrap	~ 6 mil
Champlain-20	Kapton / Extruded XL ETFE	5.7 mil

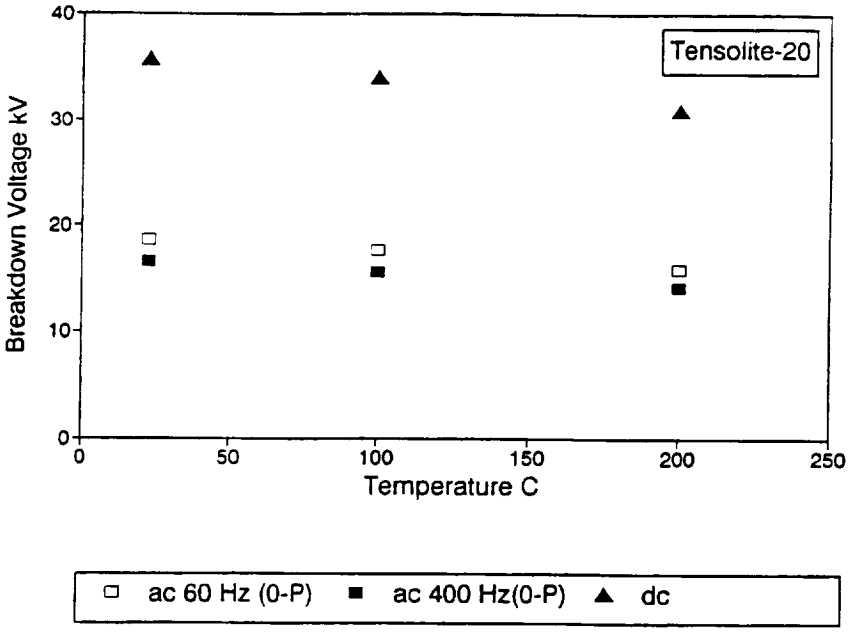
TEST FACILITY at UB

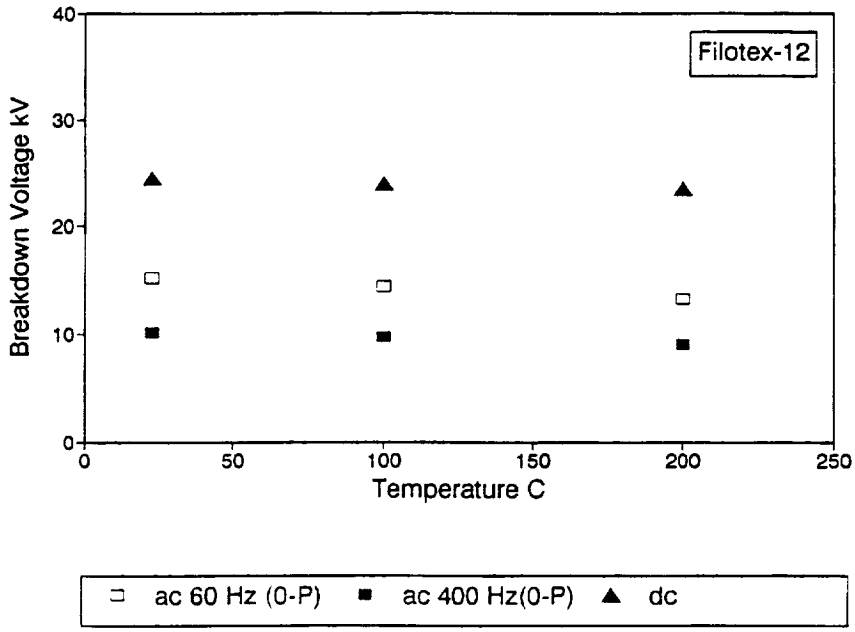


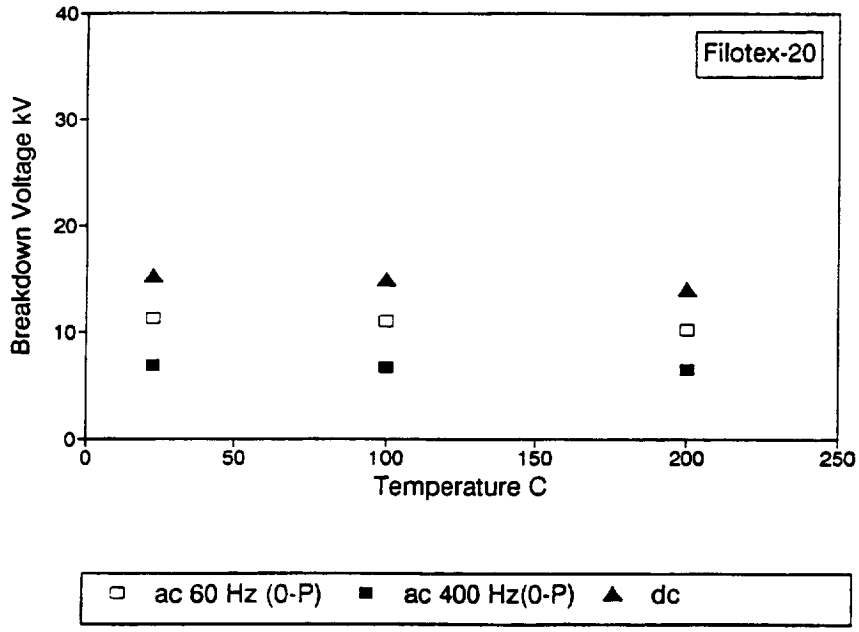

Gore-12
Breakdown Voltage kV
20
10
0
0
50
100
150
200
250
Temperature C
ac 60 Hz (0-P)
ac 400 Hz(0-P)
dc

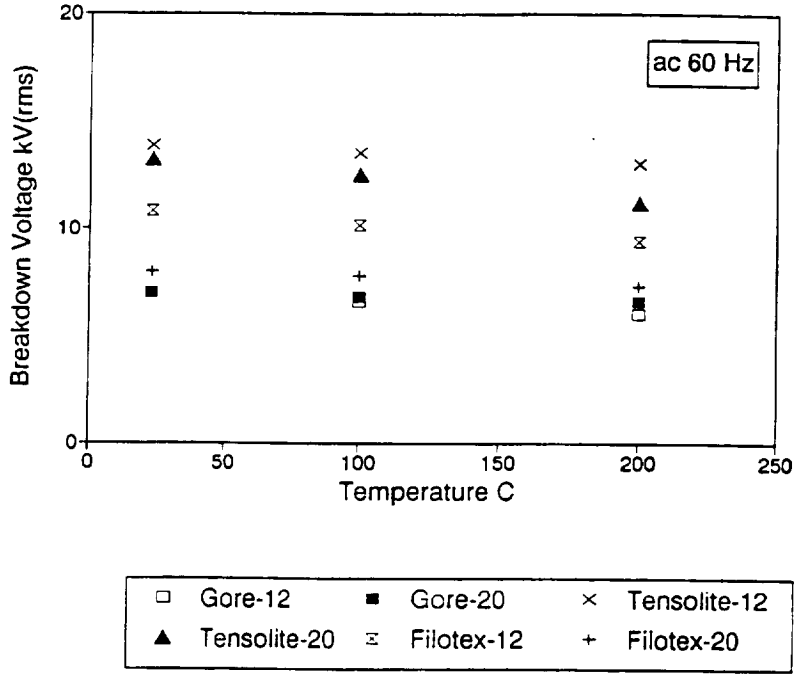

Gore-20
Breakdown Voltage kV
20
10
0
0
50
100
150
200
250
Temperature C
ac 60 Hz (0-P)
ac 400 Hz(0-P)
dc

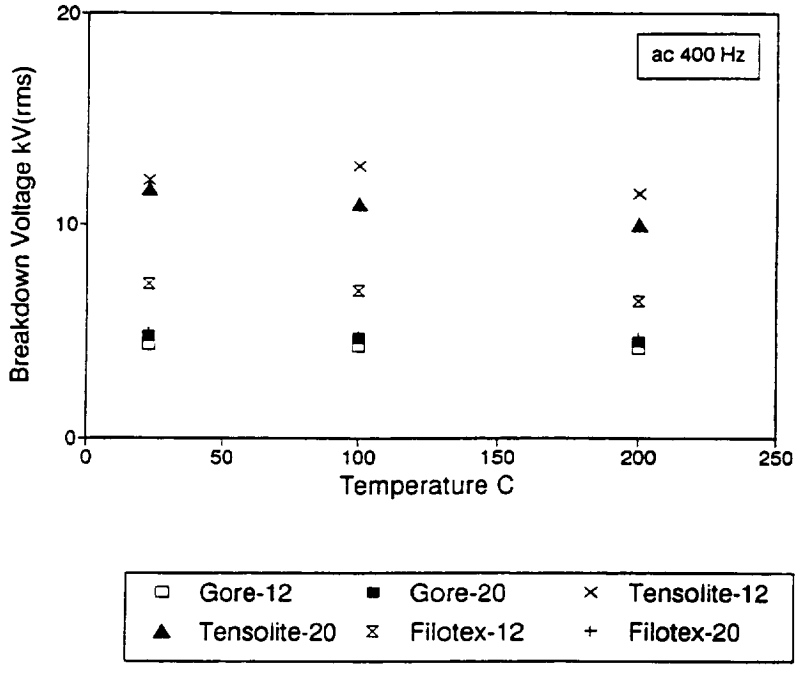

Tensolite-12
Breakdown Voltage kV
40
30
20
10
0
0
50
100
150
200
250
Temperature C
ac 60 Hz (0-P)
ac 400 Hz(0-P)
dc

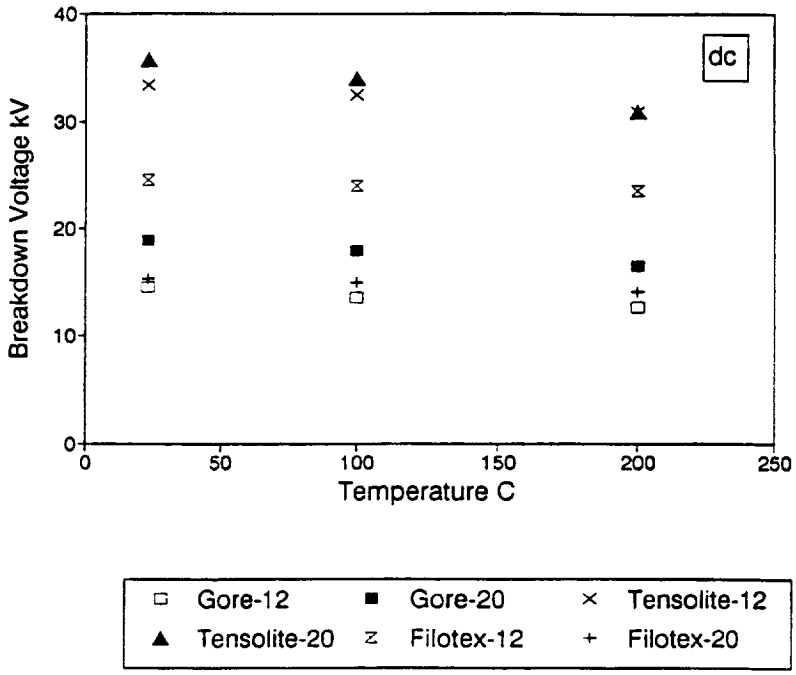

Tensolite-20
Breakdown Voltage kV
40
30
20
10
0
0
50
100
150
200
250
Temperature C
ac 60 Hz (0-P)
ac 400 Hz(0-P)
dc


Filotex-12
Breakdown Voltage kV
40
30
20
10
0
0
50
100
150
200
250
Temperature C
ac 60 Hz (0-P)
ac 400 Hz(0-P)
dc


Filotex-20
Breakdown Voltage kV
40
30
20
10
0
0
50
100
150
200
250
Temperature C
ac 60 Hz (0-P)
ac 400 Hz(0-P)
dc


ac 60 Hz
Breakdown Voltage kV(rms)
20
10
0
0
50
100
150
200
250
Temperature C
Gore-12
Gore-20
Tensolite-12
Tensolite-20
Filotex-12
Filotex-20


ac 400 Hz
Breakdown Voltage kV(rms)
20
10
0
0
50
100
150
200
250
Temperature C
Gore-12
Gore-20
Tensolite-12
Tensolite-20
Filotex-12
Filotex-20



FUTURE WORK

- Obtain breakdown strength of other constructions.
- Insulation resistance as a function of temperature.
- Multistress aging
  (Electrical, Thermal and Radiation

CONCLUSION

- No dependence of breakdown strength on temperature for constructions tested.
- Little effect of frequency on the breakdown characteristics.