

# Subject Index

## A

- Acoustic detection techniques
  - Attenuation, 334, 337, 339, 340, 346, 359, 367
  - Characteristic impedance, 336, 337, 395
  - Corona charge, 355, 358, 361, 365
  - d-constant, 342
  - Diffraction, 342
  - Diffusion losses, 337
  - Directivity, 333, 377, 399, 403
  - Discharge energy, 334, 359, 360, 365, 380
  - Gas insulation spectra, 350
  - g-constant, 332, 357
  - Human ear, 329
  - Lamb waves, 336
  - Lightning spectra, 344, 355, 359, 364
  - Liquid insulation spectra, 349
  - Line insulator spectra, 345, 348
  - Longitudinal waves, 334
  - Low pressure effects, 351, 388
  - Microphones, 330
  - Molecular absorption, 339
  - Point discharge spectra, 346
  - Point source, 337
  - Rayleigh surface waves, 335
  - Reflection coefficient, 337
  - Refraction, 343
  - Resonance in voids, 349, 402
  - RIV relationship, 365, 377, 379
  - Sensitivity, 329, 330, 331, 333, 357
  - Solid insulation spectra, 348
  - Stethoscope, listening tube, 330, 394
  - Tests on transformers, 359
  - Thin sheet behavior, 341
  - Transducers, 331, 353, 403
  - Transmission line spectra, 345, 348
  - Transverse shear waves, 335
  - Units, 328
  - Void size estimates, 353
  - Wave velocity, 335
- Acoustic emission, 329, 334, 344, 346, 351, 380
- Acoustic location techniques
  - Attenuation, 368, 380, 389, 392, 394, 397
  - Averaging and cross correlation, 373
  - Cables, 377
  - Capacitors, 382
  - Corona gun, 375
  - Delay time method, 372
  - Electronic data retrieval, 373
  - Impedance, 397
  - Parabolic microphone, 392, 399
  - Particle emission, 385
  - Reactors, 373
  - Reflection effects, 372
  - RIV measurements, 375
  - Rotating machines, 367
  - Sensitivity, 367, 375, 377
  - SF<sub>6</sub> cables, 378
  - SF<sub>6</sub> switchgear, 379
  - Sound snooper, 375
  - Transducer mounting, 367, 369
  - Transformers, 368, 370
  - Transmission lines, 375

Triangulation method, 371  
 Wave guides, 393, 395  
 Acoustic resonant column, 355  
 Acoustic velocity, 354  
 Air, 16, 24, 52, 123, 129, 230, 340,  
 359, 364, 393, 398, 453  
 Aluminum, 336, 338, 340, 355,  
 381, 387, 398, 402  
 Ammonium dihydrogen phosphate,  
 331  
 Anode, 26, 28, 452, 454  
 Antioxidant, 239  
 Apparent corona charge, 101, 106,  
 108, 117, 119, 123, 135, 140,  
 181, 310, 312, 427, 484, 490,  
 494, 498  
 Apparent discharge curve, 117, 127  
 Apparent/true charge ratio, 118,  
 120  
 Apparent voltage across void, 37  
 Arc discharge, 9  
 Argon, 24, 244  
 Avalanche (*see* Electron avalanche)

## B

Bakelite, 338  
 Balanced bridge networks  
   Common rejection ratio, 97  
   Double input balanced type, 97,  
   165  
   Low frequency bridge, 165  
   Wye-delta transformation, 98  
 Ballast impedance, 4  
 Barium titanate sensor, 331, 369  
 Barkhausen noise, 369, 374, 485  
 Basic impulse level (BIL), 114, 196  
 Beryllium, 397  
 Blocking capacitance, 69, 110, 288,  
 318  
 Bridge test methods, 264, 265, 442,  
 486  
 Bond energy, 128  
 Brass, 338, 398

Breakdown mechanisms, 25, 27,  
 473, 476  
 Breakdown potential, 24  
 Breakdown voltage, 35, 38, 41, 45,  
 50, 310, 416  
 Bushings, 115, 118, 434, 461  
 Butyl rubber, 136, 157, 339

## C

Cables, 12, 116, 136, 145, 157, 261,  
 313, 315, 378, 462  
 Cable corona tests  
    $\alpha$ -response, 93, 141, 149  
   Acoustic methods, 377  
   Attenuation, 108  
    $\beta$ -response, 93, 141  
   Calibration, 142, 149  
   Characteristic impedance, 105, 306  
   d-c methods, 434  
   Detected pulse shape, 106, 146  
   Discharge pulse reflection, 105,  
   108, 148, 169, 306, 448  
   HV cable and terminations, 156  
   Length effects, 106, 108  
   Pulse integration, 109, 149  
   Pulse superposition, 108, 141  
   Termination impedance, 105,  
   149, 306  
   Void location methods, 139, 377  
 Calibration capacitor, 70, 149,  
 152, 189, 278  
 Calibration procedures  
   Bandwidth effects, 75  
   High voltage mode, 73  
   Injected charge value, 76  
   Low voltage mode, 77  
   Pulse rise time, 75, 152  
   Pulse shape, 74, 152  
 Capacitors, 13, 116, 382, 384  
 Carbonic acid, 238  
 Cathode, 26, 28, 453, 476  
 Cavities (*see* Voids)  
 Ceramics, 131, 331

Characteristic impedance, 105, 306, 336  
 Charge content or transfer, 36, 68, 94  
 Charging current, 111, 164, 486, 489  
 Charging of particles, 19  
 Conducting paint, 207  
 Conduction current, 428  
 Copper, 338, 382, 386, 398  
 Copper oxide, 240  
 Corona cutting, 224  
 Corona discharge (definition), 3, 135  
 Corona discharge pattern, 116  
 Corona energy loss (*see* Discharge energy loss)  
 Corona extinction voltage (CEV), 115, 122, 125  
 Corona factor, 150  
 Corona inception voltage (CIV), 37, 113, 118, 121, 135, 153, 313, 411, 427, 463, 476  
 Corona mechanical stress cracking, 221  
 Cross linking, 129  
 Crystallization, 262  
 Curie point, 332  
 Cyclohexane, 340

## D

Damped oscillation transient, 139, 288  
 d-c corona discharges  
   Airborne apparatus tests, 462  
   Anomalous conductivity, 432  
   Bushing tests, 461  
   Breakdown voltage, 416  
   Cable tests, 462  
   Calibration methods, 446  
   Conductivity effects, 430  
   Detection circuits, 442  
   Discharge current, 428

Discharge energy, 429  
 Discharge inception voltage, 411, 427, 436, 463  
 Discharge magnitude, 427, 458, 461  
 Discharge rate, 416, 418, 422, 429, 436, 449, 453, 458, 461  
 Discharge sequence, 418, 432, 438  
 Discharge site, 430, 462  
 Electrical stress, 414, 419  
 Gas pressure changes, 434  
*K*-value, 419  
 Oil/paper tests, 458  
 Polarity reversal, 438, 440, 452, 456, 458  
 Pulse counting techniques, 445  
 Polyethylene tests, 449  
 Ramp voltage relationship, 456  
 Remnant (residual) voltage, 416, 429  
 Stress inversion, 434  
 Superimposed alternating voltages, 435, 456, 462  
 Temperature influence, 433  
 Time constant, 418, 419, 438  
 Time interval, 417  
 Voltage change effects, 438, 456  
 d-c insulation resistance, 162, 430  
 Dendrites (*see* trees)  
 Detection coil, 288  
 Detection impedance, 111, 139, 289, 290, 300, 442  
 Detection of discharges  
   Acoustic methods, 137, 138, 327  
   Basic circuit, 69, 71  
   Chemical method, 138  
   Heat detection method, 138  
   Light detection method, 138  
   RC circuit, 30, 70, 141, 298, 318  
   RIV method, 111, 115, 347  
   RLC circuit, 70, 106, 139, 141, 288

Under d-c conditions, 99, 409, 441

Under impulse conditions, 485

Detection system sensitivity, 68, 122, 125, 444, 488, 490, 498

Dielectric constant (permittivity), 23, 29, 419, 471

Discharge

- Area, 181
- Degradation rate, 36, 122, 127, 130, 137, 158, 215, 315, 322, 454, 458
- Energy, 36, 54, 58, 63, 118, 122, 127, 136, 266, 305, 315, 360, 429, 484
- Epochs, 37, 41, 42, 45, 310
- Intensity or magnitude, 36, 135, 140, 181, 310, 312, 427, 484, 490, 494, 498
- Pit depth, 128
- Pulse repetition rate (*see* Rate)
- Power loss, 60, 270, 429
- Rate, 40, 43, 45, 124, 293, 416, 429, 436, 495
- Sites, 32, 47, 51, 58, 63, 179, 294, 310, 312, 315, 375, 430, 478, 484
- Time, 40, 47, 145, 185

Directional pattern, 333

Dissipation factor of discharge, 62, 136, 162, 209, 214, 266, 270

Dissipation factor tip-up, 124, 270

Distilled water, 241, 340

Distributed parameter systems, 80, 85, 105, 141, 306

Double pulse calibrator, 153

Dust particles, 363, 378

## E

Ebonite, 338

Electrodes

Dielectric, 31, 323, 449, 458

Metallic-dielectric, 32, 48, 51, 303

Parallel-plane (metallic), 24, 41, 45, 311

Point-to-plane (metallic), 9, 19, 350, 374, 486

Point-to-point (metallic), 10

Sphere-to-plane, 351

Electro-mechanical stress cracking, 221

Electron

Capture, 8

Charge, 8, 26

Collision, 24

Emission, 248

Free, 26

In streamer discharge, 28

In Townsend discharge, 28

Ionizing, 26, 179, 475

Kinetic energy, 24

Mean free path, 16, 26, 388

Recombination, 8, 493

Regeneration probability, 27

Trapping, 32, 438

Velocity, 28

Electron avalanche, 7, 26, 28, 32, 473

Electrostatic

Paint spray, 19

Precipitator, 19

Separation, 17

Elmo's Fire, Saint, 3

Endurance tests

Ambient air/nitrogen effects, 230

Carbonic acid formation, 238

Copper electrodes, 240

Corona degradation of polyethylene (PE), 224, 226, 228, 230, 234

Corona degradation of polytetrafluoroethylene (PTFE), 241

Direct electrode-contact method, 223

Effect of antioxidant, 239

Effect of carbon dioxide, 235  
 Effect of electrode weight, 239  
 Effect on  $\tan\delta$  value, 234  
 Indirect electrode method, 222  
 Intrinsic dielectric strength, 222  
 Humidity effects, 231, 240, 244  
 Mechanical elongation effects, 228, 244  
 Mechanical stress relaxation, 225, 230  
 Oxalic acid crystals, 230  
 Ozone effects, 224  
 Plastic insulation, 223  
 Rod-to-plane electrodes, 226  
 Rubber insulation, 223  
 Silicone fluid immersion, 238  
 Specimen preparation, 225, 240  
 Stainless steel electrodes, 239  
 Stress annealing effects, 229  
 Stress cracking, 221  
 Surface cracks, 230, 234  
 Surface resistivity changes, 234  
 Tree growth, 221  
 Weak-link phenomenon, 222  
 Epoxy resins, 318, 322, 497  
 Equivalent void circuit, 34, 118, 283, 412, 470  
 Erosion rate, 129  
 Ethylene propylene rubber (EPR), 130, 137, 313

## F

Fiberglass, 399, 401  
 Field test equipment, 161  
 Field tests, 157  
 Foil edges, 385  
 Formative time lag, 476  
 Franklin, Benjamin, 3  
 French cell, 222  
 Full cable reel tests, 139, 141, 151

## G

### Gases

Air, 16, 24, 52, 230, 340, 359, 364, 393, 398, 453, 486  
 Argon, 24  
 Carbon dioxide, 231, 235, 398  
 Helium, 24, 56, 303  
 Hydrogen, 24, 128, 136, 350, 384, 398  
 Methane, 136  
 Neon, 24, 354, 398  
 Nitrogen, 16, 18, 24, 230, 244, 339, 398, 453  
 Oxygen, 18, 24, 52, 65, 339, 398  
 Ozone, 4, 12, 17, 223, 244, 329  
 Sulfur hexafluoride, 16, 52, 339, 344, 380, 398  
 Geiger counter, 18  
 Generator coils, 116, 123, 177, 184  
 Generator insulation, 211, 323, 325, 367  
 Geometrical relaxation régime, 388  
 Glow discharges, 52, 58, 64, 99, 346, 389  
 Glycerin, 343, 367, 384  
 Ground interference, 160

## H

Half toroid core, 218  
 Helium, 24, 56, 303  
 High frequency current transformer, 186  
 Hook-up wire, 12  
 Human ear, 329  
 Hydrogen, 24, 128, 136, 350, 384, 398  
 Hydrophilic contaminants, 262

## I

Impregnated paper, 129, 136, 271, 293, 431, 458, 470

- Impregnated pressboard, 340, 365, 415, 439, 458  
 Impulse corona discharges  
   Cable tests, 499  
   Calibration method, 488  
   Conditioning impulse, 495  
   Damped oscillation condition, 479  
   Detection methods, 485  
   Discharge duration time, 476  
   Discharge energy, 484, 489  
   Discharge inception voltage, 476, 483  
   Discharge magnitude, 484, 489, 494, 498  
   Discharge mechanism, 473  
   Discharge rate, 488, 491, 495  
   Discharge sequence, 476  
   Discharge sites, 478, 484  
   Main discharge, 493  
   Polarity reversal, 491, 495, 500  
   Polarization charge, 477  
   Polyethylene tests, 491  
   Remnant (residual) voltage, 477  
   Residual charge, 490  
   Reverse discharges, 477, 493  
   Sensitivity, 488, 490, 498  
   Shielding, 487  
   Superimposed alternating voltage, 479  
   Transformer tests, 498  
   Wavetail discharges, 493  
 Impulse wave, 114, 369, 469  
 Induced voltage tests, 186  
 Inductive shunt, 188  
 Inductively coupled probe, 215  
 Infrasonic frequencies, 329, 345  
 Insulating liquids, 334  
 Insulation resistance tests, 166  
 Insulator clamps, 377  
 Insulator strings, 448  
 Integration time, 149  
 Interference rejection, 166  
 Internal partial discharges (*see* Corona discharges)
- Inverted  $\tan\delta$  bridge, 163  
 Ionization, 5, 7, 26, 474  
 Ionization factor, 136  
 Ions  
   Bombardment, 13, 135  
   Column or avalanche, 26  
   In streamer discharge, 30  
   In Townsend discharge, 30  
   Traps, 32, 248, 458  
   Velocity in discharge, 28  
 Isolating impedance, 113
- K**
- Kerosene, 340
- L**
- Laminar insulation, 211  
 Lead titanate sensors, 331, 357  
 Lead zirconate sensors, 331, 357  
 Lightning, 327, 344, 355, 359, 364  
 Lightning rod, 3, 17  
 Line dampers, 377  
 Line filters, 114  
 Line joints, 377  
 Line noise, 114  
 Listening rod, 369  
 Lumped capacitance specimens, 116, 289, 306  
 Lumped parameter systems  
   Definition, 101  
   Lumped to distributed parameter transition, 105, 148  
   Test criteria, 102
- M**
- Machine coils, 207, 271  
 Machine slots, 207  
 Magnesium, 387  
 Magnetostrictive noise (*see* Barkhausen noise)  
 Mean free path, 16, 26, 388  
 Metallic particles, 380, 385

Metallized films, 383  
 Meteoric acoustical emission, 355  
 Methane, 136  
 Methyl alcohol, 241  
 Mica-asphalt insulation, 367  
 Mica synthetic resin insulation, 123,  
 178, 207, 367  
 Microbubbles (in oil), 363  
 Microphone detectors, 330  
 Moisture effects, 12, 158, 161, 167,  
 232, 234, 240  
 Motor coils, 116, 121, 123, 177, 184  
 Motor insulation, 211, 367  
 Multichannel analyzers, 304, 320,  
 445  
 Mylar film, 343

## N

Narrow band detectors  
   Attenuation, 147  
   Cable length effects, 148  
   Calibration method, 102  
   Corona pulse integration, 104  
   Critical damping, 106  
   Definition, 102  
   Detected corona charge, 107, 147  
   Noise rejection, 106  
   Pulse decay time effects, 104  
   Pulse form, 107, 147  
   Pulse rise time effects, 102  
   Relative response, 102  
   Sensitivity, 113  
 Negative polarity discharges, 42,  
 303, 323  
 Negative resistance, 8  
 Neoprene, 339, 343  
 Nitrogen, 16, 18, 24, 230, 244, 339,  
 398, 453  
 Nitrogen oxide, 18

## O

Oil, 184, 337, 340, 343, 350, 353,  
 355, 358, 360, 362, 364, 385,  
 470

Oil-impregnated cables, 136, 293  
 Oil-paper insulation, 129, 271, 458,  
 470  
 Organic glass, 338  
 Overhead power lines  
   a-c corona, 15, 327, 345, 356,  
   375  
   Acoustic emission, 345  
   Corona power loss, 15  
   d-c corona, 346  
   Insulator corona, 345, 347, 377  
   r-f interference, 15, 20, 377  
 Oxalic acid, 4, 230, 234  
 Oxygen, 18, 24, 52, 65, 339, 398  
 Ozone, 4, 12, 17, 223, 244, 329

## P

Parabolic acoustic reflector, 330,  
 359, 392  
 Parallelogram technique (Dakin  
 bridge)  
   Calibration method, 277  
   Capacitance increase, 279  
   Corona charge transfer, 278, 282  
   Corona pulse display unit, 280  
   Energy per cycle, 278  
   Frequency rejection, 281  
   Isolating transformer coupling,  
   281  
   Parallelogram trace, 276  
   Sensitivity, 278, 281  
   Specimen capacitance, 279  
   Standard capacitor, 274, 281  
 Particle accelerators, 470  
 Pascal's law, 328  
 Paschen curve, 25, 123, 179, 416,  
 434, 463, 495  
 Paschen's law, 24, 168, 412, 462,  
 473  
 Peak pulse corona meter, 218  
 Phase shifting circuit, 273  
 Photoelectric emission, 27  
 Photo-electrons, 7

- Photomultiplier circuit, 287, 449, 486
- Photons, 27, 287
- Piezoelectric ceramics, 331
- Piezoelectric crystals, 331
- Piezoelectricity, 331
- Pin type insulators, 348
- Plasma channel, 28
- Plastic films, 17
- Plexyglass, 393, 395, 401
- Poisson's ratio, 397
- Polarization charge, 477
- Polychlorinated biphenyl (PCB), 344
- Polyethylene (PE), 4, 13, 17, 30, 33, 121, 128, 137, 224, 255, 262, 377, 398, 414, 431, 442, 449, 491
- Polymers, 17, 137, 240, 449
- Polymethylmethacrylate, 340
- Polyolefin resins, 251
- Polystyrene, 337, 340, 398
- Polytetrafluoroethylene (PTFE), 241
- Polyvinyl chloride, 130, 157, 377
- Porcelain insulators, 312
- Positive polarity discharges, 42, 323
- Potential bushing taps, 187
- Potential difference, 5
- Potential transformers, 374
- Power factor tip-up, 124, 270
- Power frequency separation filter, 110
- Precession of discharge epochs, 38, 45, 47
- Pseudoglow discharges, 52, 55, 64, 99
- Pulse counting techniques
  - Corona charge level, 293
  - Corona pulse shaping, 289, 445
  - Corona pulse width, 294
  - Critical damping, 290, 295
  - d-c corona tests, 445
  - Demodulation circuit, 289
  - Differential counting mode, 299
  - Diode bridge inverter, 295
  - Discharge rate-voltage curve, 293
  - Discriminator circuit, 294, 299
  - Electronic counters, 286, 288
  - Emitter follower circuit, 296
  - High resolution circuit, 295
  - Isolating amplifier, 296
  - Monostable multivibrator, 295
  - Normalized counting mode, 299
  - Parasitic oscillations, 295
  - Photomultiplier methods, 287
  - Polarity sorting circuit, 291
  - Pulse inverter circuit, 290
  - Pulse resolution, 292
  - Schering bridge type circuit, 298
  - Total pulse count circuits, 288
- Pulse detection networks, 78
- Pulse-height analysis techniques
  - Analog to digital converter, 304
  - Calibration procedure, 307
  - Clipping diode circuit, 303
  - Commercial multichannel analyzers, 304
  - Corona charge pulse heights, 304
  - Corona current, 305
  - Corona energy loss, 305
  - Corona pulse distribution spectra, 303
  - Corona pulse integration, 307
  - d-c corona tests, 445
  - Dead time, 304
  - Differential pulse-height distribution, 294
  - Distributed parameter specimens, 306
  - Early high speed photography, 286
  - Effect of time on pulse spectra, 315
  - Emitter follower circuit, 301
  - Exclusive OR gate, 301
  - Isolation amplifier, 303
  - 1-f bridge type analyzer, 318
  - Metallic-dielectric electrode spectra, 312
  - Metallic electrode spectra, 311

- Monostable multivibrator circuit, 301
  - Noise pulse spectrum, 309
  - Power amplifier source, 319
  - Pulse distribution peak, 311
  - Pulse shaping circuit, 307
  - Pulse spectra of epoxy resins, 318
  - Pulse spectra of EPR cables, 313
  - Pulse spectra of impregnated papers, 318
  - Push-pull amplifier, 303
  - Single channel analyzer, 300
  - Starr analyzer method, 288
  - Test frequency, 318
  - Upper and lower level discriminator, 300
  - Window width, 301
  - Pulse phase distribution
    - Counting errors, 324
    - Distribution curve, 324
    - Measuring circuit, 323
  - Pulse propagation velocity, 141
  - Pulse separation-interval distribution
    - Calibration method, 321
    - Chopper pulse train, 321
    - Operational amplifier, 319
    - Pulse separation spectra, 322
    - Synchronization circuit, 319
    - Time-amplitude converter, 319
    - Timer unit, 321
  - Pulse transformers, 470
- Q**
- Quantum of radiation, 6
  - Quartz, 332, 338
  - Q-value of acoustic sensors, 358
  - Q-value of detection networks, 91
- R**
- Radial shock wave, 355
  - Radiant energy, 129
  - Radiated noise, 114, 125
  - Radio noise meters, 190, 196, 330, 377, 491
  - Radius of discharge, 128
  - Random noise, 218
  - Rate of voltage rise, 153
  - RC detection network
    - Amplifier bandpass, 83, 85
    - Amplifier input impedance, 85
    - Component capacitances, 82
    - Extraneous interference, 85
    - Frequency response, 84
    - Frequency spectrum, 83
    - Pulse energy content, 83
    - Pulse form, 81, 444
    - Pulse resolution, 85
    - Specimen capacitance effects, 82, 85
    - Superposition effects, 86
  - RC detection systems, 81, 290, 298, 318, 443
  - Reactor coils, 177, 485
  - Recurrence frequency of discharges (*see* Discharge rate)
  - Relaxation oscillator, 11
  - Repetition rate (*see* Discharge rate)
  - Residual (remnant) voltage, 37, 41, 45, 50, 123, 310, 416, 429, 477
  - Reverse discharges, 439, 477, 493
  - r-f choke, 319
  - RLC detection network
    - $\alpha$ -response, 93, 141, 149
    - $\beta$ -response, 93, 141
    - Bandwidth, 91, 93
    - Circuit parameters, 87, 288
    - Frequency response, 92
    - Frequency spectrum, 89
    - Pulse energy content, 91, 96
    - Pulse form, 89, 141, 288, 444
    - Pulse resolution, 90, 93, 95
    - Q-value, 91
    - Resolution time, 94
    - Resonant frequency, 89, 91, 144, 288

Sensitivity, 91, 94, 150  
 Signal to noise ratio, 94  
 Time constant, 88  
 Transformer detection impedance, 95  
 RLC detection systems, 87, 288, 295, 300, 443  
 Rochelle salt, 331  
 Rotating machine tests  
   Capacitance increase, 208  
   Capacitance-tan $\delta$  bridge method, 208  
   Charge-voltage parallelograms, 212  
   Corona charge per cycle, 212  
   Corona power loss per cycle, 212  
   Corona pulse detector measurements, 214  
   Dakin capacitance bridge, 211  
   Degradation studies, 215  
   Discharge loss analyzer bridge, 212  
   Electromagnetic probe method, 215  
   Gradation of void depths, 213  
   Guard rings, 211  
   Peak pulse corona meter, 218  
   Pulse superposition effects, 207, 214  
   Rate of corona charge change, 210  
   Semiconducting paint effects, 211  
   Specimen coil tests, 211  
   Surface or external discharges, 211  
   Tan $\delta$  increase, 209  
   Test frequency limits, 213  
   Test specifications, 210  
   Void volume, 214

## S

Safety circuit, 113

Saturation current, 8  
 Scanning method for cables, 139  
 Schering bridge, 267, 273, 298  
 Secondary electron emission, 27  
 Semiconducting paint, 207, 211  
 Semiconductor shielding, 156, 315  
 Separator-filter, 145  
 Sequence of discharge, 36, 47, 49, 418, 432, 438, 476  
 Shunt resistor (RIV tests), 193  
 Silicone grease, 379  
 Silicone oil, 156  
 Silicone rubber insulation, 130  
 Silver electrodes, 255, 387  
 Single channel analyzer, 300, 303  
 Slivers, 385  
 Soft ion finite core, 215  
 Sonic frequencies, 329, 345  
 Sound wave guides, 332  
 Space charge, 11, 28, 32, 474  
 Spacer insulators, 379  
 Spark discharges, 26, 28, 32, 54, 349, 380, 394  
 Specimen capacitance, 69  
 Statistical time lag, 474, 494  
 Stator slots, 215  
 Steel, 337, 340, 343, 398, 401  
 Stray capacitance, 70  
 Streamer discharges, 28, 30, 185, 344, 346, 350, 354, 356, 361, 364, 387, 473  
 Stress concentration factors, 180  
 Stress cones, 125  
 Surface carbonization, 130  
 Surface charge distribution, 30, 32, 179, 183, 492  
 Surface discharges, 32  
 Surface resistivity, 29, 31, 312  
 Surface resistivity time constant, 29  
 Surface temperature, 129  
 Switchgear components, 116  
 Switching surge, 469, 497  
 Synthetic rosin bonded papers, 32

## T

Tangential discharges, 32, 476  
 Temperature effects, 126  
 Temperature gradient, 129  
 Test standards, 116, 150, 155  
 Thunder, 327, 344, 355, 359  
 Townsend discharge  
   Breakdown criteria, 27  
   First ionization coefficient, 26  
   Mechanism, 25  
   Pulse form, 30, 473  
   Second ionization coefficient, 27  
 Transformer ratio arm bridge, 163, 267, 269, 272  
 Transformer tests  
   Acoustic tests, 359, 368, 370  
   Attenuation, 177, 200  
   Calibration procedure, 189  
   Detection circuit connections, 186  
   Discharge pulse shape method, 207  
   Distributed parameter behavior, 177, 306  
   Fourier spectra of pulses, 197  
   Frequency response of RIV meters, 196  
   Impedance matching, 188, 194  
   Location of discharges, 199  
   Pulse decay waveform, 186  
   Pulse reflection, 202  
   Quasi-peak to peak ratio, 199  
   Quasi-peak values, 184, 192  
   RIV bushing tap circuit, 194  
   RIV coupling capacitor circuit, 193  
   RIV measurements, 184, 190, 193  
   Time decay method, 204  
   Voltage vector analysis method, 206  
   Winding resonances, 178  
 Tree growth mechanisms

Applied voltage influence, 254  
 Contamination effects, 262  
 Controlled void vented-needle method, 258  
 Corona initiated treeing, 248  
 Double electrode interior ground test, 249  
 Electrode resin contact, 254  
 Electrochemical (water), trees, 259  
 Frequency of test voltage, 254  
 Gap length effects, 252  
 Gas pressure effects, 252  
 Grounded electrode geometry, 253  
 Intermittent tree growth, 251  
 Molding considerations, 253  
 Needle test method, 249  
 Non vented electrode test, 255  
 Particle effects, 252  
 Point electrode sharpness, 253  
 Stress initiated treeing, 248, 252  
 Sulfide trees, 261  
 Tree branching, 248  
 Tree channels (tubes), 249  
 Tree propagation in PE, 246, 247  
 Treeing in polyolefins, 251  
 Treeing in XLPE, 255  
 Vented electrode test method, 256  
 Voltage continuity considerations, 254  
 True discharge amplitude, 117  
 Two-detector bridge method, 273

## U

Ultrasonic emission, 348, 358  
 Ultrasonic frequencies, 329, 346  
 Ultrasound velocity, 354

## V

van deGraff generator, 19

Velocity of sound, 327, 348  
 Void size effects  
   Charge integration, 169  
   Charge magnitude, 169  
   Discharge energy, 172  
   Discharge potential, 168  
   Insulation degradation, 173  
   Minimum detectable charge, 169  
   Pseudoglow discharges, 174  
 Vapor pressure, 171  
   Water ingress, 170  
 Voids (cavities)  
   Alternating breakdown voltage, 23, 179, 304  
   Alternating voltage stress, 22, 119, 168, 179, 413, 472  
   Cylindrical geometry, 121, 168, 179, 182, 413, 419, 422, 427, 436, 438, 470, 472, 491  
   Depth, 124, 303, 435, 439, 471  
   Direct voltage stress, 414, 419  
   Discharge process, 53, 294, 312, 315, 348  
   Distribution, 123  
   Elliptical-cylindrical geometry, 413, 415, 419, 421  
   Flat-shaped, 22, 119, 179  
   Oblate-spheroidal geometry, 413, 415, 419, 421, 436, 472  
   Overvolting, 122, 476  
   Size, 124, 353, 451  
   Spherical geometry, 23, 120, 168, 179, 413, 427, 436  
   Surface conductivity, 415, 419, 451, 493

Surface resistivity, 29, 169, 315, 322, 414  
 Vapor pressure changes, 125, 294, 434  
 Voltage-current characteristic, 264  
 Voltage waveform across void, 35, 47, 52, 56  
 Volume, 121, 214  
 Volume conductivity, 419, 422, 430, 431, 458, 461  
 Volume resistivity, 414

## W

Water, 170, 338, 340, 395, 398  
 Wax formation, 129, 131, 136, 138  
 Wide band detectors  
   Amplitude errors, 102  
   Calibration, 102  
   Corona pulse integration, 104  
   Cut-off frequencies, 102  
   Definition, 102  
   Mid-band frequency, 102  
   Pulse decay time effects, 104  
   Pulse rise time effects, 102  
   Relative response, 102

## X

Xerography, 19

## Z

Zinc, 397