Selected bibliography of fuses

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SELECTED BIBLIOGRAPHY OF FUSES

Compiled by

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September 1969

TH-Report 69-E-08

by error
see Preface last page

1. Books, reviews and general papers.

A 1.1 J.W. Gibson: The High Rupturing Capacity Cartridge Fuse.
Journal IEE 88 pt. II (1941), 2-40.
Also in: GEC-Journal 11 (1940) 103-113.
11 (1941) 150-163.
A general discussion on the subject of current limiting fuses for use in low- and medium voltage circuits.

A 1.2 H.W. Baxter: Electric Fuses.
E. Arnold - London 1950.
Electrical behaviour of fuses under a large variety of circumstances. Design and construction of fuses. Requirements.
In this book a large number of experimental data are given; the theoretical discussions are concise.

B 1.3 H. Läpple: Electrical Fuses. A critical Review of Published Information.
Butterworth, London 1952.
A qualitative survey of the investigations on fuses with an extensive bibliography.

A 1.4 R. Rüdenberg: Elektrische Schaltvorgänge.
Springer, Berlin 1953, pp. 305-314.

B 1.5 VEM-Handbuch-Schaltanlagen, Band I.
VEB-Verlag Technik Berlin (1960), pp. 529-551.
A general survey is given of the requirements on fuses as stated in the German specification of fuses (VDE).

B 1.6 W.J. Chicken: High-Voltage Powder-Filled Fuse-Links for Power Distribution Circuits.
Electr. Rev. 174 (1964) 523-525.

A 1.7 H.W. Turner and C. Turner: Advances in Electrical Fuses.
A Summary of Published Information 1950-1965.
ERA-Rep. No. 5228 (1967).
This report offers an extensive bibliography on fuses comprising also a number of titles of publications on exploding wire phenomena.

2. Heating of fuse elements. Pre-arcing time.

C 2.1 W.H. Preece: On the Heating Effect of Electric Currents.
Proc. Royal Soc. 36 (1884) 464-471.
Connection between minimum fusing current and diameter of fuse elements. Theoretically and experimentally. This paper is only important from a historical point of view.

C 2.2 G.J. Meyer: Beitrag zur Kenntnis der Abschmelzsicherungen.
Thesis Berlin 1906.
Calculation pre-arcing time. Temperature distribution along a fuse element. Experiments.
In some respects out of date.

C 2.3 J.A.M. van Liempt: Zur Theorie des Grenzstromes bei Schmelz-Sicherungen.
Z. f. Physik 86 (1933) 387-391.
Calculation of minimum fusing current and experimental verification.

A 2.4 J.A.M. van Liempt and J.A. de Vriend: Die Schmelzzeit dünner Schmelzsicherungen.
I : Z. f. Physik 93 (1934) 100-110.
II: Z. f. Physik 98 (1936) 133-140.
Experimental verification and range of validity of Meyer's equation (see 2.2). Experimental results of a number of wire materials.

B 2.5 G. Gut and L.M. Grünberg: Erwärmung von Leitern bei kurzen Belastungszeiten und bei Kurzschlüssen.
Bull. SEV 18 (1927) 205-225.
Simple calculations, partly empirical treatment.

A 2.6 E. Wintergerst: Über die Schmelzzeit von Schmelzsicherungen.
Z. angew. Phys. II (1950) H.4, 167-174.
Pre-arcing time of fuse wires stretched in air or in a solid matter (sand), taking into account radial and axial heat transfer to the surroundings of the wire. Investigation of different mechanisms of heat transfer. Problems regarding the pre-arcing time of cylindrical fuse elements are discussed in full.

B 2.7 J. Fischer: Die stationäre Temperatur stromdurchflossener, mässig langer Drähte.
Arch. f. Elektrotechnik 15 (1951) H.3, 141-171.
Theoretical investigation of temperature distribution, influence of the properties of wire material. Analytical and numerical solutions.

B 2.8 J. Fischer: Die stationäre Temperature stromdurchflossener, langer Drähte.
Arch. f. Elektrotechnik 15 (1952) H.4, 262-274.
Theoretical. Influence convection and radiation, cross-section of the wire and electrical current.

B 2.9 E.B. Carne: A mechanism for the Fuse Pre-Arcing Period.
Trans. AIEE 72 (1953), 593-599.
Calculations of the temperature distribution in the axial and in the radial direction of a cylindrical fuse wire, taking into account the heat transfer to the surroundings of the wire.
Pre-arcing time calculations.

B 2.10 A.E. Guile and E.B. Carne: An Analysis of an Analogue Solution Applied to the Heat Conduction Problem in a Cartridge Fuse.
Trans. AIEE 73 (1954) 861-868.
Approximate analytical solution and analogue solution of temperature distribution along cylindrical fuse wires embedded in sand.

A 2.11 A.E. Guile: The calculation of the complete Time / Current Characteristics of Cartridge Fuses with Single Wire Element.
Trans. AIEE 74 (1955) 1108-1115.
An investigation of the heating processes during the pre-arcing period.

B 2.12 C. Adamson and M. Viseshakul: An analytical Method for Predicting the Performance of Semi-Enclosed Fuses.
Proc. IEE 108C (1969) 2.

B 2.13 C. Adamson and M. Viseshakul: Analytical Determination of the Characteristics of Enclosed and Oil-Immersed Fuses.
Proc. IEE 109C (1961) 478-491.
Both publications 2.12 and 2.13 give an analytical and analogue solution of the temperature distribution and the pre-arcing time of non-homogeneous fuse-elements (notched ribbons, etc.).

B 2.14 R. Groszkopf: Kurze Sicherungsschmelzleiter unter Flüssigkeit zum Schutz von Starkstromanlagen bei Kurzschlüssen.
Thesis Braunschweig 1966.
Temperature distribution along short fuse elements (ribbons) having a discontinuity in its cross-section, stretched in oil or in air.
Minimum fusing current and pre-arcing time. Applicability for low-voltage current limiting fuses. Investigation of questions regarding the arc-voltage.

B 2.15 L. Vermij: De verwarming van smeltdraden als gevolg van een doorgaande elektrische stroom.
Elektrotechniek 44 (1966) 308-317.
Approximate calculation and measurement of the stationary temperature distribution along a cylindrical fuse wire stretched in air or in sand.
Rapid heating of fuse elements. Pre-arcing time. Influence of the length of the fusing wire on the pre-arcing time.

B 2.16 Y. Suzuki, Y. Yokoi and M. Nagata: Impuls-Current Response of Time-Lag Fuses.
Electrical Engineering in Japan 88 (1968) 66-73.
Derivation of expressions for the temperature rise, minimum fusing current and pre-arcing time of time-lag fuses (lead wires) which are subject to an impuls current. Comparison with experimental results.

2.17 See also 4.5, 5.6 and 8.1.

3. Physical processes relating to the pre-arcing time and the arcing time.

B 3.1 E.F. Northrup: Some newly observed manifestations of forces in the interior of an electric conductor.
Phys. Review 24 (1907) 474-497.
Calculations of the radial pressure distribution in a current carrying conductor. Experiments.

B 3.2 W. Kleen: Über den Durchgang der Elektrizität durch metallische Haardrähte.
Ann. der Physik, 5. Folge, Band II (1931) 579-605.
Deformation of a liquid current carrying conductor under the influence of surface tension and magnetic pinch pressure.

C 3.3 W. Ende: Beitrag zur Kenntnis der Kurzschlussfunken.
Ann. der Physik, 5. Folge 17 (1933) 460-462.
High speed photographs showing the deformation process of a fusing wire of small cross-section.

B 3.4 K.A. Lohausen: Hochspannungssicherungen.
E. und M. 53 (1935) H.33, 385-390.
Explanation of the electrical behaviour of fuses from the assumption of fulgurite conduction. Survey of fuse designs (somewhat out of date).

B 3.5 H. Läpple: Die Vorgänge bei der Kurzschluss-Unterbrechung durch schnell-abschaltende Hochspannungssicherungen.
VDE-Fachber. 6 (1934) 72-76.
A qualitative treatise of the processes during the arcing time and of questions connected with current limiting action. Discussion with K.A. Lohausen mentioned in this paper is of interest.

B 3.6 H. Läpple: Die Lichtbogenlöschung in körnigem Löschmittel bei Hochspannungssicherungen.
ETZ 58 (1937) H.14, 369-372
H.16, 426-428.
A qualitative treatise of the processes during the arcing time.

B 3.7 H. Weber: Vorgänge bei der Kurzschlussabschaltung durch Schmelzsicherungen.
VDE-Fachber. 9 (1937) 92-95.

A 3.8 H.W. Baxter: The Process of Opening a Circuit by a Fuse.
BEAMA-Journal August 1955, pp. 135-138.
Investigation of the multiple arcing process. Influence circuit induction and length of fuse wire on peak voltage. Small-over-current performance.

A 3.9 S. Bors: Beitrag zur Frage der Alterung von Schmelzsicherungen.
E. und M. 79 (1962) H.6, 131-135.
Investigation of ageing effects of fuse elements of different materials and under different physical circumstances. Diffusion of the low-melting-point material in the case of fuse elements with M-effect.

A 3.10 K.A. Lohausen: Überstromunterbrechung mit strombegrenzenden Hochspannungssicherungen für Gleich- und Wechselstrom.
Elektrie 16 (1964) (1) 24-29.
Operation of a fuse explained from the electrical conductivity of the fulgurite. Influence of circuit parameters.

A 3.11 H.W. Turner and C. Turner: Fuse operation on overcurrent.
Electrical Times, 28 July, 1968.
Temperature distribution. Multiple arcing effect and its influence on the interruption of the current.

B 3.12 L. Vermij and J.E. Daalder: Energy Balance of Fusing Silver Wires Surrounded by Air.
TH-publ. no. 68-E-05, Technological University Eindhoven, 1968.
Derivation and experimental verification of an energy balance equation.

B 3.13 L. Vermij: Electrical Behaviour of Fuse Elements.
Thesis Eindhoven, 1969.
Clarification of the electrical behaviour of cylindrical fuse elements surrounded by air or by a solid matter. Investigation of physical processes. Interaction between fuse elements and the electrical circuit.

4. Electrical phenomena associated with the arcing time.

B 4.1 A. Gantenbein: Die progressiv schaltende Schmelzsicherung.
Bull. SEV 32 (1941) 189-196.
Calculation of cut-off-current, investigation of overvoltages, breaking capacity and design of fuses.

A 4.2 C.L. Schuck: Performance Criteria for Current-Limiting Power Fuses I.
Trans. AIEE 65 (1946) 1028-1034.
Electrical behaviour of current limiting fuses, influence on it of generated voltage, available current, fault starting angle, voltage angle at melting, frequency, power factor, number of phases.

A 4.3 E.W. Boehne: Performance Criteria for Current-Limiting Power Fuses II.
Trans. AIEE 65 (1946) 1034-1045.
This publication offers an elucidative treatise on an analytical basis of the influence of the arc voltage on the operation of a fuse. Also the influences mentioned under 4.2 are discussed in this paper. The two papers 4.2 and 4.3 together yield a clear insight in the electrical characteristics of current limiting fuses.

B 4.4 H. Bitter: Die Kurzschlussstrombegrenzung der HH-Sicherungen.
Siemens Z. 26 (1952) 372-377.
Investigation of current limiting action of high-voltage fuses.

B 4.5 W. Rauch: Kurzschlussstrombegrenzung bei der Gleichstromabschaltung durch Schmelzeinsätze.
Siemens Z. 32 (1958) 674-678.

B 4.6 W. Rauch: Strombegrenzung bei der Abschaltung von Wechselstrom-Kurzschlüssen durch Sicherungen.
ETZ-A 80 (1959) 543-547.
Current-limiting action of fuses in DC-circuits (4.5) and AC-circuits (4.6). Calculation of the cut-off-current and the pre-arcing time.

A 4.7 K. Lerstrup: The Current-Limiting Fuse with Special Reference to Discrimination and Breaking-Capacity.
Ingeniøren, Intern. ed. 2 (1958) 13-20.

A mainly qualitative treatise of the influence of the instant of fusing on the arc-energy. Discussion of subjects as peak voltage, fault starting angle, etc.

B 4.8 H. Bitter: Zur Frage der Lichtbogenarbeit in Hochspannungs-Hochleistungs-Sicherungen.
ETZ-B 12 (1960), 608-611.
Dependency of the arc energy on the fusing current. Critical fusing current. Experimental results obtained with high-voltage fuses manufactured by Siemens.

B 4.9 H.W. Baxter: The Relation between Cut-off Current and Arc Energy in Cartridge Fuses.
ERA-Report G/T 325 (1961).
Experimental data regarding the arc energy as a function of the prospective current (AC and DC), inductive energy and cut-off current ratio.

A 4.10 J. Hennebert: Comportement des fusibles limiteurs au cours des essais de coupure.
Règles d'essais qui en résultent.
Rev. Gen. Electr. 73 (1964) 570-576.
A critical treatise, mainly on an experimental basis, of the current interruption capacity of fuses, with special reference to the values of the current to be interrupted, the circuit voltage and the design of the fuse element (homogeneous versus non-homogeneous cross-section).

4.11 See also 2.14, 3.4, 3.5, 3.13 and 9.1.

5. Fuse design in relation with fuse characteristics.

B 5.1 H. Johann: Die Lenkung des Schaltvorganges in Hochspannungs-Sicherungen mit körnigem Löschmittel.
VDE-Fachber. II/34-38 (1954).
A qualitative investigation of the influence of the shape of the fuse element on the course of arc voltage and current.

A 5.2 A.H. Powell and C.L. Schuck: Ribbon Elements for High-Voltage Current-Limiting Fuses.
Trans. AIEE 74 (1955) 635-643.
A treatise on hand of experimental data of the characteristics of fuses with rectangular-shaped fuse elements. Effect of notches and low-melting-point alloy.

B 5.3 H. Bitter: Einfluss der Bemessung der Steuerschmelzleiter auf die Grösse der Löscharbeit bei HH-Sicherungen.
Siemens Z. 32 (1958) 39-43.
Influence of the shape of the fuse element on the arc energy and on the peak voltage. Experimental results.

A 5.4 R.H. Dean: Recent Developments in Medium-Voltage H.B.C. Fuse Links.
Proc. IEE pt. A, 106 (1958) 263-277.
Fuse design and fuse characteristics, tests and requirements.

B 5.5 H. Bitter: Hochspannungs-Hochleistungs Sicherungen mit optimalen Schmelzleiter.
Siemens Z. 34 (1960) 266-267.
This paper can be considered as a continuation of the paper mentioned under 5.3.

B 5.6 H.H. Johann: NH-Sicherungen für erhöhte Anforderungen (Probleme und Ergebnisse der Weiterentwicklung).
Siemens Z 34 (1960) 477-484.
Treatise of different fuse designs. Further a review is given on temperature distributions along fuse elements and calculation of pre-arcing times (only results are mentioned).

B 5.7 H. Bolleter: Konstruktionsprobleme und Einsatzmöglichkeiten von Apparaten-Schmelzeinsätze.
Bull. SEV 53 (1962) 583-593.
Design and application of miniature fuses.

A 5.8 J. Mocsáry: Neuere Untersuchungen an Hochspannungs-Hochleistungs-Sicherungen mit sehr hohem Abschaltvermögen und niedrigen Schalt-Überspannungen.
Elektrie 17 (1963) 305-307.
The effect of the design of the fuse element on the peak voltage and the arcing voltage.

B 5.9 J. Mocsáry: Schmelzleiterkonstruktionen Strombegrenzender HH-Sicherungen und ihr Verhalten bei Unterbrechung kleiner Ströme.
Elektrie 19 (1965) 310-312.
The electrical behaviour of fuses with non-homogeneous round fuse elements at small currents.

B 5.10 H.W. Mikulecky: Current-Limiting Fuse with Full-Range Clearing Ability.
Trans IEEE, PAS-84 (1965) 1107-1116.
Investigation of the effect of a gas-evolving spider and of an auxiliary element and arc-electrodes on the fuse characteristics, especially in the low-current region.

B 5.11 H.W. Mikulecky: Current Limiting Fuse Arc-Voltage Characteristics.
Trans IEEE, PAS-87 (1968) 438-448.
Investigation of arc-voltage characteristics of fuses with uniform-area and non-uniform-area fuse elements. Effect of the arc-voltage on circuit components. Coordination of current-limiting fuses and lightning arresters.

5.12 See also 3.10, 4.1.

6. Interaction between fuses and the electric circuit.

B 6.1 F. Meier: Einfluss von Schaltmoment und Phasenverschiebung auf die Beanspruchung von Sicherungen bei Kurzschlussabschaltungen.
Bull. SEV, 46 (1955) 101-108.

A 6.2 J. Mocsáry: Untersuchungen von strombegrenzenden Hochspannungs-Hochleistungs-Sicherungen in Stromkreisen mit unterschiedlichen Netzeinschwingfrequenzen.
E. und M. 81 (1964) 655-661.
A rather extensive investigation regarding the influence of the natural frequency of the circuit on fuses with non-uniform cross-sectional fuse elements.

A 6.3 K. Kriechbaum: Schaltspannungen von Hochspannungssicherungen.
AEG-Mitt. 52 (1962) 350-353.
The influence of a capacitance parallel to the fuse on the peak voltage, etc.

6.4 See also 3.8, 3.13, 4.2, 4.3, 4.7, 4.10, 9.1 and 9.2.

7. Discrimination.

A 7.1 M. Smith: Coordination of Fused Low-Voltage Distribution Systems. Trans. IEEE, IGA-3 (1967) 433-437.
Discrimination between fuses in series.

A 7.2 K. Bergold: Selbstschalter und Schmelzsicherung in Reihe. Arch. f. Elektrotechnik 52 (1968) 105-113.
Rather extensive treatise of fuses used as back-up protection in combination with circuit breakers, mainly with regard to low-voltage distribution systems.

8. Protection of semi-conductor devices.

B 8.1 B. Novotný: Der Schutz von Halbleiterdioden mittels Sicherungen.
Wiss. Z. Techn. Hochschule Ilmenau 9 (1963) 685.
Calculation of the temperature rise of short fuse elements. Pre-arcing time. Qualitative treatise of the requirements on fuses for the protection of semi-conductor rectifiers.

A 8.2 J. Mocsáry: Überflinke strombegrenzende NH-Sicherungen Typ NOGe und NOSi für Halbleitergleichrichter.
Elektrie 18 (1964) 208-209.
Requirements on fuses for the protection of semi-conductor devices. Treatise of designs.

A 8.3 R.G. Dale and M. Smith: New Fuse Developments and Diode Ratings Yield Compatibility.
Conf. Record of Second Industry and General Applications Group, Pittsburg, 1967, 57-70.
Gives a survey how diodes could be destroyed and how they could be protected by means of fuses.

B 8.4 J. Bekink: Protection des éléments semi-conducteurs en cas de court-circuit interne dans un redresseur de grande puissance.
Rev. Gen. Electr. 77 (1968) 213-216.
Protection with fuses of semi-conductor elements fitted to high-capacity rectifiers. Requirements and test procedures.

A 8.5 A. Stahn: Die Auswahl überflinke Sicherungen zum Schutz von Thyristoren.
Elektrie 22 (1968) 108-110.
The most important problems relating to the choide of super-quick-acting fuses for the protection of thyristors.

9. Fuse tests.

A 9.1 J. Mocsáry: Beitrag zur Frage der Prüfung des Abschaltvermögens von strombegrenzenden Hochspannungs-Hochleistungs Sicherungen (Mitteilung aus dem Forschungsinstitut der Elektroindustrie (VKI) Budapest).
Elektrie 18 (1964) 389-393.
Arc energy as a function of the ratio between the short circuit current and the nominal current. Critical current. Overvoltages. The influence of the natural frequency of the test circuit.
In this paper a large number of experimental data are given.

B 9.2 Prüfung des Schaltvermögens von Geräteschutzsicherungen nach DIN 41571.
Report Standard Elektric Lorenz (SEL) No. 3566-634-Z4 (1965).
Investigation on hand of experimental data of the testing of miniature fuses in an RC-circuit. Influence of circuit parameters.

B 9.3 R. Seysen: Über die Prüfung von Niederspannungs-Hochleistungs-Sicherungen.
Conti-Electro-Berichte 11 (1965) H.1, 29-33.

A 9.4 G. Jahn: Probleme der 660 V-Nennspannung bei Schmelzsicherungen.
Elektrie 22 (1968) 200-203.
Comparison of test circumstances and the circumstances in a three-phase low-voltage distribution system. Critical discussion on the subject of test requirements.

A 9.5 M.R. Smith: New Fuse Standards on Low-Voltage Fuses Emphasize Safety.
Conference Record of Second Industry and General Applications Group, Pittsburg, 1967, 319-324.
Treats the effect of standards on the user of low-voltage fuses.

9.6 See also 4.10, 5.4 and 8.4.

10. Exploding wires.

10.1 William G. Chase and Eleanor M. Watson: A bibliography of the Electrically Exploded Conductor Phenomenon.
Air Force Cambridge Research Laboratories, Office of Aerospace Research, United States Air Force.
AFCRL-62-1053, October 1962.
Supplement No. 1.
ARCRL-65-384, June 1965.
These publications offer an almost complete bibliography on exploding wire phenomena.

10.2 W.G. Chace and H.K. Moore: Exploding Wires, Vol. I, II, III and IV.
Plenum Press, New York, 1959, 1962, 1964, 1968.
In these four books a number of papers on exploding wire phenomena are brought together.

Some publications on exploding wire phenomena which are of particular interest for the study of the behaviour of fuses are listed below:

10.3 S.V. Lebedev: Explosion of a Metal by an Electric Current.
Soviet Physics JETP 5 (1957) 243-252.
Investigation of energies and of the course of the voltage across the wire and the resistance of the wire, especially during the prearcing period.

10.4 E. David: Physikalische Vorgänge bei elektrischen Drahtexplosionen.
Z. f. Physik 150 (1958) 162-171.
A theoretical investigation of energies, parameters of state and the influence of the magnetic pressure.

10.5 M. Keilhacker: Über den Mechanismus der explosionsartigen Verdampfung von Kupferdrähten durch sehr intensive Stromstösse und das Verhalten des Kupfers bei den dabei auftretenden hohen Drucken und Temperaturen.
Z. Angew. Physik 12 (1960) 49-59.

10.6 F.D. Bennett: High-Temperature Cores in Exploding Wires.
Phys. Fluids 8 (1965) 1106-1108.
Refers to previous publications of Bennett which are also of interest.

10.7 L. Vermij: Interaction between Exploding Wires and the Electrical Circuit.
Z. Angew. Physik 25 (1968) 350-355.
Investigation of fusing wires in an LC-circuit. Dark-time phenomena.

AUTHORS INDEX

Preface.

This bibliography has been compiled with the intention to offer the possibility of a more directed choice in studying the literature dealing with fuses. Therefore only a limited number of publications have been mentioned. In the opinion of the author the papers mentioned in this selected bibliography give more or less an overall picture of current knowledge, possibilities and requirements regarding fuses.

The papers have been arranged according to subject, whereas further an attempt has been made for a rough classification of the publications mentioned. The A-papers are the most important publications, whereas B-papers are recommended for further study. C-papers are of interest mainly from a historical point of view.
The author is indebted to Mr. J.W. Gibson (Bowthorpe Line Equipment Ltd., Bridgend, U.K.) for his critical comments and suggestions during the compiling of this bibliography.