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Journal of Pyrotechnics

FIREWORKS – PYROTECHNIC SPECIAL EFFECTS – PROPELLANTS & ROCKETRY – CIVILIAN PYROTECHNICS

Contents:

DEDICATED TO THE ADVANCEMENT OF PYROTECHNICS THROUGH THE SHARING OF INFORMATION

Keyword Index

The following list of keywords refers to articles that have appeared in Issues 1–20 of the *Journal of Pyrotechnics*. The numbers are paired. The first number is the Issue Number. The second number is the page number where the article begins. For example, 10-17 means Issue 10, page 17. See the list of Tables of Contents for article titles and beginning page. We hope that you find this list useful. For full abstracts, refer to the JPyro Web Site: http://www.jpyro.com. Also see list of authors.

Most entries have words in their common usage form (e.g., Black Powder not powder, black) or as related to a major topic (e.g., rocket motor) with some exceptions. We have incorporated many cross references to assist in finding topics of interest.

02-09-05

Editorial Policy

Articles accepted for publication in the *Journal of Pyrotechnics* can be on any technical subject in pyrotechnics. However, a strong preference will be given to articles reporting on research (conducted by professionals or serious individual experimenters) and to review articles (either at an advanced or tutorial level). Both long and short articles will be gladly accepted. Also, responsible letters commenting on past Journal articles will be published, along with responses by the authors.

Author List for *Journal of Pyrotechnics,* Issues 1 to 20

The following list of authors refers to articles that have appeared in Issues 1 to 20 of the *Journal of Pyrotechnics*. The numbers are paired. The first number is the Issue Number. The second number is the page number where the article begins. For example, 10-17 means Issue 10, page 17. See the list of Tables of Contents for article titles and beginning page. We hope that you find this list useful. For full abstracts, refer to the JPyro Web Site: http://www.jpyro.com. Also see keyword list.

Future Events Information

If you have information concerning future—explosives, pyrotechnics, or rocketry—meetings, training courses or other events that you would like to have published in the *Journal of Pyrotechnics*, please provide the following information:

Name of Event

Date and Place (City, State, Country) of Event

Contact information — including, if possible,

- name of contact person
- postal address
- telephone number
- fax number
- email address
- web site information

This information will also be published on the Journal of Pyrotechnics Web Site:
http://www.jpyro.com

Journal of Pyrotechnics

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Issue 19, Summer 2004

Issue 20, Winter 2004

Author's Guide for Full Articles

Also See Guidance for Authors of Book Reviews, Comments and Short Articles

Scope

Articles accepted for publication need to address technical aspects of pyrotechnics, including fireworks, pyrotechnic special effects, propellants & rocketry, and civilian pyrotechnics. The Journal is "dedicated to the advancement of pyrotechnics through the sharing of information". This is accomplished with a mix of different types of articles; however, most fall into two areas. One area is reports on research conducted by both professional scientists and individual experimenters. The other area is reviews of various technical and craft areas of pyrotechnics, some at an advanced level and others at a tutorial level.

Submission

Submissions should be made directly to the publisher at the address below. Upon receipt of an article, the author will be sent an acknowledgment and a tentative publication date. For specific requests regarding editors, etc. please include a note with that information. Preferably the text and graphics will be submitted electronically or on a 3-1/2" diskette or CD in IBM format with a print copy as backup. The Journal is currently using Microsoft Word, which allows for the import of several text formats. Graphics can also be accepted in several formats. Please also inform us if any materials need to be returned to the author.

Style

- The Journal of Pyrotechnics has adopted the ACS Style Guide [ISBN 0-8412-3462-0]. It is not necessary that authors have a copy.
- General information:
  - The first time a symbol, abbreviation, or acronym is used, it is to be written in full to define it [e.g., heat of reaction (ΔH_r) or potassium nitrate (KNO_3)].
  - Avoid slang, jargon and contractions.
  - Use the active voice when possible.
  - Use of the third person is preferred; however, first person is acceptable where it helps keep the meaning clearer.

General Format

- Title
- Authors' names, including an affiliation for each author and an address for at least the first author.
- A short abstract (An abstract is a brief summary of the article, not a listing of areas to be addressed.)
- Keywords — 4 to 10 to be used in a reference database: However, multi-word names and phrases constitute only one keyword (e.g., potassium nitrate and heat of reaction are each one word).
- Use SI units for measurements. If English units are used, please provide conversions to SI units.
- Every figure (including photographs and graphs) must be referred to in the text. All figures are to be numbered with Arabic numerals in the sequence in which they are cited. Every figure is to be accompanied by a caption. Figures will be printed in black and white. Place figures at the end of the text or as separate files. For graphs, please also submit "raw" X–Y data.
- Every table must be referred to in the text. Tables are to be numbered with Arabic numerals in the sequence in which they occur. Every table is to begin with a caption that explains in detail the contents of the table. Footnotes to a table should be indicated by lower-case letters in parentheses and typed directly under the table.
- Footnotes in the text are to be avoided.
- Acknowledgement of financial support, advice or other kinds of assistance should be made at the end of the paper under the heading "Acknowledgements".
- It is the responsibility of the authors to assure the accuracy of references. References cited in the text are numbered sequentially in the order in which they are cited in the text, The

numbers should be enclosed in square brackets and written as superscripts after their reference (i.e., "Smith[1] states"; or "the research[2,3] shows"). References are to be listed in numerical order at the end of the manuscript under the heading "References". The full citation, including author, title of book or article, publisher for books or journal title plus volume number for journals, year of publication, pages cited, etc. is to be provided. Examples:

1) A. E. Smith, *Pyrotechnic Book of Chemistry*, XYZ Publishers, 1993, [p nn–nn (optional)].
2) A. E. Smith, R. R. Jones, "An Important Pyrotechnic Article," *Pyrotechnic Periodical*, Vol. 22, No. 3 (1994) [p n–n, (optional)].

Editing

The *Journal of Pyrotechnics* is refereed. However, the editing style is friendly, and the author makes the final decision regarding what editing suggestions are accepted.

More Information

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Last Updated June 2004.

Author's Guide for Communications: Short Articles, Comments and Book Reviews

Guidance for Authors of Book Reviews, Comments and Short Articles

Style Guide

The *Journal of Pyrotechnics* has adopted the *ACS Style Guide*. It is not necessary that authors have a copy as we will suggest changes that are needed.

Manner of Submission

Submissions should be made directly to the publisher. Upon receipt of an article, the author will be sent an acknowledgment. Preferably the text and graphics (if there are any) will be submitted electronically or on a diskette (3-1/2) or CD in IBM format with a printed copy as backup. However, because of the short nature, handwritten or typed comments are also acceptable. The Journal currently uses Microsoft Word for Windows, which allows for the import of several text formats. Graphics, if there are any, can be accepted in several formats. Please also inform us if any materials need to be returned to the author.

General Writing Style

- The first time a symbol is used, it is preferred to write it out in full to define it [e.g., enthalpy of reaction (□Hr) or potassium nitrate (KNO3)].
- Avoid slang, jargon, contractions, and abbreviations.
- Use of the active voice is preferred.
- The use of third person is preferred; however, particularly for comments on previous articles, first person is acceptable.

Format

Book Reviews

- For the book, provide its full title, name(s) of author(s), publisher, location of publisher (city, state, country), year of publication, ISBN [number usually found on the back of the title page].
- Usually, the author of the book will be sent a copy of your Review and allowed to respond if they so choose.
- Follow information in the "Short Articles" section to the extent that it applies.

Comments

- These are usually comments on an article that appeared in an earlier issue of the *Journal of Pyrotechnics*. They can be in the form of a letter directed to either the editor or the author.
- The author of the article will be sent a copy of your Comments and allowed to respond, if they so choose.
- Follow information in the "Short Articles" section, to the extent that it applies.

Short Articles

- In addition to the author's name, please include an affiliation and an address for at least the first author when there are multiple authors.
- A short abstract at the start of the article is optional. (An abstract is a brief summary of the article, not a listing of areas to be addressed.)
- Optionally, the author can include a few keywords to be used in a reference database. Multi-word names and short phrases are acceptable (e.g., potassium nitrate and enthalpy of reaction).
- Use of SI units is preferred. If English (or Imperial) units are used, please provide a conversion to the appropriate SI units (e.g., 1 inch equals 25.4 mm).
- Figures, Graphs and Photos are numbered consecutively. For submission, place them at the end of the text or as separate files. For graphs, please also submit "raw" X-Y data.
- Tables are numbered separately from figures, graphs and photos.
- References cited in the text will be referred to by number, i.e., "Smith[1] states"; or "the research[2,3] shows ..." In the reference section, they will be ordered by usage and not alphabetically. A full citation is preferred, including author, title of book or article, publisher for books, title of publication plus volume for journals, and year of publication. Reference to specific pages is optional, but encouraged. The citation that includes the pages in the Journal makes it easier if someone wishes to read the original source material. If multiple pages in an article or book are cited, they should be referenced like in example 3. Examples of citations:

1) A.E. Smith, *Pyrotechnic Book of Chemistry*, XYZ Publishers, 1993, [p nn–nn optional].

1) A.E. Smith, R.R. Jones, "An Important Pyrotechnic Article", *Pyrotechnic Periodical*, Vol. 22, No. 3 (1994) [p n–n optional].

2) A.E. Smith, "Excellent Article on Pyrotechnics", *Pyrotechnic Journal*, Vol. 100, No. 5 (1995) pp 6–35. [a] p 9; [b] pp 5; [c] Tables on pp 30–35.

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Last Updated June 2004

Pyrotechnic Reference Series

Includes:

- ***Illustrated Dictionary of Pyrotechnics***
- ***Lecture Notes for Pyrotechnic Chemistry***
- ***Lecture Notes for Fireworks Display Practices***

Illustrated Dictionary of Pyrotechnics

Cover $40 **Discounted Price $24.00***

Many areas of applied pyrotechnics, fireworks in particular, suffer from a lexicon that contains many specialized terms, is poorly documented, and about which there is much disagreement. For example, what you call *glitter*, others still call *flitter*, and vice-versa; your *separation distance* may be someone else's *setback*. As a result, effective communication is made more difficult than necessary. Having an extensive dictionary of terms will not instantly solve such communication problems, but it can help, especially over time. Unfortunately, until now such a dictionary has not been available.

The *Illustrated Dictionary of Pyrotechnics* [ISBN-1-889526-01-0] is 130 pages in length, 8½" by 11", and it has a durable binding. There are more than 1200 entries, 130 figures and illustrations, and 50 short tables. It includes scientific and craft terms from fireworks, explosives, rocketry and pyrotechnic special effects.

In addition to the principal authors, eight individuals with expertise from each of the technical areas addressed, reviewed and contributed to the development of the dictionary. Most entries go well beyond merely defining a term; many terms are explained using examples, data, and/or illustration. Accordingly, the dictionary should be both authoritative and easy to comprehend.

Excerpts from review by L. Homan for the *Western Pyrotechnic Association Newsletter*, March, 1995.

"A dictionary is undoubtedly the most daunting of literary tasks, only for the most motivated and knowledgeable. In this case the selection of terms is somewhat eccentric, as any beginning project must be, including technical terms of little value to the average pyrotechnician. The content might form the basis for a game of knowledge amongst a group of fireworks enthusiasts, see who can find a term which someone else in the group does not know. The dictionary is very readable, being clearly laid out and not too specific or complicated, giving good meanings yet stopping short of excessive explanations... The individual reader will have to gauge his own level of need, the less you understand it, the more useful it is, I suggest a sneak preview... This new dictionary is very well done, worth the reasonable price for most, but I wouldn't steal it."

Excerpts from review by R. Winokur for *American Fireworks News*, No. 163, April, 1995.

"The content of this volume is eclectic in the extreme. It contains entries on all aspects of fireworks, from regulatory definitions to Italian and Japanese shell making. It also contains a large variety of terms used in rocketry which are not normally seen in the fireworks literature. In addition there are many terms taken from high explosive science and technology, and some from stage and movie special effects. To illustrate the eclectic nature of this volume one only has to open the pages at random. For example, on pages 74 and 75 we find "M-80" defined: "One type of small but powerful exploding device...". In the next entry we find "Mach Diamonds: Diamond shaped features exhibited by the exhaust plume of rocket motors and engines"... Several entries later we find "Magnesium, Magnalium, Magnesium carbonate and Magnus Force". Terms are sometimes grouped together based on their being closely related in definition rather than strictly alphabetically. For example, the terms "Color Purity, Color Species and Color Spectrum come before Colored Heart and Colored Smoke". Although this is unusual in a dictionary, it is an extremely functional aspect of the volume. The entries are usually considerably more than brief definitions. On average an entry is composed of a short paragraph or more, and often includes one or more illustrations in the form of diagrams, drawings and graphs. In some instances a series of closely related entries may take up several pages. For example, if one searches for the term Mortar, the following entries are found Mortar (fireworks), Mortar (special effects), Mortar Burst, Mortar Length, Mortar Organization, Mortar Placement, Mortar Plug, Mortar Rack, Mortar Racks - Dense-Pack, Mortar Strength, and Mortar Trough. These eleven entries take about 2½ pages and contain a wealth of information on structure, physical properties, composition, safety, and function of mortars..."

Lecture Notes for Pyrotechnic Chemistry

Cover $90 **Discounted Price $54.00***

Lecture Notes for Pyrotechnic Chemistry [ISBN-1-889526-16-9], **revised and enlarged in early 2005**, contains the class notes for a three-day course on the Pyrotechnic Chemistry. The Course Notes assume only minimal levels of understanding of Chemistry and Pyrotechnics. Each 8½×11" page contains a pair of viewgraphs from the course lectures. The over 440 viewgraphs include many illustrations and tables. Each viewgraph of text is complete enough for the reader to be able to understand the subject being discussed. Following is the outline of topics:

I Basic Chemical Principles
II Pyrotechnic Chemistry, Ignition and Propagation
III Pyrotechnic Primes and Priming
IV Factors Affecting Burn Rate
V Aspects of Pyrotechnic Burning
VI Physical Basis for Colored Light Production
VII Chemistry of Colored Flame
VIII Chemistry of Sparks, Glitter and Strobe
IX Pyrotechnic Smoke and Noise
X Approaches to Formulation Development
XI Pyrotechnic Sensitivity
XII Pyrotechnic Hazard Management

Lecture Notes for Fireworks Display Practices

Cover $90 **Discounted Price $54.00***

The *Lecture Notes for Fireworks Display Practices* [ISBN-1-889526-03-7] contains class notes from a week-long course on practical and safety aspects of performing fireworks displays. Each 8½×11" page contains a pair of viewgraphs from the course lectures. The 440 viewgraphs include many photographs and tables. Each viewgraph of text is complete enough for the reader to understand the subject being discussed. **Revised 02/05.**

I. Elements of Hazard Management for Fireworks

II. Fireworks Construction, Operation, and Characteristics

Aerial Shell Components and Manner of Functioning
Aerial Shell Malfunctions
Typical Performance Characteristics
Other Fireworks Types

III. Fireworks Display Safety

Display Site Requirements
Fireworks Display Equipment
Mortar Placement
Chain-fusing Techniques
Making Repairs to Fireworks
Ground and Low-level Fireworks
Manual Display Procedures
Setup of Electrically Fired Displays
Techniques for Electric Firing

IV. Fireworks Transportation and Storage Requirements

Fireworks Sensitivity to Accidental Ignition
Pyrotechnic Combustion
Sensitivity Indicators
Fireworks Sensitivity
Fireworks with Electric Igniters
Storage Considerations
Blast and Thermal Effects from Fireworks

V. Fireworks Display Design

* Includes shipping within the US & Canada. Shipping to Mexico – add US$ 1.50/book; to all other countries add US$ 5.00/book.

Pyrotechnic Chemistry

Cover $90 **Discounted Price $54.00***

Pyrotechnic Chemistry [ISBN: 1-889526-15-0] is a hard cover book on the chemistry of pyrotechnics. The book was authored by a collection of 13 renowned pyrotechnic researchers from around the world. It contains over 400 pages in a large 8½ × 11" format.

This text is written at an introductory to intermediate level. As such it is intended for readers with limited prior knowledge of chemistry or limited knowledge regarding specific areas of applied pyrotechnics. One goal of this text is to provide an extensive list of references, thus directing readers to sources of additional information.

The Table of Contents is extensive, running to 9 pages with approximately 600 entries. Because of the extensive table of contents, this text has not been provided with an index. It is suggested that readers wishing to research a specific topic first consult the list of chapters to find the one most relevant to the topic of interest, and then consult the detailed table of contents to locate the page number(s) of the section(s) addressing that topic.

List of Book Chapters and Authors

1 Introduction to Pyrotechnic Chemistry
2 Chemical Components of Fireworks Compositions
3 An Introduction to Chemical Thermodynamics
4 Pyrotechnic Ignition and Propagation: A Review
5 Control of Pyrotechnic Burn Rate
6 Our Present Knowledge of the Chemistry of Black Powder
7 Pyrotechnic Primes and Priming
8 Pyrotechnic Delays and Thermal Sources
9 The Chemistry of Colored Flame
10 Illuminants and Illuminant Research
11 Propellant Chemistry
12 Principles of Solid Rocket Motor Design
13 Pyrotechnic Spark Generation
14 Glitter Chemistry
15 Strobe Chemistry
16 A Study of the Combustion Behaviour of Pyrotechnic Whistle Devices (Acoustic and Chemical Factors)
17 Sensitiveness of Pyrotechnic Compositions
18 Hazardous Chemical Combinations: A Discussion
19 Assessing the Risks — Suggestions for a Consistent Semi-Quantified Approach

Review of: Pyrotechnic Chemistry

Bernard E. Douda
Crane Division, Navel Surface Warfare Center

Pyrotechnic Chemistry is the fourth in the Pyrotechnic Reference Series produced by the publisher of the *Journal of Pyrotechnics*. It is composed of nineteen stand-alone presentations each authored by pyrotechnic experts in their specialty area.

There are chapters dealing with pyrotechnic materials, thermodynamics, ignition and propagation, burning rate control, black powder, primes and priming, delays and thermal sources, illuminants, solid rocket motor design, spark generation, whistle devices, and the chemistry of colored flames, propellants, glitter, and strobes. Safety aspects are addressed in chapters discussing composition sensitiveness, hazardous chemical compositions, and risk assessment.

One advantage of a compilation of this sort is that it makes it convenient for the reader to find information across a wide range of pyrotechnic topics. The extensive Table of Contents makes this possible. The book contains a large number of figures and tables to support the text material. There are many examples of application of the information to pyrotechnic practical situations. For the most part, this book addresses the topics thoroughly but perhaps in some cases not to the degree that one would find in a textbook.

The compilation format provided the opportunity for each of the authors to address their topic to a degree sufficient to relate all aspects of their topic to practical pyrotechnics. They accomplished this by providing the underlying theory, the relevant equations, illustrative figures, and tables of supporting data. The result of this is that some chapters are much larger than others.

Another important characteristic of this book is that it addresses many pyrotechnic safety issues in chapters dedicated to this purpose. Not only were the authors able to point out safety concerns with material incompatibilities throughout their individual topics but also they prepared three chapters dedicated to sensitivity of pyrotechnic compositions, hazardous chemical combinations, and risk assessment.

Each chapter includes a set of its own references. These will be valuable to those wishing to explore a subject further. The book is easy to read. The topics are presented in an informative and educational manner. This book not only addresses topics related to fireworks but also addresses topics relevant to military pyrotechnics. It complements other pyrotechnic reference books and will serve as a valuable addition to one's library.

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Pyrotechnic Literature Series

Includes:

- ***Selected Publications of K. L. and B. J. Kosanke, Parts 1 to 5***
- ***Selected Publications of Dr. Takeo Shimizu,***
  - ***Part 1. From IPS (1985–1994)***
  - ***Part 2. Translated Articles***
  - ***Part 3. Studies on Colored Flame Compositions of Fireworks***
  - ***Part 4. The Design Criteria for Chrysanthemum Shells***

Selected Pyrotechnic Publications of K. L. & B. J. Kosanke, Parts 1–5

The following five books are collections of articles that originally appeared in a variety of pyrotechnic publications. The articles were reformatted into a 2-column, 8½×11" format.

Part 1 (1981–1989) [ISBN 1-889526-05-3]

Cover Price $30 **Discounted Price $18***

Table of Contents:

Physics, Chemistry & Perception of Colored Flames, Part 1: Physics
Taming Triangle Diagrams
Festival Ball Comets
Physics, Chemistry & Perception of Colored Flames, Part 2: Chemistry
An Idea for Small Shows
Electrical Firing of Musically Choreographed Aerial Fireworks Displays
Sizzling Colored Comets
HDPE Mortars for Electrically Fired Displays
Economics of Plastic Shell Construction
An Evaluation of "Pyro-Flake" Titanium for Use in Fireworks
RAP Shell Assembly Techniques
Destructive Testing and Field Experience with HDPE Mortars
Understanding Product Liability (Parts 1 and 2)
Japanese Shell Break Radii
CMC — Its Properties and Uses
Reduction of Shell Ignition Failures
Determination of Aerial Shell Burst Altitudes
Pyrotechnic Spark Generation
Further Information about HDPE Mortars
The Use of Titanium in Pyrotechnics
Recommended Lift Charge Amounts

Part 2 (1990–1992) [ISBN 1-889526-06-01]

Cover Price $25 **Discounted Price $15***

Table of Contents:

Report of Aerial Shell Burst Height Measurements
Physics and Chemistry of Low Explosives (Pts. 1–3)
Shimizu Aerial Shell Ballistic Predictions (Pts 1–2)
Hazard Data for Chemicals Used in Pyrotechnics
Burn Characteristics of "Visco" Fuse
Saran Resin — Its Properties and Uses
Pyrotechnic Fuse Burn Rates
A Collection of Star Formulations
Production of Benzoate Color Agents
Parallel and Propagative Burning
Dautriche - Shock Tube Measurement of High Propagation Rates in Pyrotechnic Materials
Repeat Firing from HDPE Mortars
Aerial Shell Drift Effects
Computer Modeling of Aerial Shell Ballistics
Pyrotechnic Accelerants

Part 3 (1993–1994) [ISBN 1-889526-07-X]

Cover Price $25 **Discounted Price $15***

Table of Contents:

Timing Aerial Shell Bursts for Maximum Performance & Safety
Aluminum Metal Powders Used in Pyrotechnics
Explosions and Detonations
Fireworks Displays – Abnormally Dangerous Activity
Lancework — Pictures in Fire
Successful Bidding and Performance on Government Fireworks Display Contracts
Electric Matches & Squibs
"Skip Burning" of Visco Fuse
Electric Shock Tube Firing Systems

The Role of the Expert Witness
Measurement of Aerial Shell Velocity
Control of Pyrotechnic Burn Rate
Hypothesis Explaining Muzzle Breaks
Basics of Hazard Management

Part 4 (1995–1997) [ISBN 1-889526-12-6]

Cover Price $30 **Discounted Price $18***

Table of Contents:

Stars Blown Blind
Fireworks and their Hazards
Concussion Mortar Internal Pressure, Recoil and Overpressure as Functions of Powder Mass
Hazardous Chemical Combinations
Explosive Limit of Armstrong's Mixture
Aerial Shell Drift Effects: A) The Effect of Long Mortars, B) The Effect of Capsule-Shaped Shells
Pyrotechnic Spark Generation
An Instrument for the Evaluation of Black Powder as a Propellant for Aerial Shells
Simple Measurements of Aerial Shell Performance
Flash Powder Output Testing: Weak Confinement
New Fast Fuse
Burn Rates of Clusters of Gold Sparklers
ATF's Classification of Flash Powder
A Survey of Concussion Powders
Sky Rocket Performance Characteristics
Performance Comparison between Old and New Obron German Dark Aluminum
Pyrotechnic Ignition and Propagation: A Review
Burn Rates of Clusters of Colored Sparklers

Part 5 (1998–2000) [ISBN 1-889526-07-X]

Cover Price $30 **Discounted Price $18***

Table of Contents:

Development of a Video Spectrometer
Some Measurements of Glitter
Lift Charge Loss for a Shell to Remain in Mortar
Configuration and "Over-Load" Studies of Concussion Mortars
Quick Match: A Review and Study
Pyrotechnic Primes and Priming
Dud Shell Risk Assessment: NFPA Distances
Dud Shell Risk Assessment: Mortar Placement
Performance Test of Civil War Black Powder
Caution: Very Fast "Black Match"
Peak In-Mortar Aerial Shell Acceleration
Firing Precision for Choreographed Displays
Sticky Match and Quick Match: Temperature Dependent Burn Times
Mortar Separations in Troughs and Drums
Preliminary Study of the Effect of Ignition Stimulus on Aerial Shell Lift Performance
Particle Morphology—Metal Fuels
Peak Mortar Pressures When Firing Spherical Aerial Shells
Indoor Pyrotechnic Electrostatic Discharge Hazard
Pyrotechnic Particle Morphology—Low Melting Point Oxidizers

Selected Pyrotechnic Publications of Dr. Takeo Shimizu, Part 1. From the IPS (1985–1994).

Cover Price $30 **Discounted Price $18***

A collection of previously published technical papers that appeared in *Proceedings of the International Pyrotechnics Seminars* from 1985–1994. The articles have been reformatted into a 2-column, 8½×11" format. [ISBN 1-889526-08-8]

Table of Contents:

Hypothesis on the Cause of Serious Accidents Related to Salutes Charges
A Concept and the Use of Negative Explosives
Ballistics of Firework Shells
An Example of Negative Explosives: Magnesium Sulfate/Magnesium Mixture
The Effect of Hot Spots on Burning Surface and Its Application to Strobe Light Formation with Mixtures that Contain No Ammonium Perchlorate
The Surface Explosion of Pyrotechnic Mixtures
Stabilizing Firework Compositions:
I. Minimum Solubility Law to Foresee the Degeneration
II. A New Chemical Method of Magnesium CoatingBurning Rate and Grain Size of Component Materials of Pyrotechnic Mixtures

Selected Pyrotechnic Publications of Dr. Takeo Shimizu, Part 2. Translated Articles

Cover Price $30 **Discounted Price $18***

A collection of previously published technical papers that appeared in various publications between 1978 and 1995. These articles were translated into English and reformatted into a 2-column, 8½×11" format. [ISBN 1-889526-10-X]

Table of Contents:

Selected Pyrotechnic Publications of Dr. Takeo Shimizu, Part 3. Studies on Colored Flame Compositions of Fireworks

Cover Price $35 **Discounted Price $21***

A series of seven articles that originally appeared in the *Journal of Industrial Explosives*. The articles were translated from Japanese by Dr. Shimizu. The articles have been formatted into a 2-column, 8½×11" format. [ISBN 1-889526-11-8]

Table of Contents:

Selected Pyrotechnic Publications of Dr. Takeo Shimizu, Part 4. The Design Criteria for Chrysanthemum Shells

Cover Price $40 **Discounted Price $24***

This is Dr. Shimizu's PhD thesis that was translated from Japanese by Dr. Shimizu. The articles have been formatted into a 2-column, 8½×11" format. [ISBN 1-889526-14-2]

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