
UNITED STATES DEPARTMENT OF LABOR

FRANCES PERKINS, Secretary

CHILDREN'S BUREAU . . . Katharine F. Lenroot, Chief

Occupational Hazards to Young Workers

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REPORT NO. 1

THE EXPLOSIVES-MANUFACTURING INDUSTRIES



BUREAU PUBLICATION No. 273

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1942

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OCCUPATIONAL HAZARDS TO YOUNG WORKERS

- Report No. 1.—The Explosives-Manufacturing Industries, Publication No. 273.
- Report No. 2.—Motor-Vehicle Drivers and Helpers, Publication No. 274.
- Report No. 3.—The Coal-Mining Industry, Publication No. 275.
- Report No. 4.—The Logging and Sawmilling Industries, Publication No. 276.
- Report No. 5.—Woodworking Machines, Publication No. 277.

CONTENTS

	Page
Letter of transmittal.....	iv
Introduction.....	1
Method and scope of study.....	1
Definition of explosives.....	2
Nature of the explosives industries and their hazards.....	2
Size and location of plants.....	2
Processes and hazards.....	3
Special hazards to minors.....	6
Statistical measures of hazard.....	6
Industrial-injury rates.....	6
Experience under workmen's compensation.....	7
Employment of minors in the explosives industries.....	8
State standards.....	8
Report of Advisory Committee on Employment of Minors in Hazardous Occupations, 1932.....	9
N. R. A. codes.....	9
Industry policies.....	10
1930 census data.....	10
Attitudes toward an 18-year minimum-age standard.....	10
Conclusions.....	12
Appendix A—Legal basis for the investigation.....	13
Appendix B—Principal articles classified as explosives by the Interstate Commerce Commission.....	14
Appendix C—Number of explosives-manufacturing plants in specified States and their chief product.....	15
Appendix D—State minimum-age standards for explosives manufacturing and for general manufacturing.....	16
Appendix E—Provisions in State laws establishing minimum-age standards for work in connection with explosives, January 1, 1939.....	17
Appendix F—Hazardous-Occupations Order No. 1.....	18

LETTER OF TRANSMITTAL

UNITED STATES DEPARTMENT OF LABOR,
CHILDREN'S BUREAU,
Washington, June 17, 1941.

MADAM: There is transmitted herewith a report on the occupational hazards to young workers of employment in the explosives-manufacturing industry. This study is the first of a series made by the Children's Bureau to guide the Chief of the Bureau in determining occupations that are particularly hazardous for young workers and therefore subject to an 18-year minimum age under the child-labor provisions of the Fair Labor Standards Act of 1938. The data in this report formed the factual basis for Hazardous-Occupation Order No. 1, effective July 1, 1939, which declared all occupations in or about plants manufacturing explosives or articles containing explosive components to be particularly hazardous for minors 16 and 17 years of age. A copy of this order appears in the appendix.

The report was originally published in mimeographed form on March 15, 1939, when the proposed order was issued. In this printed bulletin the information presented is that which appeared in the original mimeographed report, without the addition of figures that have since become available.

The study was planned and carried on under the general direction of Beatrice McConnell, Director of the Industrial Division of the Children's Bureau. The research was conducted and the report written by Elizabeth S. Johnson, then specialist in hazardous-occupations research.

Respectfully submitted.

KATHARINE F. LENROOT, *Chief.*

HON. FRANCES PERKINS,
Secretary of Labor.

Occupational Hazards to Young Workers

The Explosives-Manufacturing Industries

The Fair Labor Standards Act of 1938 recognizes the need to protect young workers 16 and 17 years of age against unsafe and unhealthful working conditions. Under the child-labor provisions of this act, the basic minimum age for general employment is 16 years, but there is an 18-year minimum age for occupations declared by the Chief of the Children's Bureau to be particularly hazardous for young workers.

The present investigation of the hazards of employment in the explosives-manufacturing industries was undertaken to guide the Chief of the Bureau in determining whether or not occupations in these industries should be declared particularly hazardous for minors 16 and 17 years of age under the Fair Labor Standards Act. The need to investigate the hazards to young persons of work in explosives factories was indicated by the danger from explosions which exists in such plants despite all safety precautions. Although accidents of this type may happen infrequently, they are likely to assume the proportions of a major disaster when they do occur, killing or severely injuring a number of workers at one time.

METHOD AND SCOPE OF STUDY

In this investigation published and unpublished material has been used, including reports of the United States Bureau of Labor Statistics on industrial accidents and on employment in the explosives-manufacturing industries and statistics on workmen's-compensation costs compiled by agencies which set insurance rates for workmen's compensation.

The experience of persons directly connected with the industries manufacturing explosives, including articles containing explosive components, has been extensively drawn upon. The persons consulted included trade-association officials, employers, representatives of organized-labor groups, and safety experts with specialized knowledge of the manufacture and handling of explosives. These persons provided valuable information on hazards and employment practices in these industries and gave their opinions regarding the need of forbidding employment of minors under 18 years of age in plants manufacturing explosives.

Extensive investigation of conditions now existing in individual plants was not deemed necessary in view of information and advice received from employers and workers in the industries and from the safety and explosives experts consulted. However, a few plants, including one fireworks factory and one ammunition plant, were visited, and the occupations and plant lay-out were observed.

DEFINITION OF EXPLOSIVES

In general, the term "explosives" means any chemical compound or mechanical mixture which, upon the application of fire, friction, shock, or detonation, will generate gases capable of causing destructive pressure upon surrounding objects.

The term "explosives" is customarily used to refer to compounds or mixtures that are explosive, such as dynamite, black powder, smokeless powder, and fulminate of mercury. Manufactured articles containing explosive components are not commonly spoken of as explosives, even though they are technically so classified. However, in the Transportation of Explosives Act¹ and regulations of the Interstate Commerce Commission issued thereunder, ammunition, blasting caps, fireworks, primers, detonating and time fuses, and many similar articles as well as the basic explosive compounds and mixtures are classified as explosives for the purpose of regulating their transportation in interstate and foreign commerce.² A list of the principal articles in this classification is shown in appendix B, page 14.

The term "explosives" as used in this report—for example, in the references to explosives industries, explosives manufacture, or explosives plants—means any goods classified as explosives in the regulations of the Interstate Commerce Commission.

NATURE OF THE EXPLOSIVES INDUSTRIES AND THEIR HAZARDS

Size and location of plants.

Explosives manufacture embraces several distinct industries with different types of products. These products are divided by the Census of Manufactures into three groups: (1) ammunition and related products, (2) explosives, and (3) fireworks and allied products. The 1935 Census of Manufactures reported a total of 11,757 wage earners and 139 establishments in these groups, as follows:

	<i>Number of establishments</i>	<i>Number of wage earners (average for year)</i>
Ammunition and related products (including blasting caps)-----	13	5, 599
Explosives ¹ -----	74	4, 570
Fireworks and allied products-----	52	1, 588
Total -----	139	11, 757

¹ "Explosives" is used by the Census of Manufactures to mean basic explosive compounds and mixtures only.

Source: Biennial Census of Manufactures, 1935, pp. 607, 658, 671. U. S. Bureau of the Census, Washington, 1938.

These figures are probably understatements both of the number of establishments and of the number of wage earners, since the Census of Manufactures reports only establishments with products valued at \$5,000 or more during the given year. A larger number of

¹ Act of March 4, 1921 (41 Stat. 1444).

² Regulations for Transportation by Rail of Explosives and Other Dangerous Articles in Freight, Express, and Baggage Services, Docket 3666, as amended. Interstate Commerce Commission, Washington.

plants (151) was reported in February 1938 by the Bureau of Explosives of the American Association of Railroads, an agency inspecting for compliance with the Interstate Commerce Commission regulations for the transportation of explosives. This number presumably includes all plants shipping in interstate commerce by rail, regardless of value of product.¹ These plants were distributed by type of product as follows:

	<i>Number of plants</i>
Ammunition -----	11
Blasting caps -----	3
Basic explosive compounds and mixtures -----	61
Fireworks -----	73
Other and type not specified -----	3
Total -----	151

This source gives no information on the number of employees. Neither these figures nor any others on number, size, and location of explosives plants given in this report include arsenals or other establishments operated by the United States Government.

Explosives plants are scattered over the United States. Despite their comparatively small number, they are found in 29 States.² The largest number is in Pennsylvania, the most important mining State in the United States, where 27 plants were reported by the Bureau of Explosives. The other States which lead in number of plants are Ohio (18), New Jersey (16), Illinois (15), and California (10). The distribution of plants throughout the country is shown in appendix C, page 15.

The plants tend to be small except in the ammunition industry. According to the Census of Manufactures, plants manufacturing basic explosive compounds and mixtures employed on an average 60 wage earners each during 1935. Those manufacturing fireworks and allied products employed even fewer, averaging 30 wage earners each. Establishments manufacturing ammunition and related products, on the other hand, employed an average of 431 wage earners during the same year.

Processes and hazards.

Basic explosive compounds and mixtures.—The two chief types of basic explosive compounds and mixtures are high explosives and black powder. High explosives, such as dynamite and picric acid, are manufactured by chemical processes. In the case of dynamite, this involves first the making of nitric and sulphuric acid and then the nitration process, in which glycerin is combined with nitric and sulphuric acid to produce nitroglycerin, the explosive base of dynamite. Other supplementary processes include the preparation of a dope (that is, an absorbent carrier for the nitroglycerin), the making of paper shells, and the packing of appropriate quantities of dynamite into the shells. The manufacture of black powder, on the other hand, involves chiefly a pulverizing and mixing process. The essential

¹List of Manufacturers of Explosives, compiled by the Chief Inspector, Bureau of Explosives, Association of American Railroads, New York, February, 1938.

²The Biennial Census of Manufactures, 1935, and the Bureau of Explosives both give this total number of States, although there was a slight variation in the States and in the distribution of plants.

ingredients of the powder are saltpeter, charcoal, and sulphur, which the manufacturer procures as raw materials.

Plants manufacturing basic explosive compounds and mixtures are usually small, so that losses in case of explosion may be minimized, and they are usually located near the place where the product is used. However, the demands for technical skill in manufacture and for capital investment are considerable. These requirements have contributed to the integration of ownership and management that characterizes the industry. Three companies employ about three-fourths of the wage earners in the manufacture of high explosives and about one-half of the wage earners in the black-powder branch of the industry.³

The grave danger of explosions has given rise to elaborate precautionary measures for promoting safety in manufacturing operations and in the handling of materials. These include the use of small separate buildings for various operations, the control of some processes from a distance in order to remove the worker from the immediate scene of danger, avoidance of open fires and of mechanisms or tools capable of generating sparks, and limitation of quantities of explosive materials kept in one place at any time. Storage of explosives, whether at explosives-manufacturing plants or elsewhere, is also governed by carefully developed standards.

Highly developed safety programs characterize the large companies operating several plants. Furthermore, methods of safe practice and safe construction and operation of plants have been prescribed by State authority in important explosives-producing States through special codes or laws applying specifically to plants manufacturing or using explosives. Several important explosives-producing States, including Massachusetts, New Jersey, Pennsylvania, and Washington, have codes regulating the manufacture of explosives in addition to others regulating the storage and use of explosives in manufacturing plants and elsewhere.

The manufacture of explosives is characterized not only by the danger of explosion but also by danger of poisoning from the acids and other chemicals used in some processes, as in the manufacture of nitroglycerin, fulminate of mercury, and picric acid.⁴ Several States have special codes or laws providing for the protection of workers from the injurious effects of nitro-amido compounds contained in many of the explosives.

Fireworks.—The fireworks industry has three divisions, according to product: The commercial division, producing fireworks for the open market; the display division, producing fireworks for special displays; and the fusee division, producing flares, fusees, and torpedoes for signals on railways and highways.⁵

Fireworks manufacture, particularly in the commercial and display divisions, requires relatively little capital, uses chiefly hand processes, and is highly seasonal. The peak season is just before

³ Earnings and Hours in the Explosives Industry, October 1937. Monthly Labor Review Vol. 47, No. 2 (August 1938), pp. 378-392. Bureau of Labor Statistics, U. S. Department of Labor, Washington.

⁴ Occupation Hazards and Diagnostic Signs, by Louis I. Dublin and Robert J. Vane. Bulletin No. 582, p. 7, U. S. Bureau of Labor Statistics.

⁵ Earnings and Hours in the Fireworks Industry, October 1937. Monthly Labor Review, Vol. 46, No. 4 (April 1938), pp. 942-955.

the Fourth of July, and lesser seasons precede special holidays or festivals celebrated by the use of fireworks. The industry has many small operators and is highly competitive. An important feature of the fireworks industry, from the point of view of employment of young workers, is the presence in the commercial and display divisions of very small enterprises carried on intermittently in the proprietor's dwelling, instead of in a permanent place of business. The small concerns which make up this unstable fringe of the industry are commonly referred to as family enterprises, but it is probable that many of them employ neighbors and relatives as well as members of the proprietor's immediate family, and that they come under the jurisdiction of the Fair Labor Standards Act if they ship in interstate commerce.

The seasonal nature of the industry and the small size and instability of many concerns contribute to the hazard to the workers. Lack of technical knowledge on the part of the proprietor, lack of proper equipment, and the periodic recruiting of inexperienced workers unfamiliar with the precautions essential for safety in the industry increase the danger of explosion, even though the quantities of explosive materials handled are not nearly so large as in plants manufacturing basic explosive compounds and mixtures. The hazards of fireworks manufacture are recognized by State safety codes. In addition to the State codes governing the manufacture, storage, and use of explosives in general, at least four States have special codes setting forth the requirements and precautions which must be observed in fireworks factories (Massachusetts, New Jersey, Ohio, Pennsylvania).

Fireworks manufacture comprises chiefly hand-work operations. The most hazardous occupations are the mixing of the powders and other ingredients for explosive and color effects and the loading of these ingredients into cardboard shells or other containers. Much of the work is in the assembling and decorating of parts after the loading, and it is at these light hand-work tasks that young persons are likely to be employed.

Ammunition.—The manufacture of ammunition is quite different from the manufacture of fireworks or of the basic explosive compounds and mixtures. It is essentially a fabricating industry using highly mechanized processes and is conducted in a few large operating units. The processes are chiefly the forming and shaping of metal or metal-and-paper shells, of primer parts, of bullets, and of shot, and the loading and assembling of these parts. Many of the parts are metal and are fabricated by the use of power presses, chiefly punch, stamping, and drawing presses. Private concerns make mainly small-arms ammunition, although they may also manufacture some bombs, tear-gas cartridges, and similar articles.

The major types of occupations involved in the making of small-arms ammunition are:

- (1) Forming parts by machine before they are primed or loaded.
- (2) Manufacturing primers, which involves the handling of fulminate of mercury or other initiating or priming explosive.
- (3) Loading primed shells with powder, much of which is done by machine.

(4) Forming and assembling parts by machine after they are primed or loaded with explosive materials.

(5) Inspecting and packing, practically all of which is done after the parts or products are primed or loaded.

Almost all the opportunities for employment in the industry involve either work on machines (chiefly power presses) or work in handling explosives in large or small quantities.

The hazard from explosion appears to be definitely less in many occupations in ammunition manufacture than in the manufacture of fireworks or of basic explosive compounds or mixtures. The most dangerous part of the manufacture of small-arms ammunition is the making of primers. The fulminate used is an industrial poison, and it or other initiating or priming explosives used in the primer are set off chiefly by shock or impact. In many occupations the amount of explosive in the parts being handled is relatively small, so that explosions in ammunition factories are less likely to spread than in other types of explosives plants. Furthermore, the powder used in ammunition is for the most part smokeless powder, which is less readily ignited than black powder.

Most ammunition plants have well-developed safety programs. No special State codes have been issued for ammunition manufacture, but general codes on the storage and use of explosives apply to plants manufacturing ammunition as well as to other plants.

Blasting caps.—A blasting cap is a small device consisting of a metal container and a quantity of an initiating or priming explosive, such as fulminate of mercury or lead azide. It is used in setting off a charge of dynamite or other explosive in blasting.

The processes of manufacture are similar to those in the making of ammunition, but on the whole they are more hazardous since proportionately more explosive material is used and since the construction of the cap is such that it is more readily set off than ammunition. The manufacture of blasting caps and the manufacture of ammunition are carried on in separate plants and are considered to be separate industries.

Special hazards to minors.

Work in the manufacture of explosives, including articles containing explosive components, is hazardous, particularly for the young worker, who is characteristically curious and irresponsible. A young person cannot be expected to exercise at all times the good judgment and caution which are required in this work; nor can he be expected to recognize conditions that may call for special attention to prevent an explosion, even though he has been told of the principles and rules for safe practice. Also, he is very likely to venture about the plant and handle objects in an unsafe manner, whether or not he has been given proper instructions or has been forbidden to enter certain parts of the plant.

STATISTICAL MEASURES OF HAZARD

Industrial-injury rates.

Nation-wide figures on accident rates in explosives manufacture are available for 1936 for a sample group of establishments reporting

to the United States Bureau of Labor Statistics.¹ These show for 33 explosives-manufacturing establishments² a high severity rate of disabling injuries, though a low frequency rate. The severity rate (that is, the number of days lost per 1,000 employee-hours worked) was 4.34 for explosives industries, compared with 2.08 for all manufacturing industries combined.³ These figures indicate that explosives manufacture was twice as hazardous as all manufacturing industries combined, in terms of severity of injuries. Explosives ranked sixth in severity among the 66 manufacturing industries for which the Bureau of Labor Statistics published injury rates for 1936. On the other hand, the frequency rate (that is, the number of disabling injuries per 1,000,000 man-hours worked) was 6.61 for explosives manufacture, compared with 16.61 for all manufacturing industries combined.

This low frequency rate doubtless reflects the safety consciousness of the explosives industries and the general effectiveness of their safety programs. The high severity rate, on the other hand, reflects the hazards inherent in these industries, which result in a high total injury cost despite all the precautions taken.

No comparable figures are available for earlier years. For 1937, preliminary figures are available for explosives plants but not for all manufacturing industries combined. The frequency rate of disabling injuries in explosives industries in 1937 (6.30) was about the same as in the preceding year (6.61). The severity rate (2.36) was lower than in 1936 but was nevertheless higher than the 1936 severity rate for all manufacturing industries (2.08).⁴ Unfortunately, no figures are available showing injuries to minors only.

Experience under workmen's compensation.

Another statistical measure of hazard is workmen's-compensation costs in relation to pay rolls. In order that premium rates for workmen's-compensation insurance may bear a relation to the costs incurred in a particular industry, rate-making agencies tabulate insured pay-roll and compensation losses for specific industry and occupation classifications for use in arriving at the premium rates to be charged for workmen's-compensation insurance in each classification. The pure premium (that is, the rate of compensation loss in relation to insured pay roll) for explosives classifications is available for 34 States and the District of Columbia combined from the National Council on Compensation Insurance, an organization serving insurance companies by preparing workmen's-compensation premium rates.⁵ Similar figures are available for Pennsylvania from its sepa-

¹ Industrial Injuries in the United States During 1936, Monthly Labor Review, Vol. 47, No. 1 (July 1938), pp. 18-30.

² Most of these establishments manufacture basic explosive compounds and mixtures.

³ In cases of temporary disability, the time loss represents actual days of disability. In cases of fatal or permanent injuries, the time loss is computed according to the American standard scale of time charges; death and permanent total disability, for instance, are charged as 8,000 days. (American Standard Method of Compiling Industrial Injury Rates, p. 6. American Standards Association, New York City, 1937.)

⁴ Preliminary figures from the U. S. Bureau of Labor Statistics.

⁵ Workmen's Compensation Experience Compiled in 1937. National Council on Compensation Insurance, New York. All States are represented except Arkansas, Delaware, Florida, Mississippi, Nevada, New Hampshire, North Dakota, Ohio, Oregon, Pennsylvania, South Carolina, Washington, West Virginia, Wyoming.

rate rate-making agency, the Pennsylvania Compensation Rating and Inspection Bureau.⁶

Figures for 34 States and the District of Columbia, based on the 5 policy-years 1930-34, show a pure premium of 4.25 (that is, \$4.25 per \$100 of pay roll) for explosives classifications, about three and one-half times the average for all manufacturing classifications (1.24).⁷ For Pennsylvania the pure premium for explosives manufacture, based on \$1,750,000 of pay roll during the 5 policy-years 1932-36, was 1.38, two and one-half times the average for all manufacturing classifications in the State (0.54).⁸

These figures on compensation costs show the explosives industries to be even more hazardous, relative to all manufacturing industries, than do accident statistics. This is probably due in part to the fact that the reports of rates prepared by the insurance rate-making agencies do not include the experience of firms that are self-insuring under State workmen's-compensation laws. These firms are the ones most likely to have highly developed safety programs, and they are well represented in the accident figures of the Bureau of Labor Statistics, which are based on a voluntary reporting system.

As a measure of hazard, compensation costs in relation to pay roll are themselves subject to distortion because factors other than extent of disability enter into their determination. Differences in wage levels affect comparisons between industries and between States, and differences in benefit provisions of workmen's-compensation laws, as well as differences in method and standards of administration, likewise affect comparisons between States or regions. However, in the case of the explosives industries, which are scattered geographically and which as a group have a wage level apparently not far from the average for all manufacturing, it is believed that the figures on compensation costs are significant as an indication of relative hazard.

EMPLOYMENT OF MINORS IN THE EXPLOSIVES INDUSTRIES

State standards.

Work in connection with the manufacture of explosives is recognized as hazardous for young workers under the laws of 22 States. Of these States, 11 prohibit such employment for all minors under 18 years of age, 1 for minors under 17 years, and 10 for minors under 16 years. In 1938, 65 of the 151 plants reported to be engaged in the manufacture of explosives were located in States with an 18-year minimum age for work with explosives (including Pennsylvania and Ohio). One plant was in a State with a 17-year minimum age for such employment. Twenty-three plants were located in States where a 16-year minimum age applied either by specific provision or by provision for general manufacturing. The remaining 62 plants were located in 13 States that permitted employment in explosives plants at 14 years of age. (Appendix D, p. 16.)

⁶ Classification Experience Policy Years 1932 Through 1936. Pennsylvania Schedule Z, vol. 1. Pennsylvania Compensation Rating and Inspection Bureau, Harrisburg.

⁷ Workmen's Compensation Experience Compiled in 1937, pp. 185-188. National Council on Compensation Insurance, New York. See also the Council's Circular Letter, Nov 16, 1937.

⁸ Classification Experience Policy Years 1932 Through 1936, vol. 1, pp. 99, 100. The average for all manufacturing classifications was computed from statistics contained in this report.

The State minimum-age provisions for work in the manufacture or handling of explosives vary in application with respect both to the occupations and to the types of explosives covered. (Appendix E, p. 17.) For the most part the provisions are broad in coverage so far as occupations are concerned, applying in many States to any work "in or about establishments where * * * explosives are manufactured, compounded, or stored." The provisions of some States are narrower, applying either to work "in the manufacture, packing, or storing" of explosives or to the handling or use of explosives. The range of products covered varies to some extent, and the lack of definition of such terms as "explosives" or as "other dangerous explosives" means that the exact coverage is not always clear. However, when the provision relates to any work in or about plants where explosives are compounded or stored as well as manufactured, at least part of the explosive materials handled in the plant would probably be within the coverage of the provision, and the entire manufacturing plant would therefore be affected by the minimum-age requirement.

Report of Advisory Committee on Employment of Minors in Hazardous Occupations, 1932.

This committee, appointed by the Chief of the Children's Bureau in 1932 on the recommendation of the White House Conference on Child Health and Protection, recommended a list of specific occupations that should be prohibited to minors under 18 years of age. This list included among the occupations involving mechanical hazards any employment "in the manufacture, transportation, or use of explosives, or explosive or highly inflammable substances."¹ The recommendations of this committee served as the basis for recommendations made by the Labor Advisory Board to N. R. A. code authorities regarding lists of occupations hazardous to minors. The establishment of such lists was provided for by many of the N. R. A. codes.

N. R. A. codes.

When the National Recovery Administration set up minimum-age standards in the industry codes, some recognition was accorded the hazardous nature of work in explosives plants. A flat 18-year minimum age was provided in the code for the pyrotechnic-manufacturing industry (fireworks) from the outset. However, work in explosives plants was not definitely recognized as requiring a higher standard than the basic 16-year minimum in the other two codes governing explosives industries—that is, the codes for the manufacture of small arms and ammunition and for chemical manufacturing. The latter code, however, contained a provision to the effect that any higher minimum age set by State law should be observed. The former contained provision for an 18-year minimum age in hazardous occupations to be listed by the code authority, but no list of such occupations was set up.²

¹ Report of the Advisory Committee on Employment of Minors in Hazardous Occupations. Monthly Labor Review, Vol. 35, No. 6 (December 1932), pp. 1315-1322.

² History of the Code of Fair Competition for the Small Arms and Ammunition Manufacturing Industry, pp. 45, 48-49. Division of Review, National Recovery Administration. (Manuscript on file with the N. R. A. Records Section, U. S. Department of Commerce, Washington.)

Industry policies.

All persons representing management, either as officials of trade associations or as employers, who were consulted in the course of this study stated that it was the policy of the concern or concerns they represented to hire only persons 18 years of age or over for work in or about explosives plants. Indeed, many said that no one under 21 or even under a higher age was permitted to work at the more hazardous occupations in the plants, such as mixing powder. Although observing an 18-year minimum age in general, one ammunition plant reported that it made an exception in the case of mail boys, using boys between 16 and 18 years to carry mail and messages through the plant (including some workrooms where the explosive materials were handled).

Several persons representing the industries involved and others familiar with various branches of explosives manufacture reported that so far as they knew minors under 18 were employed in such manufacture only by small fireworks concerns not represented in the trade association of the fireworks industry.

1930 census data.

Unfortunately, no current data are available regarding the number and ages of children in the explosives industries. Figures from the 1930 Census of Occupations probably represent a maximum estimate of current employment. In 1930, 584 minors under 18 years of age were reported as operatives or laborers in explosives, ammunition, and fireworks factories. These 584 comprised about 5 percent of the 10,951 workers of all ages (10 years and over) in these occupational groups. No break-down is given for the 3 types of explosives manufacture, but it is probable that the vast majority of the young workers included in the following figures were in the fireworks industry:

<i>Age of worker</i>	<i>Number</i>	<i>Percent</i>
Total -----	10,951	100.0
10 to 13 years-----	4	(1)
14 and 15 years-----	26	.2
16 and 17 years-----	554	5.1
18 and 19 years-----	956	8.7
20 years and over-----	9,411	86.0

¹ Less than one-tenth of 1 percent.

Source: Fifteenth Census of the United States, 1930. Population, vol. V, table 6, pp. 122-125, and table 10, pp. 353-354. U. S. Bureau of the Census, Washington, 1933.

ATTITUDES TOWARD AN 18-YEAR MINIMUM-AGE STANDARD

All persons consulted regarding an 18-year minimum age for work in or about explosives plants, including representatives of employers and of labor and safety experts, were of the opinion that a general 18-year standard is desirable for employment in explosives industries. From the point of view of employers, the most important reason for this opinion appeared to be the need of the industries

for steady, mature, and responsible employees in a working environment entailing many hazards and requiring strict observance of many rules of safe practice for the protection of life and property.

Some persons questioned the desirability of applying the order to office workers, including mail boys. However, others regarded office and errand work at explosives plants as occupations that should be declared hazardous for minors under 18. With this one exception, the persons consulted during the investigation were in agreement that a hazardous-occupations order relating to explosives manufacture should apply to any work in or about the plant.

CONCLUSIONS

1. Workers in plants manufacturing explosives, including articles containing explosive components, are especially subject to accident hazards from explosion despite the progress made by manufacturers in developing safeguards.

2. The accident severity rate for explosives manufacture was about twice as great as the average for all manufacturing industries in 1936, on the basis of available but incomplete figures. The accident frequency rate was not high, but injuries due to explosion are very likely to be serious or fatal. Workmen's-compensation experience likewise shows a high injury cost for explosives manufacture.

3. Occupations in explosives-manufacturing plants are especially hazardous for young persons, who are characteristically curious and irresponsible, because they cannot be relied upon to exercise caution and good judgment in observing the many necessary safety precautions in conducting themselves about the plant and at their work. This obviously concerns not only the safety of the minor but that of his fellow worker as well.

4. The unsuitability for young persons of work in establishments manufacturing or handling explosives has been recognized by 22 States in setting a higher minimum age for work in connection with the manufacture or use of explosives than for other employment. Eleven States at present prohibit the employment of minors under 18 years of age in connection with explosives manufacture, including Pennsylvania and Ohio, two of the most important explosives-manufacturing States.

5. It is the policy of leading manufacturers operating explosives plants to observe an 18-year minimum age regardless of the State of operation. At the present time the only type of work in explosives manufacture in which any substantial number of minors under 18 years of age appear to be engaged is in small fireworks factories not represented by the trade association of the fireworks industry.

6. The term "explosives" should be understood to include ammunition, black powder, blasting caps, fireworks, high explosives, primers, smokeless powder, and all goods classified and defined to be explosives by the Interstate Commerce Commission in Regulations for Transportation by Rail of Explosives and Other Dangerous Articles in Freight, Express, and Baggage Services, as amended, Docket 3666, issued pursuant to sec. 233 of the Act of March 4, 1921 (ch. 172, 41 Stat. 1445, U. S. Code, ti. 18, sec. 383).

Appendix A.—Legal Basis for the Investigation

This investigation has been conducted by the Industrial Division of the Children's Bureau pursuant to the regulation entitled "Procedure Governing Determinations of Hazardous Occupations,"¹ issued by the Chief of the Children's Bureau on November 3, 1938, pursuant to the authority conferred by section 3 (1) of the Fair Labor Standards Act of 1938 (Act of June 25, 1938, ch. 676, 52 Stat. 1060, U. S. Code, Supp. IV, ti. 29, sec. 201), hereafter referred to as the Act. This subsection, which defines oppressive child labor as that term is used in the Act, provides in part as follows:

(1) "Oppressive child labor" means a condition of employment under which (1) any employee under the age of sixteen years is employed by an employer * * * in any occupation, or (2) any employee between the ages of sixteen and eighteen years is employed by an employer in any occupation which the Chief of the Children's Bureau in the Department of Labor shall find and by order declare to be particularly hazardous for the employment of children between such ages or detrimental to their health or well-being; * * *.

For the purpose of establishing an orderly procedure for determining and declaring occupations to be particularly hazardous for the employment of minors 16 and 17 years of age or detrimental to their health or well-being, the Chief of the Children's Bureau issued the regulation, Procedure Governing Determinations of Hazardous Occupations, the first section of which provided in part as follows:

Sec. 421.1. *Investigation and conference.*—Preparatory to the making of a finding by the Chief of the Children's Bureau that an occupation or a group of occupations is particularly hazardous for the employment of minors between 16 and 18 years of age or is detrimental to their health or well-being, a study shall be made of information obtained by the Bureau, or submitted to it with respect to the hazardous or detrimental nature of such occupation or occupations. Conferences may be held with representative employers and workers in the industry, experts in industrial health and safety, and others for the purpose of discussing the nature and characteristics of the occupation or occupations under consideration. A public hearing may be held upon reasonable public notice of the time and place thereof whenever such action is deemed by the Chief of the Bureau to be expedient for the purpose of obtaining such evidence with respect to the nature and characteristics of such occupation or group of occupations. A transcript of the proceedings of any such hearing shall be made and filed with the Bureau. A report of facts and conclusions with respect to the hazardous or detrimental nature of the occupation or occupations under consideration shall be prepared upon the basis of such information and evidence.

In accordance with the provisions of the Act and the regulation referred to above, the Chief of the Children's Bureau instructed the Industrial Division of the Bureau to conduct an investigation with respect to the hazardous or detrimental nature of occupations in plants manufacturing explosives, including articles containing explosive components, with special reference to young workers, and to consider the problems involved in drafting an order under section 3 (1) of the Act.

¹ Procedure Governing Determinations of Hazardous Occupations, Title 29—Labor, ch. IV—Children's Bureau—Child Labor—pt. 421. Federal Register, vol. 3, p. 2640 DI, November 5, 1938.

Appendix B.—Principal Articles Classified as Explosives by the Interstate Commerce Commission¹

Ammunition for cannon with explosive projectiles, including gas, smoke, and incendiary projectiles.
Ammunition for cannon without explosive projectiles, or without projectiles.
Ammunition for small arms with explosive bullets.
Black powder.
Blasting caps.
Bombs, explosive.
Boosters.
Cartridge shells, primed, empty.
Chemical ammunition containing explosive components.
Combination fuzes.
Combination primers.
Cordeau detonant.
Delay electric igniters.
Detonating fuzes.
Diazodinitrophenol.
Electric squibs.
Empty cartridge bags—black-powder igniters.
Fireworks.
Fulminates.
Fuse igniters.
Fuse lighters.
Grenades, explosive, including hand and rifle grenades.
Grenades, primed, empty.
Guanyl nitrosamino guanylidene hydrazine.
Guanyl nitrosamino guanyl tetrazene (tetrazene).
High explosives.
Instantaneous fuse.
Lead azide.
Lead styphnate.
Low explosives.
Mines, explosive.
Nitro mannite.
Nitrosoguanidine.
Pentaerythrite tetranitrate.
Percussion caps.
Percussion fuzes.
Primers.
Projectiles, explosive.
Safety squibs.
Small-arms ammunition.
Small-arms primers.
Smokeless powder for cannon.
Smokeless powder for small arms.
Tetrazene.
Time fuzes.
Torpedoes, explosive.
Tracer fuzes.

¹ Regulations for Transportation by Rail of Explosives and Other Dangerous Articles in Freight, Express, and Baggage Service. Docket 3666, pt. I, pars. 51, 52, pp. 25, 26, and Supplement No. 1, p. 2.

Appendix C.—Number of Explosives-Manufacturing Plants in Specified States and Their Chief Product

State	Plants operated by private concerns					Plants operated by U. S. Government
	Total	Chief product				
		Basic explosive compounds and mixtures	Fire-works	Am-muni-tion	Blast-ing caps	
United States	151	61	73	11	3	16
Alabama	3	3				
Arizona	1	1				
Arkansas	1	1				
California	10	4				
Colorado	1	1	5			1
Connecticut	5			2		1
Delaware	1			1		
District of Columbia	1					
Illinois	15	6	6	1		
Indiana	4	2	2	3		1
Iowa	3	1	2			
Kansas	2	2				
Kentucky	1	1				
Maryland	4		4			2
Massachusetts	5	1	4			
Michigan	2	2				
Minnesota	1			1		
Missouri	7	3	4			
Nebraska	1		1			
New Jersey	16	4	10	1	1	4
New York	8	1	6		1	2
Ohio	18	5	10	2		1
Pennsylvania	27	13	12	1	1	1
South Carolina						1
Tennessee	3	2	1			1
Texas	1		1			
Utah	1		1			
Virginia	1	1				1
Washington	7	5	2			2
West Virginia	1	1				
Wisconsin	1	1				

¹ Includes 2 plants manufacturing cordeau detonant and safety fuse and one plant with product not specified.

Source: List of manufacturers of explosives, compiled by Bureau of Explosives, American Association of Railroads, revised February 1938, New York. This list includes all plants known to ship in interstate commerce products classified as explosives by the regulations of the Interstate Commerce Commission.

Appendix D.—State Minimum-Age Standards for Explosives Manufacturing and for General Manufacturing

Minimum-age standards applicable to work in explosives manufacture	States with minimum-age standards		
	Number	Number with explosives plants	Number of plants
Total	49	29	151
Minimum age specified for work with explosives: ¹			
18 years	311	10	65
17 years	31	1	1
16 years	410	4	22
No minimum age specified for work with explosives but minimum age set for general manufacturing:			
16 years	53	1	1
14 years	624	13	62

¹ Appendix E, gives the exact coverage of these provisions.

² Arizona, Delaware, Indiana, Maryland, Massachusetts, Michigan, New Mexico, Ohio, Pennsylvania, Virginia, Wisconsin. Explosives plants are located in all these States except New Mexico.

³ Texas.

⁴ Connecticut, Iowa, Missouri, Nevada, New York, North Carolina, Oklahoma, Rhode Island, Vermont, Wyoming. Explosives plants are located in Connecticut, Iowa, Missouri, and New York.

⁵ Montana, South Carolina, Utah. Only Utah has an explosives plant.

⁶ In a few of the 24 States exemptions are found permitting employment of children under 14 years of age in factories under certain circumstances.

⁷ Alabama, Arkansas, California, Colorado, District of Columbia, Illinois, Kansas, Kentucky, Minnesota, Nebraska, New Jersey, Tennessee, Washington.

Appendix E.—Provisions in State Laws Establishing Minimum-Age Standards for Work in Connection With Explosives, Jan. 1, 1939

Provisions	States	Minimum age
In or about establishments where nitroglycerin, dynamite, gunpowder, or other high or dangerous explosives are manufactured, compounded, or stored. (Delaware and Massachusetts laws omit "stored." Some States list a few other explosives, such as dualin and guncotton.)	Nevada.....	16
	Arizona, Delaware, Indiana, Maryland, Massachusetts, Michigan, ¹ Ohio, Wisconsin. }	18
In establishments where explosives are manufactured, handled, or stored, as follows: Black powder (all varieties), dry guncotton, nitroglycerin, dynamite, chlorates, fulminates, picric acid, fireworks, and any other substances which are subject to expansion by the aid of shock, friction, spark, or heat. (Smokeless powder, wet guncotton, and wet nitrostarch, while not properly classed with the above as explosives, are also included.)	Pennsylvania ¹	18
In the manufacture, packing, or storing of powder, dynamite, nitroglycerin compounds, fuses, or other explosives. (New York: "manufacture, packing, or storing of explosives.")	Connecticut, Missouri, New Mexico, New York, Oklahoma, Rhode Island. }	16
In connection with the manufacture, transportation, or use of explosives or highly inflammable substances.	North Carolina.....	16
In the handling of explosives.....	Vermont.....	16
	Virginia.....	18
Any work in which the handling or use of gunpowder, dynamite, or other like explosive is required.	Iowa.....	16
At or about any place where explosives are used. (Texas: "In any place.")	Texas.....	17
	New Mexico.....	18
In operating any place where gunpowder, dynamite, or other dangerous explosive is manufactured, stored, or compounded or in handling in any manner any dangerous explosive.	Wyoming.....	16

¹ Established by regulation in accordance with authority granted by the State child-labor law.

Appendix F.—Hazardous-Occupations Order No. 1

MAY 18, 1939.

Occupations Particularly Hazardous for the Employment of Minors Between 16 and 18 Years of Age or Detrimental to Their Health or Well-Being

SEC. 422.1. *Occupations in or about plants manufacturing explosives or articles containing explosive components.*—(a) *Finding of fact.*—By virtue of and pursuant to the authority conferred by section 3 (1) of the Fair Labor Standards Act of 1938 (52 Stat. 1060) and pursuant to the regulation prescribing the Procedure Governing Determinations of Hazardous Occupations;¹ an investigation having been conducted with respect to the hazards for minors between 16 and 18 years of age in occupations in or about plants manufacturing explosives or articles containing explosive components; a report of the investigation having been submitted to the Chief of the Children's Bureau showing that, despite progress in the promotion of safe working conditions, the manufacture of explosives and articles containing explosive components is hazardous in nature, that according to available figures the accident severity rate for such manufacture has been higher than the average for all manufacturing industries, that workmen's compensation experience likewise shows a high injury cost for such manufacture, that employment in plants manufacturing explosives or articles containing explosive components is especially hazardous for young workers who are characteristically lacking in the exercise of caution, that in recognition of the particular hazards for young workers of employment in connection with explosives, 22 States have set a specific minimum age for such employment, higher than for other employment, and that the policy of many manufacturers of explosives or articles containing explosive components is to employ no minors under 18 years of age in their plants; a public hearing having been held with respect to a proposed finding and order based upon the said report and all parties appearing at the hearing having been given opportunity to be heard, to question witnesses, and to file briefs and additional statements subsequent to the hearing; the record of the hearing having been duly considered and certain changes having been made in the proposed finding and order in accordance with suggestions made at the hearing; opportunity having been given to all interested parties to file objections within 15 days following publication in the Federal Register² of the proposed finding and order, as revised, and no objection disclosing just cause for further revision thereof having been received; and sufficient reason appearing therefor,

Now, therefore, I, Katharine F. Lenroot, Chief of the Children's Bureau of the United States Department of Labor, hereby find that all occupations in or about plants manufacturing explosives or

¹ Issued November 3, 1938, pursuant to the authority conferred by section 3 (1) of the Fair Labor Standards Act of 1938 (52 Stat. 1060), published in the Federal Register, vol. 3, p. 2640 DI, November 5, 1938.

² The Federal Register, vol. 4, p. 1758 DI, May 2, 1939.

articles containing explosive components are particularly hazardous for the employment of minors between 16 and 18 years of age.

(b) *Order.*—Accordingly, I hereby declare that all occupations in or about any plant manufacturing explosives or articles containing explosive components are particularly hazardous for the employment of minors between 16 and 18 years of age.

Definitions. For the purpose of this order—

(1) The term “plant manufacturing explosives or articles containing explosive components” means the land with all buildings and other structures thereon, used in connection with the manufacturing or processing of explosives or articles containing explosive components.

(2) The terms “explosives” and “articles containing explosive components” mean and include ammunition, black powder, blasting caps, fireworks, high explosives, primers, smokeless powder, and all goods classified and defined as explosives by the Interstate Commerce Commission in Regulations for Transportation by Rail of Explosives, et cetera, as amended, Docket 3666, issued pursuant to the Act of March 4, 1921 (ch. 172, 41 Stat. 1444, U. S. Code, ti. 18, sec. 382).

This order shall become effective on July 1, 1939, and shall be in force and effect until amended or repealed by order hereafter made and published by the Chief of the Children's Bureau.

KATHARINE F. LENROOT,
Chief of the Children's Bureau.

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