Spark Ignition Properties of Hand Tools

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THIRD EDITION, JULY 1989

American Petroleum Institute
1220 L Street, Northwest
Washington, D.C. 20005

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Safety and Fire Protection Department

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FOREWORD

This publication emphasizes that the use of nonferrous hand tools, sometimes referred to as nonsparking tools, is not warranted as a fire prevention measure in petroleum operations.

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SECTION 1—GENERAL

1.1 Scope

This publication emphasizes that the use of nonferrous hand tools, sometimes referred to as nonsparking tools, is not warranted as a fire prevention measure in petroleum operations.

1.2 Background

As early as 1930, fire protection engineers in the petroleum industry questioned the justification for recommending the use of special nonferrous tools instead of ordinary steel tools in petroleum operations. These engineers pointed out that although numerous opportunities existed for the production of sparks from violent contact of steel objects with other steel objects, there was a negligible record of fires resulting from such a cause. It was therefore illogical to attribute a special hazard designation to steel hand tools.

A paper presented at the Group Session on Fire Protection at the Annual Meeting of the American Petroleum Institute in 1941 described a series of tests conducted about 15 years earlier. The paper reported that sparks produced by contact of steel with steel, steel with an abrasive wheel, or even steel with power-driven equipment were unlikely to ignite petroleum vapors [1]. The nature of sparks was discussed, and it was shown that any material harder than steel (even nonsparking material) could produce sparks upon striking steel. The authors concluded that insistence on the use of special nonsparking tools fostered a false sense of security to the detriment of other, more important fire prevention measures. They also concluded that blanket rules covering the use of such tools were unwise and against the best interests of the petroleum industry.

SECTION 2—SUMMARY OF RESEARCH

2.1 API Research Project

The use of nonsparking tools had not been universal in the petroleum industry before 1941, but after the presentation of the paper, many companies began to gradually eliminate the use of special tools. It was, however, thought desirable for additional research to be performed by an independent service. In 1950, API entered into a research contract with Underwriters Laboratories under the sponsorship of the API Committee on Accident Prevention and Fire Protection.

During the next three years, little was accomplished other than the confirmation of previous conclusions. Tests showed that even with mechanical devices operating at high speeds and with high contact pressure, it was extremely difficult to produce sparks capable of igniting petroleum vapors. No method was developed by which to correlate the results of these tests with the properties of sparks produced in the ordinary use of hand tools. It became apparent that the original objectives of the program would probably not be attained. API therefore decided to terminate the contract.

2.2 Sparks From Hand Tools

The API Committee on Accident Prevention and Fire Protection reviewed the situation and proposed the preparation of "Sparks From Hand Tools" [2], which was approved for publication by the Safety Committee of API's Board of Directors on February 3, 1956. The conclusion of this publication read:

> Based on experimental evidence and ample practical experience, it has been concluded that in petroleum operations no significant increase in fire safety will result from the use of nonsparking hand tools in lieu of ordinary tools made of steel.

About a year later, the U.S. Department of Commerce, Office of Technical Services, issued "Sparking Characteristics and Safety Hazards of Metallic Materials" [3]. A review of the literature and some experimental work led to the following conclusion:

> No benefit is gained by the use of low sparking materials in place of steel in hand tools to prevent ignitions.

2.3 Other Investigations

Petroleum industry interest in the role of friction sparks in the occurrence of accidental fires was paralleled by concern in the coal mining industry, since many mine fires had been attributed to sparks produced by power-driven coal mining equipment.

In 1955, the U.S. Bureau of Mines published "Frictional Ignition of Gas by Mining Machines" [4], which recounted fire experiences in U.S. and various Euro-

pean coal mining areas. This paper discussed investigations which demonstrated that ignitions were possible with certain combinations of materials and forms of abrasion and impact. It suggested 23 remedial measures, none of which involved a restriction on the material used for hand tools.

About 1928, the Safety in Mines Research Establishment initiated a continuing program of investigation in Great Britain. F. Powell cited the publications resulting from this program and 82 other papers in his paper entitled "Ignition of Gases and Vapors—Review of Ignition of Flammable Gases and Vapors by Friction and Impact" [5]. Only a few of the references involved hand tools, and Powell avoided drawing any conclusions.

Around 1960, the Institute of Petroleum apparently started to consider the significance of sparks from tools as an ignition source. It referred the problem to the Committee on Industrial Fires and Explosions of the Fire Research Board. Progress reports were issued in 1961 and 1963. "The Relative Hazards in the Use of Ferrous and Non-Sparking Tools in the Petroleum Industry," by H.G. Riddlestone and A. Bartels [6], included a comprehensive review of published information but did not contain any new experimental evidence. An introductory note prepared by the Institute of Petroleum's Engineering Committee indicated that further experimental work was not considered justified. The Institute of Petroleum accepted the principal conclusion, that "tools of nonsparking materials do not effect a significant reduction in the risk of ignition of petroleum vapors by frictional sparks compared to that arising from ferrous tools," but members were cautioned not to construe this conclusion as applying to gases more easily ignited than petroleum vapors, as an excuse for not ensuring the absence of flammable concentrations of gases or vapors, or as an excuse for not taking other applicable precautions when mechanical work was in progress.

2.4 Conclusion

Nothing essentially new has been learned since the publication of "Sparks from Hand Tools" in 1956. Sparks produced by violent contact between some substances and others, including some of the metals ordinarily termed "nonsparking," can, in fact, ignite gases or vapors if sufficient energy is dissipated in the impact. However, such conditions are far removed from the actual conditions under which hand tools are used. The fire records of more and more companies that have never used or have ceased to use nonsparking tools amply confirm the position taken by the Safety Committee of API's Board of Directors in 1956:

> The Institute's position is that the use of special nonferrous hand tools, sometimes referred to as nonsparking tools, is not warranted as a fire-prevention measure applicable to petroleum operations.

SECTION 3—REFERENCES

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2. "Sparks from Hand Tools," American Petroleum Institute, New York, 1956.

3. "Sparking Characteristics and Safety Hazards of Metallic Materials" (PB 131131), U.S. Department of Commerce, Office of Technical Services, Washington, D.C., 1957. (Reprint of U.S. Department of the Navy Technical Report NGF-T-1-57, NAVORD Report 5205, April 1957.)

4. "Frictional Ignition of Gas by Mining Machines" (IC 7727), U.S. Bureau of Mines, Washington, D.C., 1955.

5. F. Powell, "Ignition of Gases and Vapors—Review of Ignition of Flammable Gases and Vapors by Friction and Impact," *Industrial and Engineering Chemistry,* 1969, Volume 61, Number 12, pp. 29–37.

6. H. G. Riddlestone and A. Bartels, "The Relative Hazards in the Use of Ferrous and Non-Sparking Tools in the Petroleum Industry," *Journal of the Institute of Petroleum,* 1965, Volume 51, Number 495, pp. 106–110.