

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND FIRE OFFICES' COMMITTEE
JOINT FIRE RESEARCH ORGANIZATION

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DESTRUCTION OF FORTY GALLON DRUM BY AN
EXPERIMENTAL GASEOUS EXPLOSION

by

Z. W. Rogowski

Summary

A mixture consisting of 5% propane in air was exploded in a forty gallon drum. This explosion dished one end of the drum with considerable distortion of the seam. The other end failed at the seam and became a missile.

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Fire Research Station,
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Herts.

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INTRODUCTION

It is known that the standard forty gallon drums used for the conveyance and storage of flammable liquids presents considerable explosion hazards. These drums when empty usually contain a sufficient quantity of residual liquid left to form an explosive mixture.

Accidents occur when such drums undergo repair, by welding or brazing. It has been shown⁽¹⁾ that such operations may result in the formation of an explosive mixture even with heavy hydrocarbons. Solvents or fuels with flash point less than ambient temperature may form explosive mixtures without any external heat source, and here the welding or brazing torch would act merely as an ignition source.

The Joint Fire Research Organization was asked to provide a drum in which an explosion had been performed for demonstration purposes at a safety exhibition and an experiment was carried out in which a drum was destroyed by exploding 5 per cent propane-air mixture. The experiment is described in this note.

EXPERIMENTAL

Apparatus

The experiment was carried out in a substantially constructed room, which acted effectively as a barricade.

A standard forty gallon drum which had previously contained kerosine was used. The cylindrical part of this drum was made from sheet steel 0.055 in thick with a longitudinal butt weld. The ends of this drum were of sheet steel of the same thickness and they were joined to the cylinder by the seams.

The drum was filled by metering in 5 per cent propane-air mixture.

The mixture was ignited by an electric fuse which consisted of a thin resistance wire surrounded by a bead of flammable solid. This fuse was introduced through the $\frac{1}{2}$ in B.S.P.T. socket situated in the cover of the drum and this hole remained open when the mixture was ignited. The position of the fuse was approximately in the centre of the drum.

Test procedure

The drum was placed with its bottom end resting on the ground. A quantity of 5 per cent propane-air mixture equivalent to seven changes of drum volume was metered through the $\frac{1}{2}$ in B.S.P. hole. The gas supply tube was withdrawn, and the mixture was ignited.

RESULTS

Plate a and b shows photographs of the drum after the explosion. It can be seen that the cylindrical part of the drum did not sustain any damage caused by the explosion pressure. Some dents, however, were made by the drum hitting the wall after being propelled by the force of the explosion. Both ends were extensively damaged. The end resting on the ground was distorted, with

some damage to the seam. The other end was detached from the cylindrical part of the drum by the failure of the seam. This end was projected upwards until its flight was arrested by the ceiling of the enclosure. It appears that this cover folded on impact with the ceiling.

DISCUSSION

The explosion of a hydrocarbon-air mixture within a forty gallon drum will result in its destruction. It is likely that during such an explosion the drum will fail by the disruption of the seams joining the cylindrical part of the drum to the end diaphragms. At this stage these diaphragms could become a missile capable of causing serious injuries to anybody in the proximity. It is likely that during such an explosion the drum may become a missile itself, this depending on the position of drum during the explosion.

If such a drum is locally heated prior to explosion the mode of rupture may be somewhat different, as in this case the heated portion of the drum may be the point of origin of the failure.

Reference

- (1) F. E. T. Kingman, E. H. Coleman and Z. W. Rogowski. Explosions in oil drums and tanks. H.M.S.O. 1951.



**a. PHOTOGRAPH SHOWING THE DISHED
END**



**b. PHOTOGRAPH SHOWING THE END WHERE
THE SEAM FAILED**

FIG. 1.