

Welding and Cutting

Acetylene (C_2H_2) consists of 92.3 per cent by weight of carbon and 7.7 per cent by weight of hydrogen in chemical combination. It contains stored-up energy which is released as heat when it burns, as in the welding flame. This heat is in addition to that which would be obtained by combustion of equivalent amounts of elemental carbon and hydrogen.

Acetylene burned with oxygen can produce a higher flame temperature (approximately 6000 F) than any other gas used commercially. Acetylene, like other combustible gases, ignites readily, and in certain proportions forms a flammable mixture with air or oxygen. The range of flammable limits of acetylene (2.5 to 81 per cent acetylene in air) is greater than that of other commonly used gases, with consequently greater hazard.

Acetylene is either supplied in cylinders or generated as needed. It is a product of the reaction between water and calcium carbide, a gray crystalline substance made commercially by fusing lime and coke in an electric furnace. Calcium carbide itself is neither flammable nor explosive. It is stored and sold in airtight and watertight cans or drums. If the drums are damaged in handling and if water comes in contact with carbide, acetylene will be generated and there is then danger of ignition and explosion.

Hydrogen is furnished in cylinders under a pressure of about 2000 psi at 70 F. It may ignite in the presence of air or oxygen when in contact with a spark, open flame, or other source of ignition. Hydrogen-air mixtures in the range from 4.1 to 74.2 per cent hydrogen are flammable.

Other fuel gases are used with oxygen in torches, primarily for oxygen cutting. For example, propane, butane, and their mixtures are supplied in cylinders in liquid form, generally under various trade names. These gases are discussed in Chapter 34, "Flammable and Combustible Liquids."

Acetylene generators

Acetylene should never be generated, distributed, or used at a pressure in excess of 15 psi (30 psia). (In this Manual, psi is used as the abbreviation for pounds per square inch gauge pressure.) The 15 psi pressure limit is intended to prevent unsafe use in

pressurized chambers such as caissons or tunnels under construction because, at greater pressures, the acetylene may become unstable. Acetylene may be safely stored and shipped at higher pressures if compressed into a cylinder containing a porous substance impregnated with a suitable solvent (such as acetone).

Acetylene generators are of three principal types: carbide-to-water, water-to-carbide, and water displacement. In the carbide-to-water, the most generally used in the United States, the carbide is placed in a hopper in the upper part of the generator. From the hopper, regulated amounts of carbide are fed into water in the lower part of the generator.

In the water-to-carbide generator, a regulated amount of water is allowed to come in contact with the carbide. This type of generator is not currently used in this country except for such uses as miners' lamps.

In the water displacement generator, calcium carbide is placed in a basket or holder which becomes partially immersed whenever the consumption of gas so reduces the pressure within the gas chamber that the water rises in it. The water displacement type is not extensively used except in small portable generators or floodlights. For this type of generator the carbide is frequently formed into cakes by a binder for easier handling.

Many accidents have been caused by home-made generators. It is advisable to secure the best generator possible and get the benefit of the experience of reliable manufacturers and trained designers. Reliable makers of generators publish instructions for safe operation; these rules should be posted where they will be seen and should be rigidly followed.

The regulations of NFPA Standard No. 51, *Oxygen-Fuel Gas Systems for Welding and Cutting*, should be followed in the installation and operation of all generator equipment. Only apparatus, such as torches, regulators, generators, etc., that has been examined and tested and found to be safeguarded insofar as is practicable should be used. Most insurance companies and local authorities accept apparatus listed by Underwriters' Laboratories, Inc., or approved and listed by Factory Mutual Engineering Division of Associated Factory Mutual Fire Insurance Companies.

Generators are designed either as medium