CGA G-1.3 70 2307549 0000436 5

CGA PAMPHLET G-1.3

ACETYLENE TRANSMISSION FOR CHEMICAL SYNTHESIS

(RECOMMENDED MINIMUM SAFE PRACTICES FOR PIPING SYSTEMS)

COMPRESSED GAS ASSOCIATION, INC.
NEW YORK, NEW YORK

Copyright by the Compressed Gas Association Inc
Sun Jun 28 22:28:16 1998

Documents
Document Sharing Hub

Full document details: CGA G-1.3-1970 scan

CONTENTS

Page

1. INTRODUCTION 3

2. GENERAL DESIGN 4
   - 2.1 Scope 4
   - 2.2 Materials 4
   - 2.3 Code Construction 4
   - 2.4 Grounding 4
   - 2.5 Weather Protection 5
   - 2.6 Overheating Protection 5
   - 2.7 Maintenance 5
   - 2.8 Regulations 5
   - 2.9 Properties of Acetylene 5

3. PIPING
   - 3.1 Scope 5
   - 3.2 Materials 5
   - 3.3 Design and Construction 6

4. STORAGE (GASHOLDER)
   - 4.1 Scope 8
   - 4.2 Type of Equipment 8
   - 4.3 Design of Equipment 9

5. BOOSTER SYSTEMS
   - 5.1 Scope 9
   - 5.2 Type of Equipment 9
   - 5.3 Design of Equipment 10
   - 5.4 Controls 10

6. PROTECTIVE DEVICES
   - 6.1 Scope 10
   - 6.2 Types of Devices 10
   - 6.3 Arresters 10
   - 6.4 Pressure Relief 12
   - 6.5 Flow Controls 13
   - 6.6 Special Valves 13
   - 6.7 Emergency Shutdown 13
   - 6.8 Packed Lines 13

7. GENERAL EXPLOSIVE BEHAVIOR OF ACETYLENE
   - 7.1 Deflagrations 14
   - 7.2 Detonations 15
   - 7.3 Application to Design 19

8. REFERENCES 20

COMPRESSED GAS ASSOCIATION, INC.
NEW YORK, N. Y.

AS RECOMMENDED BY INTERNATIONAL ACETYLENE ASSOCIATION

Copyright by the Compressed Gas Association Inc
Sun Jun 28 22:28:16 1998

Documents
Document Sharing Hub

Full document details: CGA G-1.3-1970 scan

1. INTRODUCTION

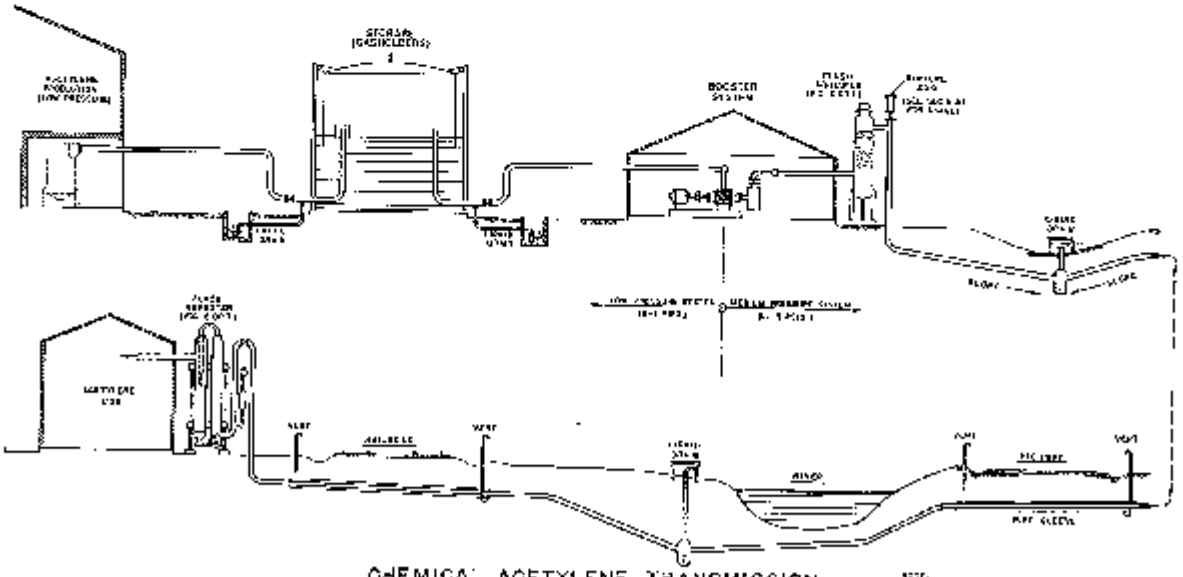
The increasing usage of acetylene as a raw material for the production of chemicals has created a need for a guide for the safe handling of acetylene in transmission piping systems. Recognizing this, the Scope of Activities Committee of International Acetylene Association established a Chemical Acetylene Transmission Committee composed of members having considerable experience in this field. The committee prepared this guide as representing the minimum recommendations for safe operation. Subsequent to the development of this pamphlet the International Acetylene Association became affiliated with the Compressed Gas Association, Inc. Its former activities are carried on by the Oxygen, Acetylene and Related Products Division of the Compressed Gas Association, Inc.

This guide is composed of two basic parts. Sections 2 through 6 are a compilation of practices which have evolved through the years and have been demonstrated experimentally by test to be pertinent to the safe transmission of acetylene. Section 7 discusses the general explosive behavior of acetylene in piping transmission systems on the basis of numerous tests and observations which have been made over the years.

Primary consideration was given to those properties peculiar to acetylene and requiring special handling techniques and protective measures. In addition to those special techniques required by the unstable nature of acetylene, precautions in construction and operation formally applicable to flammable gases must be observed.

This guide is confined to the safety aspects of transmitting acetylene between the source of production and the use point. When the pressure at the source is less than one psig, the distance of transmission to the use point may make it necessary to increase the pressure (Figure 1). When acetylene is produced at medium pressure, the gasholder and probably the booster system would be eliminated (Figure 2). Both the low pressure (0-1 psig) and the medium pressure (1-15 psig) systems have been considered. Higher pressures are discussed in some instances. Production and use facilities have their own problems and these are outside the scope of this guide.

Acetylene is considered to be of commercial quality, containing small amounts of impurities normally present when produced from calcium carbide or hydrocarbon processes. Handling mixtures of acetylene with diluents is not included. Also, acetylene cylinder filling plants are not considered.



CHEMICAL ACETYLENE TRANSMISSION
TYPICAL SYSTEM
(LOW PRESSURE PRODUCTION)
FIGURE 1

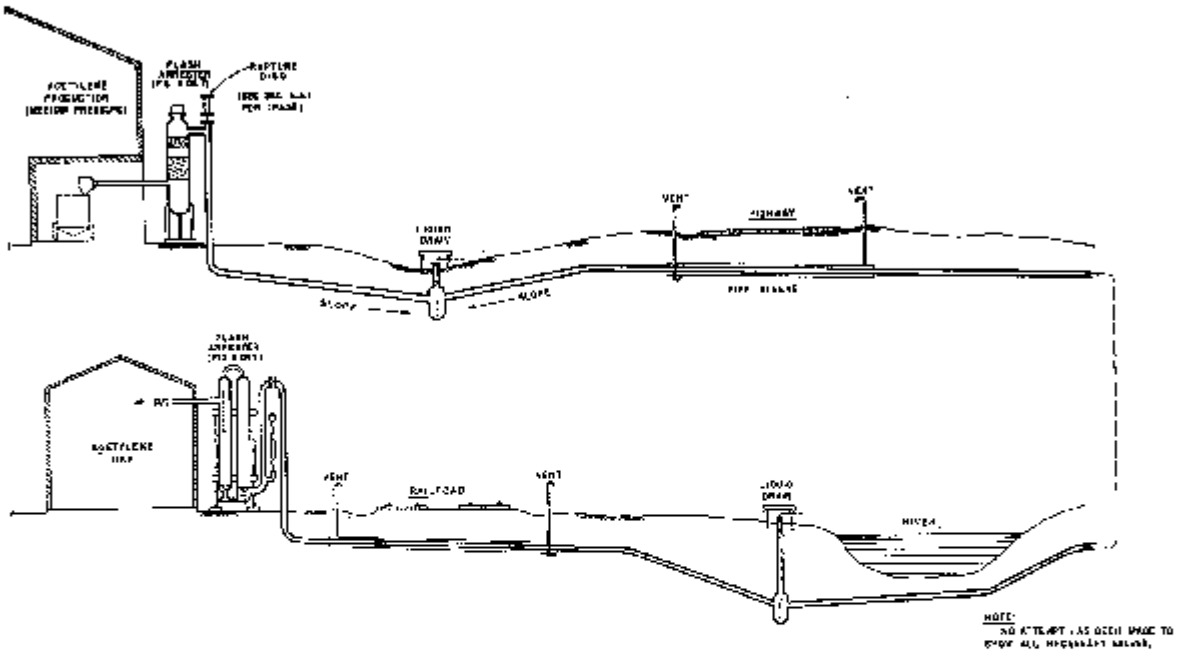
PROBLEM HARD COPY

Copyright by the Compressed Gas Association Inc
Sun Jun 28 22:28:16 1998

Documents
Document Sharing Hub

Full document details: CGA G-1.3-1970 scan

By issuing this guide, the Compressed Gas Association, Inc. and its members make no guarantee of results and assume no liability in connection with the information or safety suggestions herein contained. It should not be assumed that every acceptable safety procedure is included, or that unusual circumstances may not require additional procedures. These recommendations should not be confused with state, municipal, or insurance requirements that may apply.



CHEMICAL ACETYLENE TRANSMISSION

TYPICAL SYSTEM
(MEDIUM PRESSURE PRODUCTION)
FIGURE 2

2. GENERAL DESIGN

2.1 Scope. Those design features which are common to the various sections of this transmission system are covered in this general section and should be considered an essential part. The pertinent properties of acetylene are also stated.

2.2 Materials

2.2.1 COMPOSITION. In all cases, copper, silver and mercury should be excluded from contact with acetylene in transmission and control systems. Copper alloys may be considered in those cases where their specific use has proved safe in practice.

2.2.2 STRENGTH. All of the specific recommendations throughout this guide are considered to be the minimum for safe transmission of acetylene. Other design or operating conditions may dictate the use of stronger materials.

2.3 Code Construction. All pressure vessels should be constructed in compliance with the ASME code for unfired pressure vessels.

2.4 Grounding. All acetylene piping and equipment should be electrically bonded and grounded. The resistance to ground should not exceed one ohm and should be checked annually. At flanged and bolted connections, jumpers or shakeproof washers properly installed should be used for continuity of grounding.

PROBLEM HARD COPY

Copyright by the Compressed Gas Association Inc
Sun Jun 28 22:28:16 1998

Documents
Document Sharing Hub

Full document details: CGA G-1.3-1970 scan

2.5 Weather Protection. In locations subject to freezing, where the acetylene is water saturated, cold weather protection is recommended for all vessel parts, valves and piping subject to the accumulation of water. Steam or sheathed electrical tracing or thermal insulations may be used. Care should be exercised in the design and installation of the tracing to avoid localized overheating.

2.6 Overheating Protection. The design and installation of piping systems should provide protection from localized overheating to temperatures above those encountered from atmospheric exposure. Examples of such protection are insulation, fire wall or isolation.

2.7 Maintenance. Periodic patrolling of the system should be made a part of the operating procedure, with particular attention to corrosion, leaks, liquid drains and any abnormal conditions. Lubrication and cleaning should be on a routine schedule established through operating experience. Protective devices should be periodically tested or closely inspected to assure that each would function properly in emergency. Rupture discs should be inspected and replaced at intervals calculated to guard against bursting incidental to fatigue or corrosion.

2.8 Regulations. Each section of the transmission system should comply with existing regulations established by the authority having jurisdiction.

2.9 Properties of Acetylene. Acetylene is a colorless flammable gas and ordinarily has some type of odor due to the impurities introduced by the method of production.

2.9.1 The approximate explosive limits in air are 2.5% to 82% of acetylene by volume. Also, mixtures from 82% to 100% acetylene are flammable under certain conditions.

2.9.2 Sections 7 and 8 include further information and references to the explosive properties of acetylene and acetylene-air mixtures.

2.9.3 In view of the appreciable solubility of acetylene in water and other liquids, the disposal of liquids containing dissolved or entrained acetylene should be done in such a manner that it will cause no hazard.

3. PIPING

3.1 Scope. This section covers piping systems for the transmission of acetylene at pressures from 0 to 1 psig (low pressure) and from 1 to 15 psig (medium pressure). Materials, design and construction of transmission lines are described. The components of the line are considered to be pipe, pipe fittings, valves, gaskets, flanges, valve packing and bolts and nuts. Other major units in an acetylene transmission system such as compressors, acetylene storage, protective devices and general design are discussed in other sections. The piping incidental to these units should be considered as a part of this section. The recommendations contained in Section 2, General Design, also apply.

3.2 Materials. The materials used should meet the requirements of appropriate specifications as set forth by the latest publications of the American Standards Association, American Society for Testing and Materials, American Society of Mechanical Engineers, American Petroleum Institute or other recognized organizations. Appropriate specifications should be applied in design so that the strength of the materials used will enable the pipe line to contain a decomposition of the maximum pressure which could be developed in the system. Such decompositions and the possible pressures involved may be predicted by the data presented in Section 7, *General Explosive Behavior of Acetylene.*

3.2.1 PIPE (Ref. #1). The physical and chemical requirements and tests equal to ASTM Specifications A-53, A-106 or A-120 should be met in selecting the type, grade and schedule of pipe used in the system. Section 7 of these recommendations may be used as a guide in the selection of pipe wall thickness. In selecting the type of pipe used, consideration should be given to the locality as well as the condition of service. Up to and including 6 inch pipe size, ASTM 120, Schedule 40 welded pipe has been found satisfactory by repeated detonation tests in a medium pressure system. For 8, 10 and 12 inch pipe sizes, ASTM A-106, Grade B, Schedule 60 pipe can be specifically recommended on the basis of satisfactory performance in detonation tests in a medium pressure system.

3.2.2 PIPE FITTINGS AND FLANGES (Ref. #1). Screwed fittings may be used up to and including 3 inch pipe size. Banded malleable iron fittings with ASTM Specification

Copyright by the Compressed Gas Association Inc
Sun Jun 28 22:28:16 1998

Documents
Document Sharing Hub

Full document details: CGA G-1.3-1970 scan

A-197 are satisfactory. Fittings of cast iron or other materials such as semi-steel having similar limitations should be excluded whenever possible. Where nipples, couplings and half-couplings are used for making attachments, they should be scheduled 80 and 3,000 lbs. respectively. Cast steel flanged fittings or forged steel welding fittings may be used in all pipe sizes. ASTM specifications A-234 and A-181 are recommended for forged welding fittings and flanges. ASTM specification A-216 Grade WCB can be recommended for cast steel flanged fittings. Flanged, 150 lb. 6 inch cast steel fittings with raised faces of ASTM specification A-216 Grade WCB successfully passed detonation tests in a medium pressure system.

Similar detonation tests were also satisfactorily conducted on 150 lb. 6 inch and 300 lb. 12 inch flanged welding neck and slip-on flanges with raised faces complying with ASTM specification A-181.

Blind flanges of the class equivalent to the mating flanged fitting are not always satisfactory for detonations in a medium pressure system. Blind flanges fabricated from welding neck or slip-on flanges and welding caps in accordance with the above specifications were found to be satisfactory in detonation tests on a 6 inch pipeline.

3.2.3 VALVES.

3.2.3.1 TYPES (Ref. #1). Flanged or welding-neck valves are generally recommended for lines over 2 inches in diameter. Valves of conventional type such as plug, gate or globe may be used. The strength of the valves should be consistent with that of the other components of the system. In detonation tests in a medium pressure system, 6 inch, 150 lb. semi-steel plug valves failed; similar valves of cast steel were found to be satisfactory and are recommended for medium pressure service.

3.2.3.2 PACKING. Conventional packing and lubricants for hydrocarbon gas service are recommended. Packing and lubricant should be free of copper bearing material.

3.2.4 BOLTS AND NUTS. Alloy studs ASTM Specification A-193 Grades B6 and B7 with ASTM-A-194 class 2H heavy hex nuts have proven satisfactory in detonation tests and are recommended for medium pressure service. Bolts and nuts complying with ASTM-A-307 specification are commonly used for low pressure service.

3.2.5 GASKETS. Red rubber and compressed asbestos gaskets can be recommended. Asbestos composition ring gaskets $\frac{1}{16}$ inch thick have performed satisfactorily in medium pressure detonation tests.

3.2.6 PIPE JOINT COMPOUND. Any good pipe joint compound which is free of copper bearing material is satisfactory for use on screwed joints.

3.3 Design and Construction. General design and construction of piping systems will vary with location, layout and local conditions.

3.3.1 PROXIMITY TO OTHER FACILITIES. It is recommended that main acetylene transmission lines be run not closer than fifty feet to buildings, fire protection facilities such as water reservoir towers and storage tanks containing hazardous or flammable liquids. Increased clearances should be provided at locations in the area of fire and explosion hazards. Avoid installing acetylene lines in the midst of other lines which may require maintenance of a type in which high temperature or heavy equipment is involved. Caution should be exercised in placing acetylene transmission lines near buildings, tunnels or sewers to prevent acetylene leaking into such facilities.

3.3.2 CROSSINGS. The type of crossing employed should be consistent with locality and layout. Either overhead or underground crossings may be used. If the underground type crossing is used, consideration of minimum entrance and exit distances from edges of crossings, depth of fill over sleeve, location of sleeve vents and type of seal for sleeve should be included in designing the crossing.

3.3.3 DRAINS. Provision should be made to drain accumulated liquid from acetylene transmission lines. Special provisions should be made in the design to prevent entry of air into the acetylene line and to prevent freezing of any seal liquid used. Figure 3 illustrates a suitable design for the low pressure system and Figure 4 illustrates one for the underground medium pressure system.

3.3.4 PURGING FACILITIES. It is recommended that provisions be made for purging all acetylene transmission lines with inert gas.

The connection of permanent purge piping into the acetylene lines should be by two valves in series plus an intermediate bleed valve.

Copyright by the Compressed Gas Association Inc
Sun Jun 28 22:28:16 1998

Documents
Document Sharing Hub

Full document details: CGA G-1.3-1970 scan