ACETYLENE (Second Edition)

Republic of Vanuatu Maritime Bulletin

Introduction

In late 1993 a tuna purse seiner was lost as the result of an acetylene cylinder fire. The fire spread rapidly to other flammable materials, resulting in sequential "explosions" of other acetylene cylinders and other pressure cylinders. The fire continued to spread until it engulfed the entire working deck of the vessel.

The crew were able to safely launch the vessel's skiff and helicopter, and the pilot was able to initiate a "mayday". The vessel sank within 60 minutes of the initial fire being reported. All officers and crew were safely rescued.

To recap the incident, during evening rounds the assistant engineer found one acetylene cylinder glowing red near the bottom, with a stream of fire emanating from the cylinder. The crew quickly organized to fight the fire, first emptying the contents of 3 dry chemical fire extinguishers at the base of the cylinder with no success. They then attempted to cool the cylinder and extinguish the fire with fire hoses. However, with the heat generated inside the cylinder, the bottom fusible metal plug relieved, resulting in an "explosion" or fire ball rising some 10 - 15 feet. This fire ignited fuel storage tanks in the area, melted hydraulic oil lines, and spread to other acetylene cylinders, ammonia tanks, oxygen cylinders, etc.

The incident is a stark reminder of the potential danger of acetylene cylinders, be they full or empty, in use or idle. This Bulletin will discuss the properties of acetylene; its potential for disaster; and recommended handling, storing, and safety procedures.

Background

Consider where would we be today without acetylene. Consider the repairs that are conducted underway, saving countless thousands of dollars in shipyard or shoreside repair costs and out of service time. Consider also that acetylene cylinders are often taken for granted, and their potential for disaster not recognized.

Shoreside, potential problems with acetylene cylinders have been recognized and addressed by a number of organizations. For example, in the United States the Compressed Gas Association (CGA), the American National Standards Institute (ANSI), and the National Fire Prevention Association (NFPA) have all contributed: the latter 2 by preparing standards, guidelines, and regulations for safe welding, cutting, and fire prevention; and, the former by preparing pamphlets, bulletins, and video tapes, on the safe handling of acetylene, and acetylene cylinders in fire situations.

We acknowledge the important work of these organizations. Many of the recommended guidelines included herein have been extracted from their publications and tailored for use aboard ships. A bibliography of various pamphlets available, and references used in the preparation of this Bulletin, are included below.

General

Acetylene is a compound of carbon and hydrogen, expressed by the chemical symbol, C_2H_2 with the carbon atoms triple bonded. Acetylene is usually manufactured by reacting calcium carbide and water. This reaction produces acetylene and calcium hydroxide.

The Condensed Chemical Dictionary defines acetylene as:

> "Colorless gas; ethereal odor; highly flammable; explosive when compressed or mixed with air in certain proportions; toxic when inhaled; forms explosive compounds with copper and silver; boiling point minus 84° C; soluble in alcohol, acetone and

water..."

Kirk's Fire Investigation goes on to warn:

> "Acetylene is a flammable gas which is particularly hazardous in an enveloping fire because it has a flash point of minus 180° C (0° F) and a vapor density of 0.9, allowing it to mix readily with air. It forms an explosive mixture in concentrations between 2.5% and 80 % by volume. It can detonate under certain conditions of heat and pressure, but even when simply burning in air, it can create considerable damage because of the excessively high temperatures develop."

Acetylene is slightly lighter than air, and in its commercial grade may have a garlic-like odor. It burns with an intensely hot, bright and smoky flame. It is generally considered to be non-toxic because fire or explosion would most likely occur before concentrations high enough to produce chronic harmful effects are experienced. It is an asphyxiant if present in such concentrations that the lungs are deprived of sufficient oxygen. Table 1 below identifies some of the properties of acetylene:

TABLE 1

	U.S. UNITS
International Symbol	C_2H_2
Molecular weight	26.04
Vapor Pressure at 70° F.	635 psig
Specific Gravity of the gas at 32° F.	0.906
Specific Volume of the gas at 70° F.	14.7 ft^3/lb
Critical temperature	96.8° F.
Critical pressure	907 psia
Critical density	14.4 lb/ft^3
Autoignition temperature	635° F.

In its free state, under pressure, acetylene can decompose violently into its constituent elements of carbon and hydrogen. Decomposition can be initiated by shock; by high temperature; under high pressure; or by reactive substances like silver, copper or mercury. Oxygen is not required either to start or sustain decomposition. The higher the pressure, the smaller the initial energy input required to cause decomposition. To reduce the possibility of decomposition, and suppress propagation, acetylene cylinders are made differently from other compressed gas cylinders: they are filled with a porous mass, usually silica lime. This mass takes up as much as 92% of the volume of the cylinder. The cylinder is then filled with a carefully determined amount of solvent, usually acetone, to absorb and stabilize the acetylene. Acetone is a colorless volatile liquid with a characteristic odor. It is highly flammable, has a specific gravity of .792, a flash point of plus 15° F, and is miscible with water.

The porous mass in the cylinder suppresses acetylene decomposition, should it be started, reducing the potential of a violent cylinder failure. In theory, the heat of decomposition in one cell of the mass is absorbed by the walls of the cells and passages in the mass, so that the temperature generated remains below that needed for decomposition. If no porous mass or solvent were available, or if the mass broke down, decomposition could begin with explosive results.

When the valve on a charged cylinder is opened, the acetylene comes out of the acetylene/acetone solution in gaseous form.The porous mass and acetone permits the

cylinder to contain approximately eight times the volume of acetylene that could safely be compressed in the same cylinder without either acetone or the mass. However, cylinder and regulator pressures are critical: experience indicates that a maximum cylinder pressure of 250 psig at 70° F, and a working pressure of 15 psig, are generally safe, acceptable pressures. Compare this to the pressure of oxygen or air cylinders of 2000 to 3000 psi.

Contact between acetylene and certain metals like copper or silver, their salts, compounds, and high concentration alloys should be avoided: brass containing less than 65% copper, and certain nickel alloys, are suitable for use in acetylene service under normal conditions. However, conditions involving contact with caustic salts or solutions, or corrosive materials, can make these normally acceptable alloys unsatisfactory.

Table 2 compares acetylene with other gases and with acetone. Note that acetone is twice as heavy as acetylene and that acetylene has the lowest ignition temperature of all those listed:

TABLE 2

	VAPOR DENSITY	% EXPLOSIVE MIX WITH AIR		IGNITION TEMP IN DEG. F
		LOWER	UPPER	
Acetylene	0.9	2.5	81	581
Acetone	2.0	2.6	12.8	869
Ethylene	0.98	3.4	10.8	914
Methane	0.55	5.0	14	900-1170
Propane	1.6	2.2	9.5	920-1120
Butane	2.0	1.9	8.5	900-1000
Natural Gas	0.55	4.7	15	900-1170
Hydrogen	0.07	4.0	75	932
Ammonia	0.6	16	25	1204
Carbon Monoxide		12.5	74	1128
Oxygen	1.105	--	--	non-flammable

Acetylene produces an extremely hot flame, and so is an excellent gas for cutting and welding. The flame temperature of acetylene is the highest of those materials listed above at 4217° F. Compare that to Butane at 3443° F, Methane at 3407° F, Propane at 3497° F.

In the incident described in the introduction to this Bulletin, witnesses described the burning cylinder as glowing "red". From the color scale listed in the Table on the next page, we can conclude that the skin temperature of the cylinder was in the range of 930 to 1830° F. No wonder the fusible plug melted! Its design melting point is approximately 212° F. Anytime a cylinder is found to be glowing, assume that the fusible metal relief device will melt, and take proper steps to cool the cylinder immediately.

TABLE 3 Color comparison by temperatures of incandescent surfaces	
Color	**Temperature - Degrees F.**
Dull red	930 - 1100
Dark dull red	1110 - 1470
Bright (cherry) red	1470 - 1830
Orange	1830 - 2190
Bright Yellow	2190 - 2550
White	2550 - 2910

Cylinders General

Acetylene is classified as a flammable compressed gas. As such, the cylinders used must be steel, and meet certain chemical and physical requirements. The shells must pass hydrostatic testing; in the U.S. and many other countries, possess fillers of 92% porosity; and, be charged with a specified amount of acetone.

Since any gas confined in a container increases in pressure with an increase in temperature, it is always possible that a cylinder charged with gas at normal temperatures, could reach a dangerous pressure at higher temperatures. Therefore, most countries have developed regulations that limit the amount of acetone and acetylene that may be charged into a cylinder. In the U.S. for example Regulations provide that the internal pressure of a cylinder when it is filled may not exceed 250 psig at 70° F.

The table below compares one standard sized acetylene cylinder with a similar sized cylinder of oxygen. The color of the cylinders is that used by one manufacturer, but other color schemes do exist. The pressures and ratios of weights to volume will generally be consistent with those below for different sizes of cylinders:

TABLE 4		
	ACETYLENE	OXYGEN
Cylinder color	Maroon	Blue
Water Capacity, liters	40	40
Gas capacity, kg	6.2	7.9
Gas capacity @ 1 nm^3	6	6
Filling pressure, bar	15	147
Tare weight, kg	65.8	52.6
Gross weight, kg	72	60.5
Acetone content, kg	13.6	N/A

Cylinders must be protected by adequate pressure relief devices, normally fusible metal devices, located on the top and/or on the bottom head of the cylinder. Since these devices are designed to melt at a low temperature, care must be taken to avoid other sources of heat, such as weld spatters, or burning slag, which can cause failure of the devices. (Some marine use acetylene cylinders are not fitted with fusible metal relief devises, but these cylinders are constructed of thicker steel (similar to oxygen cylinders), which can withstand higher pressures.)

Internationally, when acetylene cylinders are carried on ships as cargo, they are governed by Chapter VII of SOLAS and the International Maritime Dangerous Goods Code (IMDG). Under the IMDG, acetylene is defined as a class 2.1 flammable gas. The following must be marked on the cylinders for shipment under the Code:

1. name or mark of the manufacturer or owner
2. registration number
3. test pressure or service pressure
4. date of initial and most recent periodic test
5. the stamp of the expert who carried out the tests
6. unladen mass
7. the proper shipping name of the gas
8. the maximum permissible filling ratio
9. the maximum permissible filling pressure at 15° C

The IMDG Code warns: "...rough handling and exposure to local heating should be avoided. Results of such rough handling or heating may be delayed explosion. Empty cylinders must be carried with the same precaution as filled cylinders."Stowage is permitted "On deck only. Shade from radiant heat. Clear of living quarters."

Many countries have prescribed similar regulations for shoreside industrial use of acetylene.

Acetylene Cylinder Fires

If acetylene from a leaking cylinder should ignite, avoid panic! An experienced person should take charge, evacuate the area, and immediately commence fire fighting procedures.

Kempe's Engineers Year Book, under "Industrial Hazards" discusses acetylene cylinders and their potential for disaster:

> "These become dangerous when heated as the result of being involved in a fire; as the result of a backfire, careless handling or the decomposition of acetylene and acetylene solvent contained in the cylinder. Once decomposition within the cylinder has begun the most effective action is to turn off the cylinder valve whenever possible and cool the cylinder with copious supplies of water in the form of a spray, leaving the cylinder in position until it is cooled sufficiently when it should be immersed in water for at least 12 hours. Treat the cylinder as an explosive missile and keep people as far away as possible."

When fires occur on acetylene cylinders, they are most frequently located at the valve outlet where it is connected to a pressure regulator; or at the regulator outlet where the hose is connected; or at the pressure relief devices. All acetylene cylinders are equipped with pressure relief devices designed to function between 208° F and 220° F, roughly the boiling point of water. The most common cause of fires at the pressure relief devices is hot metal or slag coming in contact with them from other operations in the area. They may also function if cylinders are located too close to heat sources as when the flame from a torch is carelessly or inadvertently played on them.

Acetylene cylinders are not expected to withstand unwarranted rough handling. As a result of rouch handling, the pressure relief device may be damaged and start leaking. Also, it is unusual, but not impossible, for the shell of an acetylene cylinder to become damaged by piercing. It may happen if a sharp object strikes a cylinder or if a cylinder is dropped from a height.

Whenever the pressure relief device operates, the escaping acetylene may be ignited. This relief action is intended to prevent a pressure capable of rupturing the cylinder wall from developing inside the cylinder. When sufficient heat is generated to melt the fusible metal in a pressure relief device, a rather loud noise may be heard when the gas is released. This is erroneously referred to as a "explosion". When a pressure relief device releases, a large

volume of acetylene will rush out, and may be ignited by any nearby source of ignition. This action will result in a sustained "roaring" sound.

A flame from a full cylinder will be larger than from a partially full one, and therefore, the sound will be louder. Initially, the flame will be brightly luminescent. As the cylinder discharges and the flame shortens, the brightness will decrease to a yellow flame, attributable to the increase in solvent content of the acetylene/acetone solution.

To adequately fight an acetylene fire, determine from what part of the cylinder the acetylene is escaping. It if is a small flame from a pressure relief device or from around the valve stem, try to put it out as quickly as possible. If the fire is allowed to keep on burning, it is likely that the fusible metal will melt and the resultant large release of acetylene will instantaneously become a roaring 12 to 15 foot flame.

If there is a large flame burning from a pressure relief device which has functioned, or is on some other part of the cylinder, don't try to put it out unless the cylinder is on deck or in a very well ventilated area free from all sources of ignition. Allow the acetylene to burn in order to prevent unburned, escaping acetylene from mixing with air and reigniting or exploding.

WARNING: ALWAYS EXTINGUISH AN ACETYLENE FIRE BEFORE CLOSING THE CYLINDER VALVE!

When an acetylene cylinder fire has been extinguished, the cylinder should be cooled with large quantities of water. Kempe's recommends it be immersed in water for 12 hours after a fire. Others recommend 24 hours.

If the cylinder is hot, if it "steams" when hit with water, of if the pressure relief device releases, do not approach the cylinder. Direct a fire hose on the cylinder from a safe distance or from behind a fire resistant partition until the force of the flame diminishes or until the cylinder cools down. Keep adjacent cylinders and surrounding areas cool by spraying large amounts of water until the fire burns itself out and the cylinders are cool.

Avoid standing in the line of discharge of the pressure relief device so that if it melts and releases acetylene, the resultant fire will not hit the person near it. Do not attempt to move a cylinder which displays evidence of internal heating, or one in which flame is impinging on any pressure relief devices.

On a cylinder in which a pressure relief device releases, the flames from a full cylinder will gradually shorten from 12 to 15 feet to a "soft" 3 to 4 foot or smaller flame over a period of 15 to 20 minutes.

The severity of fire on cylinders in unpredictable. Even though the pressure relief devices will safely vent the acetylene in a large majority of cases, it is possible for the heat applied to the sidewalls to weaken the cylinder before the pressure relief devices can relieve the internal pressure, usually resulting in a violent rupture.

If acetylene leaks from the valve even when the valve is closed, or if rough handling should cause any pressure relief device to leak, move the cylinder away from any possible source of ignition. Tag the cylinder and return it to the supply agents as unserviceable.

THE TEN ACETYLENE COMMANDMENTS:

1. **MINIMIZE THE NUMBER OF CYLINDERS ABOARD**

   More cylinders provide more risk along with increased storage difficulties. If you can't use the cylinders on the voyage, or the next leg of the voyage, don't order them.

2. **HANDLE, STORE AND USE ACETYLENE AS IF YOUR LIFE DEPENDED ON IT**

   Your life, and that of your fellow ship mates, depends on the safe handling, storage and use of acetylene.

3. **STORE ACETYLENE CYLINDERS PROTECTED FROM THE ELEMENTS, HEAT AND FLAMMABLES**

   Store on deck, or in a special locker, protected from the sun, rain snow and seawater, away from flammable materials, oily rags, paints, etc., and away from oxygen cylinders.

4. **NEVER STORE ACETYLENE CYLINDERS IN OR NEAR ANY ACCOMMODATIONS**

   Too many times inspectors find acetylene cylinders stored in a spare cabin, passage-ways, engine room accessways, fidleys, etc. The risk is too great; why chance it?

5. **WHEN NOT IN USE, THE VALVE PROTECTION CAPS MUST BE IN PLACE**

   Valve protection caps protect the cylinder valves from damage and prevent unauthorized handling. If the caps are in place, the valves are less likely to be damaged and unauthorized personnel will be less likely to "check it out."

6. **WHEN WORK IS COMPLETED, PURGE THE LINES: REMOVE THE REGULATORS**

   After the torch has been extinguished and the cylinder valve closed, the hoses still contain flammable gas. Purge this to the atmosphere, but never in an enclosed space where it could reignite. Remove the regulators to protect them from damage. Stow the regulators, hoses and torches in a safe place. Then refer to Commandment 5.

7. **USE THE CYLINDERS ONLY FOR THEIR DESIGNED PURPOSE**

   Too often cylinders are used as rollers, work benches, and hose or tool racks. Every time the cylinders are used for other than their designed purpose they are at risk of damage to their shells, valves, and relief devices.

8. **DON'T BE FOOLED BY A FRESH COAT OF PAINT!**

   Shoreside service agencies are required to inspect cylinders for damage and leaks before and after filling. Some agencies may skip this process. A freshly painted cylinder doesn't mean that it is new or even reconditioned. The paint may hide serious corrosion, pits, gouges, burn marks, plastic fill, brazing, welding, soldering, or unauthorized repairs.

9. **WHEN IN DOUBT, REJECT**

   If there is anything about the condition of the cylinder that causes you concern--crevice corrosion, pitting, bulges or dents, damaged pressure relief devices, cylinders without valve protection caps, burn marks, etc.--reject it! You have to sail on the ship, not the service agent.

10. **MEMORIZE THE OTHER 9 COMMANDMENTS -YOUR SAFETY DEPENDS ON IT.**

REFERENCES & BIBLIOGRAPHY

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NFPA 51A, Standard for Acetylene Cylinder Charging Plants.
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National Fire Protection Association, Inc., Batterymarch Park, Quincy, Ma 02269

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CGA G-1-1, Commodity Specification for Acetylene.
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MARITIME BULLETIN 105 (Revised) ANNEX

Cylinder Storage

For the sake of safety and orderliness, cylinders should always be stored in a specific assigned storage location, not lashed to the handrail, and never inside a spare cabin:

1. Minimize the number of cylinders carried.
2. Store in a dry and well ventilated area.
3. Never store at a temperature exceeding 125° F, nor use above 120° F.
4. Never store near sources of heat, or potential sources of heat including combustible materials like gasoline, oil waste, etc. or in direct sunlight.
5. Never store acetylene cylinders in confined spaces, such as spare cabins.
6. Never store near elevators, gangways, or where heavy objects may strike against them.
7. Never store near oxygen cylinders.

In the United States NFPA regulations require a minimum distance of 20 ft between acetylene and oxygen cylinders, unless they are separated by a noncombustible partition with a one hour fire resistant rating. Where possible aboard ship, this should also be the rule.

1. Use the cylinders in the order received from the supplier.
2. Always use valve protection caps except when cylinders are in use. Keep cylinder valves closed when the cylinders are not in use, even when empty.
3. Store empty and full cylinders separately. (Empty cylinders should be adequately marked to avoid confusion.)
4. Store and use cylinders vertically, never horizontally.
5. Post conspicuous signs forbidding smoking or open flame.
6. Protect acetylene cylinders from access by unauthorized individuals.

When storing acetylene cylinders on deck, they should be protected from seawater to prevent corrosion. In colder climates, protect cylinders from accumulations of ice or snow; and, in warmer climates, screen them from the continuous direct rays of the sun.

Cylinder Handling and Use

Dropping a cylinder or subjecting it to abnormal shock is likely to damage the cylinder, valve, or fusible metal pressure relief device.

The contents of an acetylene cylinder, unlike other compressed gas cylinders, cannot be determined accurately by pressure gauge readings. The pressure gauge attached to the cylinder indicates only the "solution-acetone/acetylene–pressure". This pressure is greatly affected by changes in temperature, and the variations are most noticeable at the temperature extremes experienced at sea in warmer or colder climates. For example, the pressure of a cylinder may be 250 psig when the temperature is 70° F. But if this same cylinder cools to O° F, the pressure will drop to less than 100 psig without any acetylene having been used. Acetylene cylinder contents can, however, be accurately measured by weight, by using the factor of 14.7 ft^3/lb.

Acetylene and air mixtures in almost all proportions are flammable and explosive. Therefore always take care to prevent acetylene leakage either through the hoses or the fusible metal pressure relief devices. While these will melt in a fire, they can also melt from other sources of high heat. Never expose any part of your body to the line of discharge of a fusible metal plug which may release in a fire, as the venting acetylene may explode or ignite at any moment.

When handling the cylinders:

1. Never attempt to repair or alter cylinders or valves.

2. Never tamper with fusible metal pressure relief devices.
3. Never, under any circumstances, attempt to transfer acetylene from one cylinder to another; to refill acetylene cylinders on board; or to mix any other gas with acetylene.
4. Avoid handling electric welding equipment where acetylene cylinders may come in contact with the welding apparatus or electrical circuits.
5. Acetylene cylinders are not rollers or supports, nor should they be used for anything other than as acetylene cylinders.
6. When moving acetylene cylinders they must not be subjected to abnormal shocks. Do not drop them nor permit them to strike each other violently.
7. Keep valve protection caps on except when the cylinders are actually in use.
8. Ensure all valves are closed before cylinders are moved. Pressure regulators must be removed and valve protection caps must be in place.
9. When loading or off loading acetylene cylinders, use a platform, cage, cradle, or net. Never lift them with magnets, slings, rope or chains, or any other device, where the cylinders themselves are an integral part of the lifting device.
10. When using hand trucks, the cylinders must be carried upright and never dragged.

When preparing to use, or using, the acetylene cylinders:

1. Never use manifolds for acetylene cylinders unless constructed and installed under the supervision of qualified personnel.
2. After removing the valve protection cap, attach a regulator and the proper flow restrictor, before opening the cylinder valve. Do not purge or blow acetylene in confined spaces.
3. Never "crack" an acetylene cylinder valve without a suitable regulator and flow restrictor.
4. Regulators and pressure gauges provided for use with a particular gas, or gases, must not be used on cylinders containing any other gas. This is particularly true of acetylene.
5. Be sure all connections are gas tight and the hose is in good condition, without leaks. Open the acetylene cylinder valve slowly. Never use a hammer to open or close a valve.
6. Never open a valve without proper regulator and torch: This can cause a cylinder to spit acetone, resulting in a fire.
7. Open the cylinder valve only enough to deliver sufficient gas so it can be closed quickly if needed. Never use acetylene above 15 psig at the torch.
8. Use acetylene cylinders in a secured upright position.
9. Use only manufacturer supplied wrenches or other tools for opening or closing cylinder valves. The wrench for opening the cylinder valve should always be kept on the valve spindle when the cylinder is in use.
10. Never apply a torch to the side of a cylinder to raise the pressure.
11. Never use acetylene through devices equipped with shut-off valves on the supply connections without reducing the pressure through a suitable regulator.
12. To minimize the withdrawal of liquid solvent during intermittent use, withdraw acetylene from the cylinder at a rate not exceeding one tenth the capacity of the cylinder per hour.
13. For full withdrawal of the contents on a continuous basis, the flow rate should be no more than one fifteenth of the capacity of the cylinder per hour.
14. Good housekeeping must always be maintained: never pile hose, tools or other objects on top of an acetylene cylinder. This might interfere with quick closing of the valve.

When the work is completed:

1. Always close the cylinder valve immediately when the work is finished.
2. After the valve is closed, purge all gas from the regulator and lines before removing the regulator from the cylinder.
3. Replace the valve protection caps.

Cylinder Inspection and Rejection

One of the most important aspects in maintaining acetylene cylinders in a acceptable condition is an adequate inspection prior to each cylinder charging. Cylinders should be inspected for shell defects such as dents, gouges, grinding scars, torch or arc burns, fire damage, corrosion, damaged footrings and headbands. Acetylene cylinders should then be inspected for leaks after charging.

While shoreside inspection should take place at each refilling, supply agents may not follow these procedures. While local regulations may be in place and well enforced in a majority of countries, it is incumbent on shipboard personnel to be familiar with common shoreside procedures and take steps to identify, and terminate business with, those supply agents which do not follow regulations and procedures.

The service agents should reject cylinders under the following circumstances:

1. When the cylinder is found to be without complete, legible, and unaltered markings.
2. When a cylinder shows signs of any type of damage or mechanical defect which may weaken the shell or porous mass; or affect the cylinder valve, external spud threads or fusible metal pressure relief devices.
3. When a cylinder leaks. Leaks can originate in a seam, at a threaded opening, valve, fusible metal pressure relief device, or from digs, gouges, or pits. A cylinder found leaking should not be shipped but must be immediately removed from service. Cylinders with unauthorized repairs such as shell defects filled with plastic filler, grinding, welding, brazing, or soldering should be rejected.
4. When the remaining sidewall thickness in an area of general corrosion has less than the appropriate minimum allowable wall thickness, the cylinder should be rejected. While it is almost impossible for ship's personnel to determine the minimum allowable wall thickness, they should err on the side of safety and reject any cylinder which appears to have its wall thickness reduced.

Ship's personnel should conduct their own inspections before accepting acetylene cylinders. They should look for:

1. Corrosion: loss of wall thickness due to rusting, including:
   a. Crevice corrosion: corrosion occurring in the area of the intersection of the footring or headband and the cylinder. The bottom head of the cylinder may be especially susceptible to excessive, harmful corrosion;
   b. General corrosion: corrosion of uniform nature that covers a given surface area; and,
   c. Line corrosion: corrosion or pitting in a continuous pattern or where pits are connected in a narrow band or line. This is more serious than isolated pitting.
2. Cuts, gouges, or digs: deformations of the cylinder shell caused by contact with sharp objects.
3. Dents: deformations caused by contact with blunt objects not materially decreasing shell thickness.
4. Pitting: corrosion of an isolated nature that occurs at discrete points.
5. Altered markings stamped on the cylinder.

WARNING: NEVER BE FOOLED BY A NEW COAT OF PAINT ON A CYLINDER: THIS COULD BE HIDING MANY DEFECTS. IF IN DOUBT ABOUT THE CONDITION OF A CYLINDER, REJECT IT!