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# Monitoring Work with Open Fire in Refining - Petrochemistry

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## Abstract

*Identifying the risk of fire is the process of assessment and determining the level of fire hazard under certain circumstances, at the same time and place. Using open fire on targets with high risk of fire involves taking a series of measures necessary to avoid occurrence of emergency situations.*

**Key words:** authorization, fire, risk, prevention.

## Introduction

Risk management of fire is all activities and procedures used by policy makers, institutions and public services and the ability to identify sources of fire risk monitoring, evaluating, analyzing and quantifying them, developing forecasts, setting and monitoring of action options for reducing fire risks.

Identifying the risk of fire is the process of assessment and determining the level of fire hazard under certain circumstances, at the same time and place.

The danger of fire, of course, is a normal state of existence of an environment, or the operation of a system technical, which can allow meeting the conditions to initiate combustion of combustible materials in the area. At this stage of identifying fire risks systematically reveal specific causes that may generate fire [5].

In the industrial objectives are frequently present different risks from the use of open fire, especially in activities of cutting, welding, smoking in places not allowed etc.

The presence of human factor in the structure of socio-technical complex systems, consisting of man-machine, is an additional factor risk from the risk associated only their technical systems.

The human factor in any form of participation in activities and processes, either directly or indirectly makes the potential risk levels associated technical systems which include.

To regulate the use of open fire and smoking each economic unit be established:

- places with high risk of fire or explosion that according to legal provisions is forbidden to use open fire, smoking and access to cigarettes, lighters, matches and other hazardous materials, demarcation and marking their places of formal planning of cigarettes and matches;
- places where fire risk is forbidden to use open fire and smoking;

- open fire places adapted for use (welding operations, melting bitumen, crematoria etc.) and smoking, and how fitting;
- persons empowered to issue authorizations (permits) to work with fire (printed);
- persons responsible for the technical state of aggregates for welding, the welders training and compliance monitoring of the implementation of PSI welding operations;
- the educational actions for negligence against smoking and open fire ;
- ways of exercising self control and the use open fire and smoke.

Welding and cutting works arc or oxyacetylene flame, and those executed with blowtorch for soldering, the defrosting pipes and removal of layers of paint, presents a great danger of fire and explosion. They are due to the use of open flames, sparks from welding or cutting bumping, incandescent metal particles, which come into contact with combustible material, and remnants of electrodes heat, throw out. Sparks that spread during welding, can reach about 10 m away. Running weld in rooms with danger of explosion or empty tanks and pipelines, in which were stored that were transported flammable, present, Also, an increased danger of explosion and fire.

Performance of the welding work, cutting or heating of metal parts can be:

- standing, organized and performed in clinics, workshops and open platform, specially equipped for this purpose;
- supplies, when the work is made directly by fire in buildings under construction or in operation, in residential buildings or other construction companies on whose territory, in order to repair equipment or installing building elements.

Before you start welding work taking a series of measures which are:

- issuing a work permit with fire by factory management or enterprise, for works that present a risk of fire and explosion;
- providing a fire guard station, provided with necessary technical means;
- check correct linking the entire apparatus and welding equipment, any defects are discovered to be remedied before you start welding;
- removal of combustible transportable materials and combustible substances, waste (paper, wood chips, boards, dust etc.) at a distance at least 10 m from the weld site.

## **General Items for Oxyacetylene Welding Flame**

### **Generalities**

Gas welding technology, is currently one of the largest technical uses. For example, welding with oxyacetylene flame, has the property that acetylene can be obtained in working areas, so in places that have done work (welding, soldering etc.). For execution of works of this kind, safe, necessary to meet a range of general and specific measures covering areas such as prevention and extinguishing of that safety. To maintain control of the risk of fire or explosion, industry assessors must know and apply both general and specific standards and fire prevention and safety in the work, they must also have the necessary training to be able to identify and assess areas at risk of explosion and fire areas, which exists when using this type of event.

### **Terminology specific**

*Technical calcium carbide* = carbide.

*Residues technical calcium carbide* = slam (mud, silt).

*Indoor storage technical calcium carbide residue* = battle (landfill, slam).

*Accident at work* = accident which generates injury human body during work or when carrying out a task at work.

*Open fire* = burning outdoor burning shall not be conducted in a combustion enclosure, may be included in this category flame produced by: lighters, matches, candles, lamps and cooking equipment, soldering equipment, cutting, welding etc., the fire was in the open, for the purpose of heating or burning of household waste and plant debris, and flame arising from chemical reactions, the category includes open flames and incandescent material condition, in special circumstances such as splashing, discharges, structures etc., which may generate fire due to heat radiation or direct contact with combustible materials.

*Burning welding pieces* = particulate molten metal or its oxide with diameters ranging from (2 ... 5) mm, which in contact with other combustible materials, can generate their ignition, starting a fire may occur after several hours of completed welding operations.

*Oxyacetylene flame direct effects* = effects consist of direct action of the oxyacetylene flame of combustible material; crucial parameter is the high temperature flame (plasma jet).

*Oxyacetylene flame indirect effects* = effects consisting in action sparks, burning welding pieces, hot gas, the secondary flame, heat conduction etc.. Arising as side effects of using flame for welding, brazing and cutting.

*Risk of explosion* = dot product of the probability producing an explosion and the consequences resulting from it.

## **Acetylene. Minimum physical - chemical properties**

Acetylene (etina) is the first time series unsaturated acyclic hydrocarbons, called Ester (aliphatic), is obtained from calcium carbide (carbide) by treatment with water (hydrolysis of calcium carbide into acetylene generators) has the formula  $C_2H_2$  chemical is a colorless, odorless and flammable, the temperature conditions 293.15 K and pressure around 100 000 Pa, has a density  $1.09 \text{ kg/m}^3$ , being lighter than the air under the same conditions has a density  $1.28 \text{ kg/m}^3$ . If this method of welding, melting metal is achieved by heat generated from burning the mixture of acetylene and oxygen flame is produced by a specially constructed burner (component of the apparatus for welding with oxyacetylene flame).

The mixture of acetylene - air is found in explosive concentration limits in (2.40 ... 82)%. In terms of work areas, acetylene can be obtained:

- local - in working areas, using acetylene generator, the device that provides controlled reaction between water and carbide (if present Article);
- industrial - in which case, after production, acetylene is stored under pressure in acetylene cylinders for industrial consumption.

To carry out the works of this type is necessary to use oxygen, which is comburent, it is delivered/used in/from the cylinders at a pressure of about 150 Pa.

## **Rules/General and Specific Measures for Prevention/Fire**

### **Obligations of individuals responsible for their management**

Individuals responsible for their management (owner, user etc.) will regulate written (decision available etc.). Way of works with open fire, an activity which involves:

- setting appropriate places where, periodically or permanently, can make work with open flames (melting bitumen, fuel combustion residues, cleaning by burning etc.) and those who supervise them;

- to establish places (areas) with the fire hazard is prohibited to use open fire;
- the nomination of persons entitled to issue work permits fire;
- description of the procedure for issuing, signing, bringing in knowledge and retention of the work permit with fire;
- establish a fire prevention specific instructions for such work to be executed and to be processed with it before work.

If work with open flames that run facilities in places (areas) where there is risk of fire or explosion, the person responsible for their management will provide appropriate additional protective action.

### **Restrictions on the use of open fire**

Is prohibited the use of open fire places (rooms, areas, facilities, equipment, vehicles etc.) of processing, use, store, convey and manipulate materials and combustible substances or in the presence of open fire, a hazard of fire or explosion and in their vicinity, such as:

- installations for production, processing, tuning, compression, transmission and distribution of combustible gases (methane gas, petroleum gas, blast furnace gas, acetylene, hydrogen etc.) and oxygen;
- facilities for production, processing, pumping, transmission and distribution of combustible liquids (oil, paint, varnish etc.);
- household lubrication, hydraulic using fuel oil or other liquids;
- sections and workshops: painting, woodworking, modeling, metal coating, maintenance and repair of motor vehicles and machinery and stacked high, vulcanization, upholstery, sewing etc.;
- deposits of liquid fuel (gasoline, benzene, paint, varnish, solvents, oils, diesel etc.) wood and wood products, textiles, paper, carbide, plastic, portable compressed gas containers, explosives etc.;
- rooms in running operations washing or cleaning products petroleum (gasoline, neophaline, parchetin, petrosin etc.) and paint that were used flammable solvents;
- where rooms run finishing with combustible substances;
- the rooms and attics of buildings whose construction elements are made of combustible materials;
- laboratories and stations - the pilot is used combustible substances;
- loading batteries rooms;
- rooms with electrical equipment, calculation, measurement, control, automation, signaling, traffic control;
- special rooms for cables. [1]

### **Obligations sectors of industry leaders**

Working with fire permit (work permit) which referred to art. 39 paragraph (3) the general rules of prevention and fire fighting, approved by Order of the Minister of Interior no. 775/1998, shall be made in duplicate in which one is handed to the head band or person performing work operations with open fire and the other remains at issue (chief industry which is carried out).

Heads of sectors of activities (workshops, stations, warehouses, plants etc.) running the open fire operations, have an obligation to provide measures to:

- prepare work areas under Art. 39 paragraph. (2) the general rules for fire prevention and approved by Order of the Minister of Interior no. 775/1998;
- staff training;
- monitoring compliance with fire prevention and, after completion of work.

## Performers obligations and issuers of permits to work with open fire

With fire work permit is given by executing issuer shall proceed similarly in the case of work authorization. Machinery and apparatus used for execution of work with open flames must be in working order, the fulfillment of this requirement the contractor responsible, all welding equipment and appliances maintained and checked in accordance with the instructions of the supplier, their owner must be proof of their term maintenance and verification by the personnel.

## Preparation areas (places) for welding

Training places (areas) that will run the operation for welding or cutting with oxyacetylene flame involves:

- the protection zone with non-combustible panels with a minimum height of 2 m, corresponding anchored wall;
- floor protection combustible materials with layers of sand with a thickness of 2 cm, with metal or non-combustible boards;
- remove combustible materials and substances transported to distances of at least 10 m of where welding or cutting;
- cleaning parts painted a portion of at least 100 mm from one side around this point;
- wetting with water or protection panels combustible construction materials and fuel elements fixed to be safe from contact with sparks or burning pieces welding, flame or other particles of incandescent material;
- removing possible sources of ignition (sparks, incandescent particles etc.) come into contact with any combustible material in adjacent rooms or the lower rate, by covering or filling voids or holes in the floor and walls with tiles or combustible closures;
- the location of safety distances acetylene generator and portable oxygen tanks, as follows: at least 10 m between them and where welding or open flame source, and that at least 5 m between them;
- the first endowment of resources appropriate intervention;
- to ensure the presence of the person designated to supervise the execution of work with open fire.

Not be used open fire at distances less than 40 m from the explosion hazardous locations (gas and liquid fuel, flammable vapors etc.) and 10 m from combustible materials or substances (wood, paper, cardboard, asphalt, bitumen, oil etc.), without being supervised and ensured by appropriate measures. [2]

## Terms of acetylene generators, portable generators

Portable acetylene is installed, usually outside the room where it is welded, away from sunlight or sources with open fire, exceptionally be allowed to install one portable acetylene generator only rooms in which you run repair, installation or maintenance of a temporary nature, the following conditions:

- maximum acetylene flow not to exceed 3.2 m<sup>3</sup>/h;
- generator should be checked and have the stamp plate;
- load of carbide does not exceed the amount of 4 kg;
- the room has a volume of at least 350 m<sup>3</sup> and be ventilated effectively;
- to respect safety distances;
- should take place throughout the generator's location in the room, stopping the operation of any equipment which working with the flame or sparking. [3]

Welding facilities, tanks, containers and pipelines which have been circulated and which were stored combustible substances or flammable vapors, shall be made only after use, ventilation, cleaning, filling with water or inert gas, isolation them by blind flanges of rest facilities and after the laboratory, parts, facilities and materials that will perform welding or cutting operations shall be clean prior to combustible materials such as oils, textiles etc..

During the performance of work with open fire must ensure:

- surveillance of dispersion (spread) and the trajectories of sparks or incandescent material particles;
- oxygen cylinder valves closed and acetylene generator if interrupted during execution of work more than 10 minutes;
- prohibition of hanging burners or oxygen cylinders for acetylene generators;
- non-operation of the burners lit travel outside work areas;
- carbide discharge from the generator in case of disruption of work for long periods of time.

In all cases where a service is up and working civilian fire will ensure that the license registration to work with fire (work permit) before starting work:

- operators assigned to the use of acetylene generators, portable welders are specialized and examined under STAS 9532/1-1974;
- welders who used checks and repairs, portable acetylene generators will be allowed under CR 9-1978 I.S.C.I.R.;
- welders wear only static clothing and footwear.

### **Measures at the end of welding work**

At the completion of work must ensure, necessarily by:

- checking places where works have been executed, the spaces located adjacent to the lower or higher rates, to ascertain whether the outbreaks were caused by fire (incandescent areas, the release of smoke etc.);
- verifying, from time to time the existing situation where the work was performed and its surroundings;
- storage conditions safety equipment used for work;
- relocation of the initial positions of the elements and combustible materials at least 6 hours of completed work;
- collecting sludge (Slam) carbide containers for this purpose and deposited in a specially arranged area.

### **Areas with Risk of Explosion. Minimum Requirements**

#### **Areas of placement. Acetylene generators, portable storage**

Generator acetylene and oxygen tube will be placed in separate rooms simultaneously meet the following minimum requirements:

- premises (rooms) must be constructed only non-combustible;
- spaces (rooms) must be separated by fire resistant walls without holes in them charged;
- spaces (rooms) must be provided with opportunities for ventilation (ventilation) nature;
- is prohibited storage of combustible or flammable materials in any form rooms for storage of acetylene generators;
- is prohibited storage of generators which also contain acetylene gas consumed in rooms designed for them. [3]

### **Areas within the acetylene generator**

Accumulation of acetylene inside of generator acetylene within the basket can be made for carbide, the bell of acetylene in the pipeline, the filter acetylene or hydraulic safety valves that allow air penetration generate explosive mixtures these areas occur during load switching operations carbide, producing an explosion may occur, for example, when the carbide decomposition process is controlled in part heat or flame when there are returns, the general situation of conditions the use of defective safety valves.

In these cases, control of explosion risks may be achieved by:

- limiting the air entering the premises of the generator and its annexes, by adopting appropriate solutions since their design phase and in operation by nitrogen wash after work;
- eliminate any source of initiation of explosion of mixtures in which they were formed by controlling the heat part of carbide decomposition process and fully respecting the prohibitions on access to open fire;
- the construction of the generator and its attachments, where there is a possibility of contact with acetylene, must not use material with which it responds (silver, lead, aluminum, copper etc.);
- for safe operation, water temperatures generally not exceed, in operation, the value of 70°C.

### **Storage areas carbide in metal containers**

In the presence of moisture in the atmosphere, calcium carbide can generate the emergence of mixtures of acetylene - air concentrations within the explosive, in this respect required a minimum number of steps:

- the obligation on the care that must show a staff to not damage any form of carbide barrels, by protecting them from shock (mechanical etc.), from heating to different sources etc.;
- the operation is prohibited opening drums that may generate sparks tools;
- metal drums in which to store carbide will be sealed and shall bear the inscription carbide, protect from moisture;
- floorings rooms for storage drums with carbide will be 0.20 m higher than the share of neighboring rooms, and if not possible, they will be installed on scaffolding at a minimum rate of 0.20 m from the floor and 0.50 m above the ground;
- storage of oxygen cylinders is prohibited with the carbide containers;
- tools used will be made of ferrous metals that do not generate sparks mechanical;
- is prohibited crossing pipes: water, heat, gas etc., the spaces in which stored carbide;
- carbide store doors will be marked with inscriptions, which prohibits the use of open fire or water, according to the standards in force;
- prohibits the storage of carbide, in basements or basements construction.

### **Areas for storage tubes oxygen**

- oxygen cylinders will be checked according to technical requirements in force developed by ISCIR;
- is forbidden technical storing oxygen cylinders loaded in the same room with other gas cylinders loaded with fuel;
- the doors of rooms for storage tubes Oxygen will be marked with signs of security standards in force (STAS 297/1/1988 and 297/2/1992 which refers to the colors and safety signs, technical conditions and representations);
- the use fatty materials in contact with oxygen tubes;
- type vessels for oxygen cylinders, full or empty, is stored only in a vertical position and ensure against the overthrow of any kind;

- is prohibited exposure to oxygen tubes directly from solar radiation.

### **Areas for storage of waste carbide**

Residues obtained from welding operations consist of carbide used, which can deliver in time of acetylene gas, in this respect is required by:

- residue storage rooms or discharge into sewers can lead to the formation of explosive mixtures with concentration, so carbide residues must be disposed only in pits furnished and located at least 20 m, portable acetylene generator, the place of welding or any construction;
- in waste discharge areas is mandatory installation of safety signs, prohibition on the use of any heat sources such standards in force.

### **Welding and Electrical Cutting**

Welding equipment can cause electrical fires caused by short circuit due to impact against and damaging electrical equipment. As for welding and cutting operations to take place in good conditions and therefore no risk of fire, must meet a range of measures, as summarized below:

- transformers and welding machines mounted outdoors will be protected by rainfall action;
- floors of rooms at which welding works, be made of not combustible materials;
- electrical cables and conductors must not pass near sources of heat or gas pipes and containers;
- electrical cables should not be hit by strong bodies, especially the parts and metal objects in the fall, because it breaks and favors the formation of short circuits;
- when crossing over roads and places circulated, cables are to be protected by the device or crossing systems;
- distribution facilities and switches are mounted on insulating boards (asbestos), in closed metal boxes and provided with adequate safety fuses used in welding;
- on sites, cables attached to the scaffolding will work through the insulator and the joints are made only by welding clamps. When passing through walls and floors, electrical wiring is placed in protective insulating tubes;
- connection of electric cables from equipment and appliances, will be made only by heads glued or clamps;
- electric cables reaching support electrodes, must be flexible and resistant to mechanical and chemical and high temperature;
- corps welding aggregates, the transformers, switchboards carcasses, welding tables and welding parts subject will be electrically connected to earth . This operation must be made before work starts;
- for the electrical installation does not come due to wrong connections or overload, it controls the voltage at the working aggregate, to be suitable and was not strip wires. During the interruption of work, electrical installation is disconnected;
- heads electrodes heated throw out but do not gather in a metal box, located near the welder;
- in open arc welding will be taken to ensure that sparks do not spread out and not reach combustible materials, a minimum safety distance of 10 m;
- during the automatic and semiautomatic welding, will follow the same rules as the regular welding, ensuring proper functioning of defeat devices.[4]

### **General Conclusions**

In general, the work of welding and cutting metals should not be performed near combustible materials.



Before work welding in a room is controlled and seals, fire resistant materials, all pipelines crossing the wall floors, cracks, not to enable the sparks to penetrate the space cities. Neighboring chambers where welded, is constantly monitored, to detect any fire caused by sparks or heat transmitted by conductivity. The welding of packaging used for transport or storage of flammable and combustible liquids, it is necessary to completely evacuated debris liquid and vapor, by washing with hot water, steam, caustic soda or dry warm air. After cleaning and washing, it will check if the packages also contain vapor and there is no need for a prior washing.

Welding of pipelines and equipment available pressure gas, vapor, liquid and air, as well as those in electric power is not allowed. Pieces or installations, which will run welding or cutting operations, will be cleaned in advance of combustible materials (oil, tows etc.).

Welding work is prohibited in rooms where products are manufactured, stored or using flammable liquids or fuel (gasoline, oil, oil etc.) pieces that are going to weld or cut, remove and transport in a workshop suitable for welding work. The freshly painted constructions, namely, before moving at least two days from painting, welding works are not allowed as yet contain substances no volatilize.

The elements of construction and other combustible materials located near the welding site, which can not be discharged, will be surrounded by fences of protection from fire resistant material, having height of at least 2 m.

Mounting distance protector screens will be not be possible in the fall of sparks or particles heated in without these protections. To interruption of the welding or cutting, open flame will be protected with care and will see her reaction continuous.

When running welding work on wooden scaffolding, platforms etc., nearby combustible construction is protected against ignition by spraying with water, fences etc. combustible. welding and cutting works in closed spaces (tunnels, wells, reservoirs etc.). will not run until after the analysis of air and ventilation to ensure these work spaces.

The operation of welding and cutting the power plants run only after they are removed from the tension and action is taken against accidents connected to the network.

## References

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## Monitorizarea lucrului cu foc deschis în rafinaj-petrochimie

### Rezumat

*Identificarea riscului de incendiu reprezintă procesul de apreciere și stabilire a nivelului de pericol de incendiu, în anumite împrejurări, în același timp și spațiu. Folosirea focului deschis în obiective cu risc major de incendiu implică a se lua o serie de măsuri necesare evitării producerii unor situații de urgență.*