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Vroče brizganje - Varnostne zahteve za opremo za vroče brizganje - 4. del: Oskrbovanje s plinskim in tekočim gorivom

Thermal spraying - Safety requirements for thermal spraying equipment - Part 4: Gas and liquid fuel supply

Thermisches Spritzen - Sicherheitsanforderungen für Einrichtungen für das thermische Spritzen - Teil 4: Gas- und Flüssigbrennstoffversorgung

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Thermal spraying - Safety requirements for thermal spraying equipment - Part 4: Gas and liquid fuel supply

Thermisches Spritzen - Sicherheitsanforderungen für Einrichtungen für das thermische Spritzen - Teil 4: Gas- und Flüssigbrennstoffversorgung

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Contents

Page

Foreword

This document (prEN 15339-4:2012) has been prepared by Technical Committee CEN/TC 240 “Thermal spraying and thermally sprayed coatings”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

1 Scope

This part of EN 15339 specifies safety requirements of machines and equipment for thermal spraying, in this case of gas supply including supply of liquid fuels.

This part of EN 15339 should be used in conjunction with prEN 15339-1, which deals with general aspects when designing, manufacturing, and/or putting in service of machines or equipment and with the responsibility for issuing the CE Conformity Declaration.

Generally, the requirements of EU Directive 94/9/EC [1] are valid for the use of this European Standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 657, *Thermal spraying — Terminology and classification*

prEN 15339-1, *Thermal spraying — Safety requirements for thermal spraying equipment — Part 1: General requirements*

EN 15339-2, *Thermal spraying — Safety requirements for thermal spraying equipment — Part 2: Gas control units*

prEN 15339-3, *Thermal spraying — Safety requirements for thermal spraying equipment — Part 3: Torches for thermal spraying and their connections and supply units*

prCEN/TR 15339-6, *Thermal spraying — Safety requirements for thermal spraying equipment — Part 6: Spray cabin, handling system, dust collection, exhaust system, filter*

3 Function of thermal spraying equipment

3.1 General

Thermal spraying processes are described and schematically represented in EN 657.

Thermal spraying uses flammable gases for flame, plasma or HVOF (high velocity oxygen fuel) spraying processes, which possess a significant potential of danger. Pure oxygen shall also be considered a dangerous gas, because also hardly inflammable material will burn in the presence of a certain concentration of oxygen.

Furthermore, pressurised air, nitrogen, or carbon dioxide (CO_2) are applied for cooling the substrate's surface or the part to be sprayed. Likewise, flammable gases and oxygen are used for fusing of sprayed coatings made out of self fluxing alloys.

For such applications, an appropriate and safe supply shall be ensured by gases from manifold cylinder banks, cryogenic gas tanks or public piping systems (natural gas). Usually, such supply systems are used for gas pressure of more than 20 bar.

The installation of the gas delivery system, taken in conjunction with control measures, such as gas detection and interlocking of the thermal spray equipment, forms a crucial part of the HAC. The respective class shall be considered. For details, see prEN 15339-1 and prCEN/TR 15339-6.

3.2 Gases for thermal spraying

Table 1 — Gases for thermal spraying

Thermal spraying processes	Gases used
Flame spraying	acetylene (C_2H_2) propane (C_3H_8) propylene (C_3H_6) hydrogen (H_2) oxygen (O_2) carbon dioxide (CO_2) air
High Velocity Oxygen Fuel spraying (HVOF)	acetylene (C_2H_2) ethene (C_2H_4) propane (C_3H_8) propylene (C_3H_6) hydrogen (H_2) oxygen (O_2) carbon dioxide (CO_2) air
Cold spraying	helium (He) nitrogen (N_2) and their mixtures air
Detonation spraying	acetylene (C_2H_2) oxygen (O_2) air
Arc spraying	argon (Ar) nitrogen (N_2) carbon dioxide (CO_2) air
Plasma spraying	argon (Ar) helium (He) hydrogen (H_2) nitrogen (N_2) and their mixtures carbon dioxide (CO_2) air
Laser spraying	helium (He) nitrogen (N_2) argon (Ar) and their mixtures carbon dioxide (CO_2) air

3.3 Safety related features of gas, liquid fuel, and cooling water supply

- Storage of burnable and inflammable gases.
- Storage of liquid fuels.
- Supply of gases in the high pressure gas supply system (> 20 bar) running from the storage to the spraying equipment, e.g. to the gas control cabinet (for details, see EN 15339-2) or to the stop and control fitting where the torch hose is connected to (for details, see prEN 15339-3).
- Supply of liquid fuel from the storage to the control cabinet (for details, see EN 15339-2).
- Supply of oxygen or air for acceleration the combustion or the spray jet.
- Storage, supply and distribution of cooling media, e.g. water or carbon dioxide (CO_2) for HVOF or plasma spraying.

4 Potential hazards

For a safe operation of gas storage and supply of gases and liquid fuels, the following hazards shall be considered for normal operation or abnormal circumstances.

- Surface temperature on cylinders can be too high.
- Risk of fire or explosion when leakage occurs on the connections in the piping system.
- Risk of fire or explosion, if the distance between gas cylinders or bundles of different gases is not appropriate, for example, if leakages are produced when changing the connections.
- Risk of over-heating or damage, if the impairment of rain, direct sunlight to the gas cylinders or manifold cylinder banks cannot be avoided.
- Release of gases or liquids under high pressure.
- The environment can be impaired, if gases like acetylene, propane, carbon dioxide (CO_2) and/or liquids like cooling media, hot water, escape.
- Release of oxygen can create and increase the risk of fire, if, e.g., insulation material has absorbed oxygen to a critical extent.
- Flashback, if the stop valve in the control unit or the gas pressure reducing stop and control fitting does not operate sufficiently.

5 Safety requirements – Protection measures

5.1 General requirements and measures

Specific safety conditions and protective measures are required by European, national or local regulations. The following equipment is covered by this European Standard.

Gas cylinders, manifold cylinder banks and cryogenic gas tanks, storage receptacle for liquid fuel, piping systems for gases, liquid fuel and cooling media.

Appropriate devices and equipment to fulfil the requirements are

— gas stop valves (manually or automatically operated),

— gas pressure control,

— pressure reducing valves,

— appropriate pipes for the connection of the gas cylinders to one another and to the bundle or from the storage receptacle to the control cabinet,

— fittings, connecting parts,

— pressure gauges,

— flashback arresters.

5.2 Safety requirements and protection measures for gas storage

Wherever possible, stores for cryogenic liquid gas tanks, bulk supply of gases and/or tanks for liquid fuels shall be located outside the work area, in purpose-built bays that can be locked.

The store should be well ventilated, kept clean and the cylinders shall be protected against rain and direct sunlight. Access shall be given for the delivery and removal of bundles or cylinders by lorries.

Fuel gases and oxygen shall be stored separately, either by a distance or by a fire resistant wall. The limit of the permissible quantity of LPG, propane and acetylene stored together shall be considered.

Heating of the fuel storage area e.g. for propylene bundles may be necessary to avoid transport problems due to reduced vapour pressure.

Annex A represents schematically layouts for gas and liquid fuel supply for several thermal spraying processes.

5.3 Safety requirements and protection measures for high pressure gas supply

A fixed installation of this gas supply system (more than 20 bar gas pressure) shall be applied for plasma, high velocity oxy-fuel spraying (HVOF) and automated flame spraying. The system shall be installed using solid piping as far as possible. Flexible piping shall be avoided, even if rubber hoses would be permitted, in order to reduce the risk of damages and leakage. A sufficient flow shall be available.

The piping shall be routed on the outside of the building as far as possible and shall contain the minimum number of connections. Any connections shall either be welded or brazed (for pipes made out of copper). Soft soldered joints or crimp connectors are not permitted.

The piping shall be visible and accessible for inspection and maintenance purposes. Installation in ducts, roof spaces and enclosed spaces should be avoided. All pipes shall be suitably marked, indicating the type of gas and its direction of flow.

To avoid the risk of fire or explosion, no organic materials such as oil or grease shall come into contact with oxygen.

Flashback arresters and non-return valves shall be used to protect the piping and storage system against flashbacks.

Gas stop valves, usually manually operated, pressure reducing valves and gas pressure control shall be applied on the cylinder, bundle, or tank.

5.4 Safety requirements and protection measures for liquid fuel supply

For systems based on liquid fuels, e.g. kerosene, the possibility of producing an explosive mixture is much reduced, since the flash point of kerosene is higher than the one of gaseous fuels such as acetylene or propane, but the flash point varies widely depending upon the specific product. An atomised kerosene spray can explode.

Usually, the fuel is fed via a pressurised line to the console. A leakage in this system can create a risk of explosion. Thus, the high-pressure side shall be equipped with an all-metal pipe.

The installation shall be leak tested. For details, see 5.8.

5.5 Safety requirements and protection measures for cooling media supply

Cooling media are applied for cooling the part to be sprayed, the coating and the spray torches. For cooling, measures are used: air, water or carbon dioxide. Usually, pressurized air or water is applied for cooling the spray torch, while pressurized air or carbon dioxide (CO_2) are applied for cooling the part and/or the coating.

Considering the safety requirements, the storage and supply system shall be operated or equipped with

— suitable storage of liquid carbon dioxide (CO_2) in cylinders, bundles or a tank,

— protection from hot cooling water exit,

— controlled distribution of cooling media in the HVOF or plasma spray torch,

— tightness test. For details, see 5.8.

5.6 Gas detection

Leaks can occur on any connections. Small leaks can be dispersed by an adequate general ventilation system. Unintentional escaping of flammable gases shall be detected, generally. If safety limits are exceeded, a monitoring and control system shall stop the further gas supply.

An appropriate positioning, accurate calibration, and regular inspection of gas detectors and testing for their effectiveness shall be performed. Instructions given by the supplier of the devices shall be considered.

A suitable risk assessment shall be performed before a gas detection equipment is installed. For details to the risk assessment, see prEN 15339-1. The appropriate location of the detectors shall be limited to the working area of the spray process, the control cabinet and inside the spray booth.

5.7 Measures in the case of a gas leakage

The function of the detector shall be integrated into the regulation of the ventilation system and the gas and electric power supply. A gas interlocking shall be introduced, the electric power supply shall be separated and the fuel supply stopped before a critical explosive level is reached. The ventilation shall continue to function or a ventilation emergency system shall be activated and shall operate until any flammable gas is removed.

5.8 Leak test – Pressure test

In any case, a leak test has to be carried out after the installation or a repair. Likewise, a leak test shall be carried out on the connecting fitting, when a change of cylinders is done.

For pressure testing, the test should be carried out according to the national or local regulations (usually at 1,5 times its maximum working pressure) using an inert or a non-flammable gas with similar properties to the fuel gas used in the system. Thus, for instance helium can be used to test a hydrogen system. The pressure shall be held in the system without a drop for a period required by the national or local regulations (usually not less than 30 min).