



Technical Specification

ISO/TS 21343

Oil and gas industries including lower carbon energy — Fuel ammonia — Requirements and guidance for boilers for power generation

Industries du pétrole et du gaz, y compris les énergies à faible teneur en carbone — Ammoniac combustible — Exigences et recommandations applicables aux chaudières pour la production d'électricité

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 67, *Oil and gas industries including lower carbon energy*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

Ammonia can be used as a carbon-free fuel with the potential to contribute to the transition to a carbon-neutral society. The greatest advantage of ammonia is that it does not produce CO₂ during combustion. In addition, the technology for safely liquefying, transporting and storing ammonia has already been implemented in the society as existing ammonia infrastructure; and further development is underway from the perspective of unprecedented large-scale transporting and storing. Appropriate use of these technologies can lead to rapid decarbonization.

There are many potential applications of fuel ammonia, such as boilers for power utility or industrial boilers, gas turbines, marine engines, industrial furnaces, both for new boilers and modified existing facilities. However, from the perspective of achieving carbon net zero, it is necessary to accelerate the application of fuel ammonia to boilers that generate particularly high amounts of CO₂ and other potential greenhouse gases (GHG).

In order to contribute to CO₂ and other potential GHG reduction at an early stage by using fuel ammonia in power generation boilers, there's an urgent need to provide requirements and guidance for manufacturers of ammonia-fired boilers. Demonstration projects of ammonia-fired boilers are progressing successfully; and commercialization is sooner than originally expected. Therefore, it is necessary to establish standards to validate the certainty of design, engineering and manufacturing in terms of envisioned improvement in environmental performance of the electric utility power boilers. This document aims to standardize the functional tests and acceptance tests to be performed in order to accomplish such validation.

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Oil and gas industries including lower carbon energy — Fuel ammonia — Requirements and guidance for boilers for power generation

1 Scope

This document specifies requirements and guidance for manufacturers of ammonia-fired boilers regarding functional tests performed at the time of design and on-site acceptance tests, in order to meet the required environmental performance.

This document stipulates the test methods, the measurement items, the evaluation methods and the test reports for each test.

This document is applicable to:

- a) land boilers used for power generation with an electrical output of 100 MWe or more;
- b) equipment that uses NH₃ of any mixing ratio as fuel;
- c) boilers with burners for combustion of fuel.

This document does not apply to heat recovery steam generators for gas turbines, fluidized bed boiler, stokers, black liquor recovery boiler and process heat transfer equipment (used in petroleum refining).

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 acceptance test

test performed at the actual ammonia-fired *boiler* (3.4), prior to the commercial operation date

3.2 fuel ammonia

NH₃ utilized as a fuel for *boilers* (3.4)

Note 1 to entry: Ammonia is used differently as “NH₃”, because NH₃ is an expression of a substance with a molecular formula and ammonia is defined as a fuel that includes the concept of purity of NH₃.

3.3 ancillary equipment

series of equipment installed at the downstream of the *boiler* (3.4)

EXAMPLE Denitrification equipment, air preheater, dust removal equipment and desulfurization equipment.

3.4

boiler

equipment generating steam by firing fuels

3.5

burner

device or group of devices for the introduction of fuel and air into a *combustion chamber* (3.7)

3.6

combustion air temperature

temperature of the air introduced into *burners* (3.5) to combust fuels

3.7

combustion chamber

part of the *boiler* (3.4) equipped with *burners* (3.5) where fuels are combusted

3.8

excess air ratio

ratio of the actual combustion air quantity to the theoretically required air quantity to combust fuels completely

3.9

functional test

test performed using the combustion test facility, prior to the fabrication of the electric utility power boilers

3.10

holding time

period required for the establishment of a steady-state operation, before the start of the *functional test* (3.9) or the *acceptance test* (3.1)

Note 1 to entry: This excludes transient time.

Note 2 to entry: See [Figure 3](#).

3.11

land boiler

stationary *boiler* (3.4) installed on land

3.12

manufacturer

supplier or vendor of the ammonia-fired boiler according to the contract with the *purchaser and/or user* (3.17)

3.14

measurement interval time

period between measurements during steady-state operations under the same load condition

Note 1 to entry: See [Figure 3](#).

3.15

multi-stage combustion air port

additional air port installed above or around *burners* (3.5)

3.16

nominal rated heat input

numerical value obtained by multiplying the fuel heating value by the maximum fuel flow rate

Note 1 to entry: This value represents the capacity of the combustion test facility.

3.17

purchaser and/or user

individual or organization that buys, owns, operates, or any combination of functions with respect to the electric utility power *boiler* (3.4) including the ammonia-fired boiler and makes the contract with the *manufacturer* (3.12)

3.18

representative point

predetermined point considered to represent the *spatial average value* (3.20) of the gas concentration and where the measurement will be conducted

3.19

selective catalytic reduction

SCR

denitrification equipment to reduce NO_x in the flue gas

3.20

spatial average value

arithmetic mean value obtained from multiple measuring points in the cross section

3.21

steady-state time

period covering all measurement(s), including interval(s) between multiple measurements, and any additional time the equipment is continuously operated for observation purposes under the same load condition

Note 1 to entry: See [Figure 3](#).

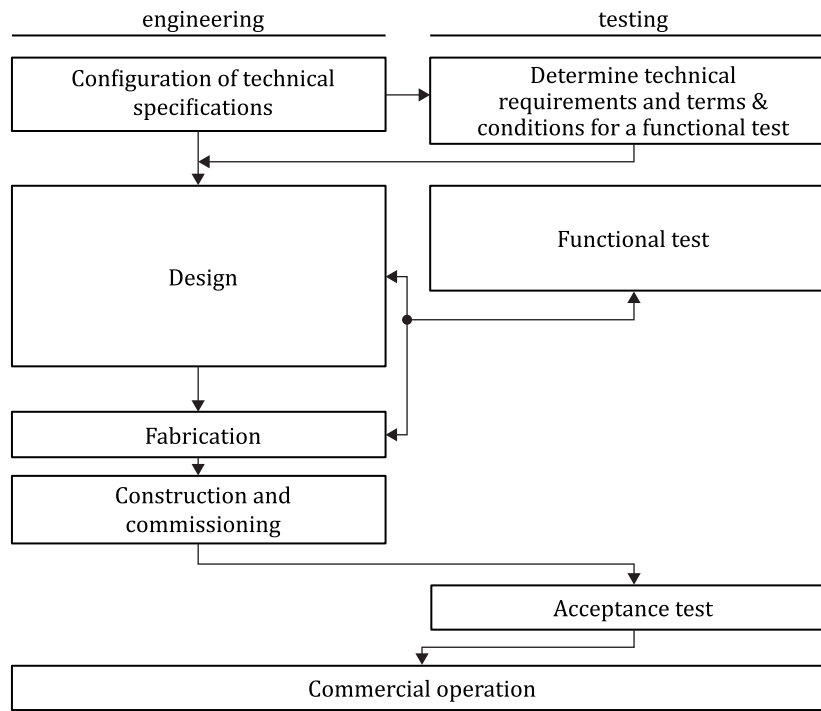
4 General test requirements

4.1 Basic concept of tests

The tests of ammonia-fired boilers shall be carried out in accordance with [Clause 5](#) (functional test) and [Clause 6](#) (acceptance test). [Figure 1](#) indicates an entire typical process, its main activities including functional test and acceptance test, and the correlations between activities.

Functional tests are performed by the manufacturer at smaller-scale test facilities with the aim of achieving such design that fulfils the purchaser and/or user's environmental performance requirements specifically in terms of levels of emissions of GHG and other flue gas emissions that are recognized as environmental pollutants. The purpose of functional tests is to verify the validity of the design in order to proceed to detailed design to reduce the risk of an acceptance test failure. The concept of the purchaser and/or user's performance requirements is shown in [Annex A](#).

Acceptance tests are conducted at the purchaser and/or user's installation site with the aim of confirming the levels of emissions of GHG and other flue gas emissions that are recognized as environmental pollutants as agreed between the purchaser and/or user and the manufacturer. The procedure of acceptance tests shall be agreed upon in writing between the concerned parties.



NOTE The order is an example.

Figure 1 — Entire typical process, its main activities including functional test and acceptance test, and the correlations between activities

4.2 Extent of test

The concept of an ammonia-fired boiler is illustrated in [Figure 2](#), which shows ammonia as a fuel, a combustion chamber, a flue gas measurement point and downstream flue gas treatment facilities. The tests shall be conducted on ammonia-fired boilers, both for new power plants and modified existing facilities.

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