INTERNATIONAL STANDARD 3544

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Atomizing oil burners of the monobloc type — Safety times and safety, control and monitoring devices

Brûleurs à combustibles liquides à pulvérisation de type monobloc — Temps de sécurité et dispositifs de sécurité, de commande et de régulation

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FOREWORD

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

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It has been approved by the member bodies of the following countries :

Canada	Korea, Rep. of	Switzerland
Chile	Mexico	Turkey
Egypt, Arab Rep. of	Poland	United Kingdom
France	South Africa, Rep. of	U.S.S.R.
Germany	Sweden	Yugoslavia

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Australia
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Atomizing oil burners of the monobloc type — Safety times and safety, control and monitoring devices

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the safety times and the functions of safety, control and monitoring devices for automatically and semi-automatically operated atomizing oil burners of the monobloc type.

These burners may use liquid fuels the viscosity of which does not exceed 380 mm^2/s* at 50 °C.

This International Standard also applies to combined type burners using alternatively liquid or gas fuels when they operate with liquid fuels.

2 DEFINITIONS

2.1 Atomizing oil burners

atomizing oil burner : A burner for liquid fuel, in which ignition of the fuel is preceded by a preparatory phase in which division of the fuel into small droplets occurs, in order to facilitate mixing with combustion air.

2.1.1 automatic oil burner : An oil burner equipped with automatic flame monitoring, control and regulating devices, so that the ignition of the flame, the flame monitoring as well as the start and the shut-off of the oil burner and possibly the regulation of the amounts of the fuel and the combustion air take place without intervention of operating personnel.

2.1.2 semi-automatic oil burner : An oil burner equipped with automatic ignition, flame monitoring, control and regulating devices, and, possibly, automatic devices for regulating the amounts of fuel and combustion air, on which each ignition for putting the burner into service is carried out manually.

The oil burner is monitored and switched off by flame detectors (and, when available, from limiting devices) during starting and during operation. The burner output (oil throughput) may be automatically or manually regulated during operation.

The switching of the burner may be achieved manually; in this case, the re-ignition, which constitutes a new start, is manual.

2.1.3 monobloc type oil burner : An assembly of components including at least the means for the air and the fuel supply and atomization, the flame monitoring, and the adjustment of operation. The components of the assembly are fixed one to another or assembled on the same frame or in the same housing. These components include at least a fuel pump, an atomizing device, a combustion air fan, an ignition device, a flame monitoring device and a motor. The assembly is catalogued in this way by the manufacturer.

2.2 Regulating, monitoring and control devices

Burners include some or all of the following devices :

2.2.1 regulating device : A device which maintains the controlled quantity (for instance temperature, pressure) at a particular determined value.

2.2.2 flame detector : A device which sends signals to the control device indicating that the flame has failed to be established, is present or has been extinguished.

Such a device generally consists of a sensor (possibly associated with an amplifier) and delivers a signal.

2.2.3 control device; controller : A device which effects starting up and switching off of the oil burner in accordance with a pre-set programme in response to signals from the regulating, monitoring or limiting devices. Some components of the flame detector may be incorporated into the control device (for instance an amplifier with a relay).

2.2.4 limiter : A device which senses the controlled quantity, causing the switching off of the burner. It operates once a predetermined limiting value has been reached.

2.2.4.1 automatically reset limiter : A limiter which resets itself automatically and allows the re-starting of the burner only after a predetermined change of the supervised quantity has occured.

2.2.4.2 manually reset limiter : A limiter which requires simple manual intervention for the re-starting of the burner.

* 1 mm^2/s = 1 cSt

2.2.4.3 reset limiter with locking device : A limiter which can only be reset by use of specialized tools, by trained personnel, to allow the re-starting of the burner.

2.3 Burner ignition systems

2.3.1 automatic ignition performed electrically : A system in which the ignition necessarily involves the sole use of electrical energy. The two following systems are distinguished :

2.3.1.1 proven spark ignition : A system which admits no fuel flow unless the presence of the spark is proved.

2.3.1.2 unproven spark ignition : A system in which the admission of the fuel is not prevented by the absence of the spark.

2.3.2 automatic ignition provided by liquid or gaseous fuels : A system in which the fuel is ignited by a small liquid or gaseous fuel burner known as a pilot burner and which may be operated continuously or discontinously. In this latter case the two following systems may be distinguished :

2.3.2.1 ignition by proved pilot burner : A system which admits no main fuel flow unless the presence of flame on the pilot burner is proved.

2.3.2.2 ignition by unproved pilot burner : A system in which the admission of the main fuel is not prevented by the absence of a flame on the pilot burner.

2.4 Conditions of burner shut-down

2.4.1 operating shut-down : A process initiated by a regulating device, by an automatically reset limiter or by a time-switch when fitted.

2.4.2 flame fault shut-down : A process initiated by the action of the flame detector when the flame fails to be ignited or is extinguished, and resulting in a lock-out of the control device under the conditions of clause 4.

2.4.3 safety shut-down : A lock-out of the control device after a response is received from either a manually reset limiter or a reset limiter with locking device (for example for pressure, temperature, water-level, atomizing medium, or combustion air).

2.4.4 lock-out : Stopping of the control device so that re-starting cannot be effected without manual intervention.

2.4.5 re-ignition : A process in which the ignition is switched on after extinction of the flame during operation, without the oil supply being interrupted.

2.4.6 re-start; repetition : A process in which the starting procedure is repeated after extinction of the flame during operation. When re-starting is carried out, the specified control programme sequence must be adhered to.

2.5 Safety and functioning times (see diagram in annex)

2.5.1 total ignition time : The period during which the ignition device is in operation. Pre-ignition, actual ignition and post-ignition times comprise the total ignition time.

2.5.1.1 pre-ignition time : The period between the starting-up of the ignition device and the release of the oil supply.

2.5.1.2 actual ignition time : The period between the release of the oil supply and the first appearance of the flame.

2.5.1.3 post-ignition time : The period between the first appearance of the flame and the switching off of the ignition device.

2.5.2 safety time : The maximum permitted period of time during which the control device allows release of the oil when no flame is present.

A distinction is made between the safety times, according to whether they are followed by fault shut-downs when starting-up or during operation.

2.5.2.1 safety time at ignition : The period beginning the instant the signal to release the oil supply is given and finishing with the signal to shut off the oil supply.

2.5.2.2 safety time during the state of operation : The period beginning at the instant of the disappearance of the flame and finishing with the signal to shut off the oil supply.

2.5.3 flame simulation : A signal indicating that a flame is present whereas in fact no flame is present.

NOTE – For protection against the simulation of a flame and against stray light (applicable only in the case of flame detection systems relating to a continuous level of illumination), see 4.2.

2.5.4 purging time : The period during which the combustion chamber is forcibly ventilated as indicated in 3.4, without the oil supply being released.

2.5.4.1 pre-purging time : The period immediately preceding the release of the fuel supply.

2.5.4.2 post-purging time : The period immediately subsequent to the cutting off of the fuel supply.

2.5.5 state of operation : The state beginning when the flame is in existence after the permitted safety time necessary for the ignition; at this point the starting-up process ends. Starting-up may be considered not to have taken place if the release of the fuel is not authorized or if it is interrupted on expiry of the safety time by lock-out of the control device.

3 SAFETY AND FUNCTIONING TIMES

3.1 General

The safety devices for flame monitoring shall ensure that the safety times given in the table below, which depend upon the oil throughput of the oil burner, are adhered to for ambient temperatures between 0 °C and 50 °C and for all the voltages between 0,85 and 1,1 times the nominal voltage.

TABLE — **Safety times**

Nominal oil throughput kg/h	**Safety times**, s (max.)	
	at starting	during the state of operation
up to 30 inclusive	20	20
over 30	7	1*

* This value may be increased to 3 s :

— when using liquid fuels with a viscosity greater than 20 mm^2/s at 50 °C,

— according to the operating characteristics of the burner.

The nominal oil throughput is, in kilograms per hour, the oil throughput corresponding to the nominal output of the generator on which the burner is intended to be installed.

3.2 Operation of the burner under extreme conditions

In those areas where there is a significant risk of low voltages, the start-up of an oil burner shall be prevented by the use of a voltage-sensitive device when the applied voltage drops sufficiently to endanger the installation. The device may be external to the burner or integral with the control device. Where it is integral, the burner shall be marked to indicate that it is so equipped.

When, as a consequence of the place of installation, an oil-burner controller is likely to be subjected to sub-zero temperatures or temperatures above 50 °C, only those controllers which have been declared by their manufacturer to be capable of functioning satisfactorily at such temperatures shall be used.

3.3 Setting of the safety time on an automatic unit and protection against re-adjustment

The adjusting means for the safety time shall be factory set, in such a way that re-adjustment is difficult and tampering would be readily obvious. Where the effectiveness of the flame detector cannot be tested without interfering with the electrical control system, the operating instructions shall indicate how this test is to be carried out.

3.4 Pre-purging times

Before the oil supply is released, purging of the combustion chamber shall be ensured in accordance with the following principles :

3.4.1 *In the case of an oil throughput of up to* 30 kg/h

a) Natural ventilation of the combustion chamber is sufficient provided that the air dampers are permanently fixed in their operating position.

b) Provision shall be made for mechanical pre-purging (with a fan) for at least 5 s duration where positively controlled (for example electro-hydraulically actuated) air dampers are used.

This mechanical pre-purging may be replaced by natural ventilation of the combustion chamber (by means of chimney draught) for at least 30 s duration.

c) Mechanical pre-purging is not required with air dampers which are controlled by the draught, providing that apertures exist such that the air volume passing through the air damper in the closed position is equivalent to at least 20 % of the maximum quantity of air displaced by the fan.[1)]

d) In the case of positively controlled dampers on the flue gas side, the rule given in b) shall be applied in suitably adapted form.

3.4.2 *In the case of an oil throughput of more than* 30 kg/h

a) The purging air quantity shall correspond to at least three times the total gas capacity up to the entry into the chimney or five times the capacity of the combustion chamber; the total gas capacity comprises the capacity of the combustion chamber and the flue passages including the smoke box.

This condition is considered as satisfied if the pre-purge is carried out for 15 s, the amount of air being equal to the air flow corresponding to the nominal output of the burner.

In special cases (such as flash steam boilers) subject to test approval, a purging time other than 15 s may be accepted.

b) The rule given in a) is to be applied in suitably adapted form for positively controlled dampers on the flue gas side.

c) If other than permanent gas ignition is used to ignite the burner, the pre-purge time shall be extended by the length of time during which gas is admitted; the latter time shall not be more than 7 s during the last part of the pre-purge period.

1) This statement is to be regarded as a test requirement.

3.5 Ignition by pilot burner (see diagrams in annexes)

The maximum thermal output of each pilot burner shall not exceed one-tenth of the thermal output at ignition of the main burner.

3.5.1 *Ignition by unproved pilot burner*

When an unproved pilot burner ignition system is used, the period during which only the pilot burner fuel is supplied shall not exceed 5 s.

The period is limited by the signals for release of fuel to pilot burner and to main burner.

In addition, the electric ignition device of the pilot burner shall in no case be involved in ignition of the main burner.

3.5.2 *Ignition by proved pilot burner*

When a proved pilot burner ignition system is used, the pilot burner flow shall be stopped if the pilot burner flame has not been formed within 15 s.

The fuel supply to a permanent pilot burner shall be interrupted less than 15 s after extinction of the pilot burner flame after a fault.

3.6 Post-ignition

On burners up to 30 kg/h the post-ignition time may continue during the operating cycle of the burner, unless the flame detector is activated by the ignition source.

4 CONTROL AND MONITORING DEVICES

4.1 Attempt at re-ignition, re-starting (recycling) and fault shut-down on extinction of the flame

4.1.1 *Flame fault shut-down with oil burners having an oil throughput up to* 30 kg/h

With oil burners having an oil throughput up to 30 kg/h, the oil supply shall be automatically interrupted before or simultaneously with the expiry of the safety time, and a fault shut-down shall be effected if :

a) during starting-up of the burners no flame is signalled before the expiry of the safety time of 20 s;

b) the flame has been extinguished during operation and has not been signalled during the following automatic re-ignition (or re-starting) attempt at the end of the safety time. The re-ignition or the shut-off of the fuel supply before the re-start shall be effected at most 1 s after extinction of the flame.

The re-start of the oil burner after shut-off according to a) or b) shall only be possible after manual resetting of the locked-out control device.

4.1.2 *Flame fault shut-down with oil burners having an oil throughput in excess of* 30 kg/h

With oil burners having an oil throughput in excess of 30 kg/h, the oil supply shall be automatically interrupted before or simultaneously with the expiry of the safety time, and a fault shut-down shall be effected if :

a) during starting-up of the burner no flame is signalled on expiry of the safety time of 7 s;

b) the flame is extinguished during operation. One single re-start is permissible in this case, the supply of fuel having been stopped within at most 1 s after extinction of the flame; when firing fuel oil having a viscosity of more than 20 mm^2/s at 50 °C, a 3 s delay is permissible.

After cutting off of the oil supply, not more than 0,1 % of the maximum hourly oil throughput of the burner shall pass into the combustion chamber.

It shall not be possible to re-start the oil burner except by manually re-setting the locked-out control device.

4.2 Insensitivity to flame simulation and stray light (applicable only in the case of flame detection systems relating to a continuous level of illumination)

Monitoring of the sensitivity of the flame detector to flame simulation and stray light shall be carried out at the moment the starting-up signal is received. It does not need to be continued throughout the pre-purging time.

In addition, during the various tests, care will be taken to leave a waiting period between two successive starting-up operations of the burner of at least :

— 60 s for burners with an oil throughput less than or equal to 30 kg/h.

— 2 s for burners with an oil throughput greater than 30 kg/h.

4.2.1 If there is continuous flame simulation or permanent stray light, insensitivity shall be provided as follows :

a) for burners with an oil throughput less than or equal to 30 kg/h without pre-ventilation or where the pressure of the fuel on the valve during pre-ventilation is at least five times smaller than the pressure during operation, start-up of the burner shall be prevented (see 2.5.5);

b) for burners with an oil throughput less than or equal to 30 kg/h where the pressure of the fuel on the valve is the normal operating pressure, it is necessary either :

— to prevent start-up of the burner (see 2.5.5);

— or, preferably, to cause lock-out of the control device;

c) for burners with an oil throughput greater than 30 kg/h, it is necessary to prevent release of the fuel and to cause lock-out of the control device.

4.2.2 Flame detectors reacting to daylight shall not be installed on burners where their function may be adversely affected by a stray light source. Compliance with this requirement is checked by one of the following tests, which

consist of comparing the greatest illumination on the detector allowing release of fuel on start-up with the illumination which, during operation, gives the signal for extinction of the flame. These conditions shall apply when the flame detector is supplied at a voltage of between 0,85 and 1,1 times the nominal times voltage :

a) If the signal corresponding to flame extinction is given for an illumination of less than 3 lx, monitoring is carried out on the burner placed in an opaque combustion chamber. The burner is illuminated from the outside by a light source producing an illumination of 20 000 lx which can be moved in order to illuminate the burner from all possible angles. The illumination on the detector shall then be less than the value corresponding to flame extinction.

b) If the signal corresponding to flame extinction is given for an illumination between 3 and 10 lx inclusive [or between 3 and 7 lx inclusive; see c)], the illumination on the detector shall then be less than or equal to the value corresponding to flame extinction.

c) If the signal corresponding to detection of flame extinction is given for an illumination of more than 10 lx (or more than 7 lx when this illumination is not affected by variations in voltage of the electrical supply system of between − 15 % and + 10 % of the nominal voltage), no monitoring is required.

NOTE – All the illuminations are given for 2 856 K.

4.3 Self checking

Re-starting of the burner shall not be possible if, during operation, there has been a break in the electrical supply circuits of the burner or if the most likely deterioration has occurred of any one component capable of causing a restart without locking-out of the safety device after a flame fault.

4.4 Resetting of lock-out conditions

Oil burner controllers shall be constructed so that a manual reset of the lock-out system (for example, a reset push-button) is necessary to effect re-starting after a stoppage causing lock-out of the control device. Automatic resetting shall not occur at the moment of re-establishing the electrical current following a break in the latter. When lock-out has resulted from electricity supply faults, automatic re-setting on the resumption of the supply shall not occur.

Blockage of the resetting device, for example locking of the reset push-button, shall not have dangerous consequences for the operation of the system.

4.5 Electricity supply faults

In the event of the mains supply failing or of an interruption of the electrical control circuit, for example by disappearance of the pilot burner flame and/or by action of limiters, the oil supply to the burner shall be cut off automatically. Re-starting on restoration of the mains supply or after re-connection of the electrical control circuit is subject to the same requirements as normal starting-up (see 4.2 for details of monitoring in respect of insensitivity to flame simulation and stray light).

This requirement need not be fulfilled by burners having a capacity of up to 30 kg/h oil throughput where the mains failure lasts less than 60 s and where this failure occurs during the actual starting-up operation. In this case, it is permissible to continue the starting-up operation from the point at which it was interrupted.

4.6 Monitoring of the atomizing medium (for example compressed air, steam) and of the combustion air

For burners using an atomizing medium, the oil supply shall be automatically cut off, at the latest on expiry of the safety time, if the atomizing medium supply is not present at the starting-up or is stopped during operation.

When the supply of combustion air is not present at starting-up or is stopped during operation, the oil supply shall be automatically cut off. This last requirement shall be deemed to be fulfilled when the oil pump is driven, via the fan, from one end of the motor shaft, or if the fan and the oil pump are positioned on either side of the motor and driven from opposite shaft ends, with direct coupling between the motor and the fan.

4.7 Control of the oil temperature

When the oil used requires pre-heating to permit atomization, a device shall be provided in order to prevent supply to the atomizing device until the oil has reached the temperature corresponding to the viscosity prescribed by the manufacturer for its use.

Means of relieving any excess pressure arising from the expansion of oil or from any other cause shall be provided.

The permitted range of viscosity for the supply of the oil to the burner and for good combustion shall be indicated in the manufacturer's operating instructions.

4.8 Ensuring the correct operating position of the oil burner

It shall not be possible to remove any components in the oil supply system of the burner without the use of a tool. If the oil burner is constructed in such a way that the burner can be swung out or extracted, these operations shall only be possible with the aid of tools and/or an automatic device which renders starting-up of the oil burner impossible in the extended or extracted position.

4.9 The various applicances or parts making up the burner and whose characteristics may affect safety shall be checked (motors, transformers, pumps, filters, atomizers, automatic valves, etc.) and form the subject of specific tests.

ANNEX A

EXAMPLE OF PROGRAMME FOR A BURNER NOT FITTED WITH A PILOT BURNER

Diagram of normal, fault-free start-up

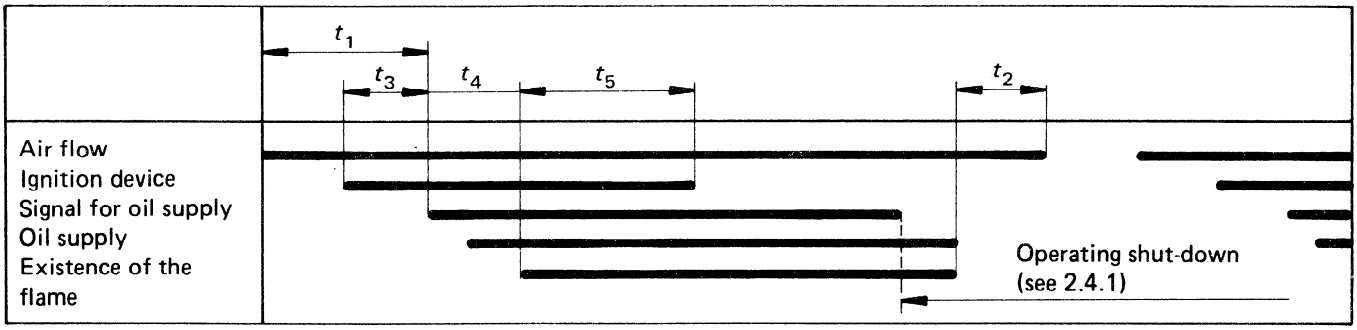


Diagram with flame fault shut-down at start-up

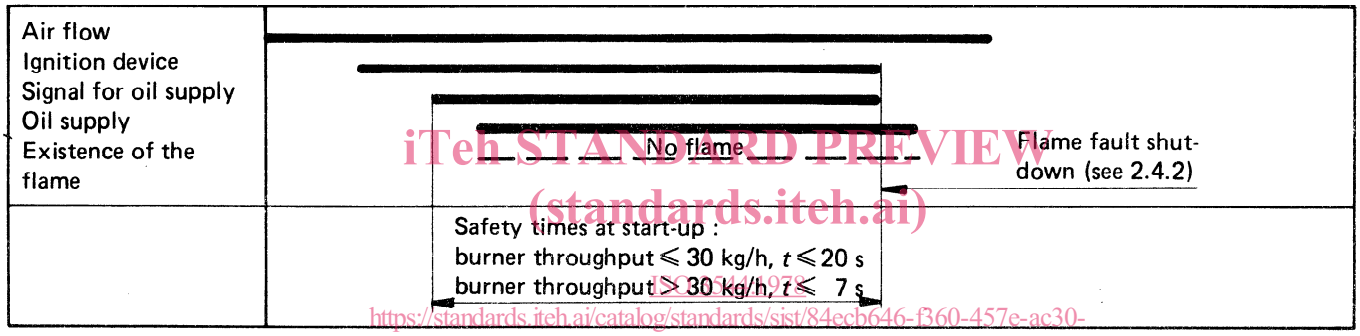
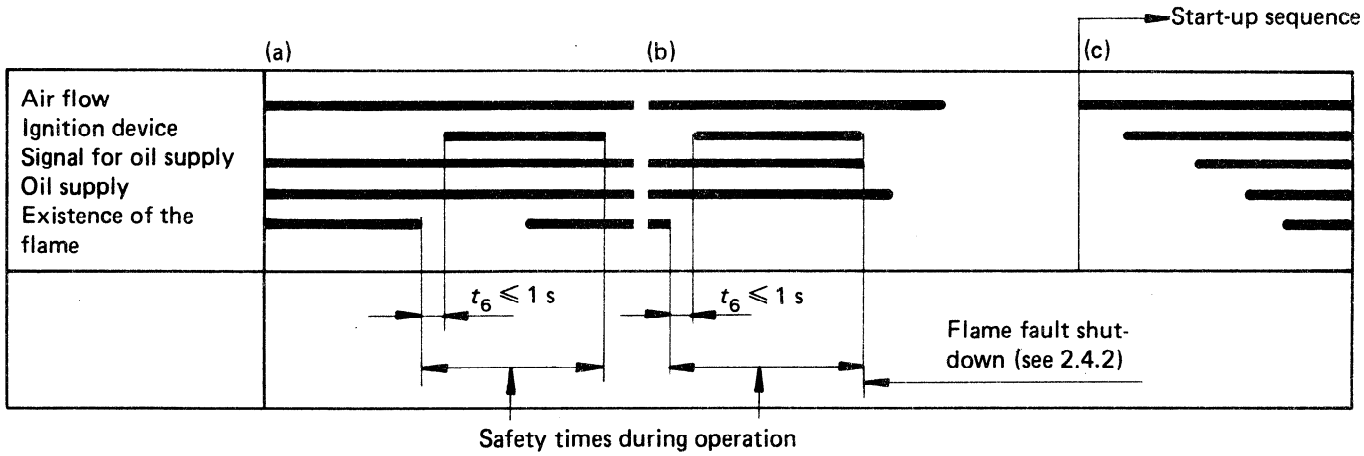


Diagram with flame extinction and automatic re-ignition, respectively (a) successful, (b) unsuccessful and (c) re-start after manual intervention



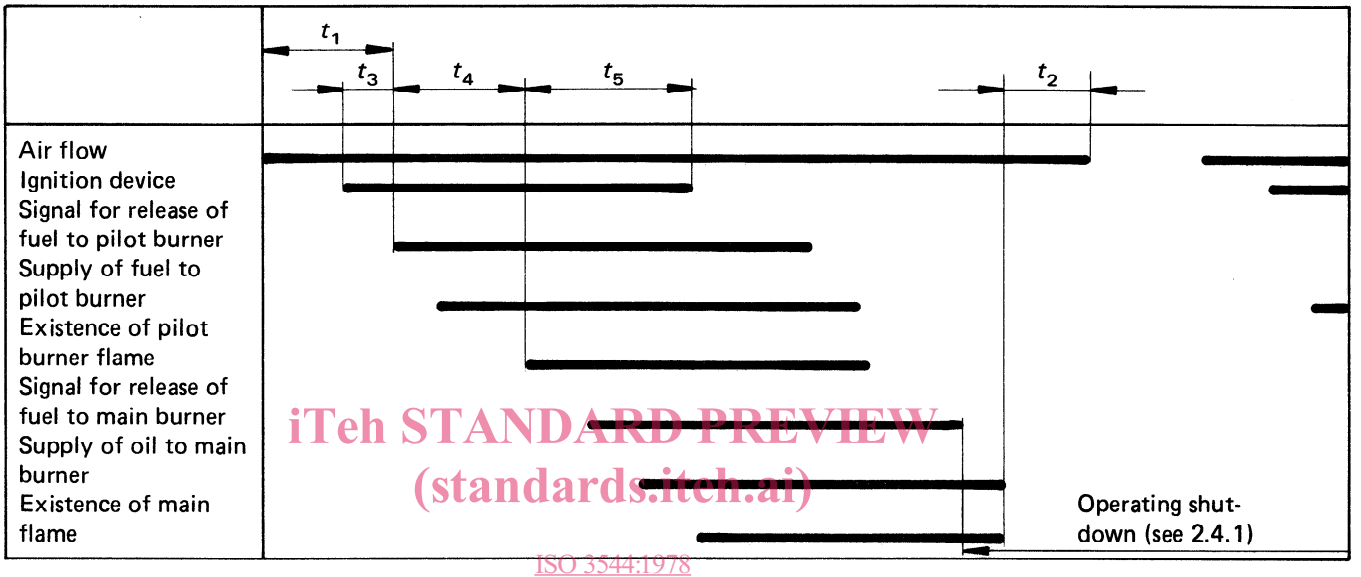
Key		Sub-clause
t_1	pre-purging time	2.5.4.1
t_2	post-purging time	2.5.4.2
$t_1 + t_2$	purging time	2.5.4
t_3	pre-ignition time	2.5.1.1
t_4	actual ignition time	2.5.1.2
t_5	post-ignition time	2.5.1.3
$t_3 + t_4 + t_5$	total ignition time	2.5.1
t_6	flame fault response time	4.1.1 b)

ANNEX B

EXAMPLE OF PROGRAMME FOR A BURNER WITH IGNITION BY PROVED PILOT BURNER

(see 3.5.2)

Normal diagram



Diagrams with safety shut-down at start-up

a) *Faulty pilot burner flame*