INTERNATIONAL STANDARD

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Medical gas pipeline systems —

Part 2: Anaesthetic gas scavenging disposal systems

Réseaux de distribution de gaz médicaux —

Partie 2: Systèmes d'évacuation de gaz d'anesthésie non réutilisables

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 7396 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 7396-2 was prepared by Technical Committee ISO/TC 121, *Anaesthetic and respiratory equipment*, Subcommittee SC 6, *Medical gas systems*.

ISO 7396 consists of the following parts, under the general title *Medical gas pipeline systems*:

— *Part 1: Pipelines for compressed medical gases and vacuum*

— *Part 2: Anaesthetic gas scavenging disposal systems*

Annexes A to E of this part of ISO 7396 are for information only.

NOTE Throughout this part of ISO 7396, a clause for which a rationale is provided in annex B is indicated by a boldface capital **R.**

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Introduction

This part of ISO 7396 specifies requirements for anaesthetic gas scavenging (AGS) disposal systems.

The anaesthetic gas scavenging system (AGSS) comprises three main parts: a transfer system, a receiving system and a disposal system. A schematic diagram of typical anaesthetic gas scavenging systems is shown in Figure 1. Requirements for receiving systems and transfer systems are specified in ISO 8835-3. Type-specific connections for terminal units are specified in ISO 9170-2. In this part of ISO 7396 specifications and test procedures are given to ensure compatibility between the components of the system.

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Medical gas pipeline systems —

Part 2:
Anaesthetic gas scavenging disposal systems

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1 Scope

This part of ISO 7396 specifies requirements for the installation, function, performance, documentation, testing and commissioning of anaesthetic gas scavenging disposal systems to ensure patient and operator safety. It includes requirements for the power device, pipeline system, performance and for non-interchangeability between key components.

This part of ISO 7396 specifies:

a) the compatibility between and safe performance of the disposal system and the other components of the AGSS by design, installation and commissioning;

b) the use of appropriate materials;

c) the testing for correct installation of the completed system to ensure achievement of the performance intended by the manufacturer;

d) the marking of pipeline and components.

NOTE In this part of ISO 7396, the term “pipeline” refers exclusively to pipelines that are part of a dedicated anaesthetic gas scavenging system.

This part of ISO 7396 is applicable only to those disposal systems which are intended to be connected via AGSS terminal units which comply with ISO 9170-2 to receiving systems which comply with ISO 8835-3.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 7936. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 7936 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 5359, *Low-pressure hose assemblies for use with medical gases.*

ISO 7396-1, *Medical gas pipeline systems — Part 1: Pipelines for compressed medical gases and vacuum.*

ISO 8835-3:1997, *Inhalational anaesthesia systems — Part 3: Anaesthetic gas scavenging systems — Transfer and receiving systems.*

ISO 9170-2, *Terminal units for medical gas pipeline systems — Part 2: Terminal units for anaesthetic gas scavenging systems.*

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ISO 14971, *Medical devices — Application of risk management to medical devices.*

ISO 15001, *Anaesthetic and respiratory equipment — Compatibility with oxygen.*

3 Terms and definitions

For the purposes of this part of ISO 7936, the following terms and definitions apply.

3.1
AGSS socket
that female part of a terminal unit which is either integral or attached to the base block by a type-specific interface, and which contains the type-specific connection point

3.2
AGSS terminal unit
inlet assembly in an AGS system at which the operator makes connections and disconnections

3.3
AGSS terminal unit base block
that part of an AGSS terminal unit which is attached to the pipeline disposal system

3.4
AGSS type 1 terminal unit
connection point between the receiving system and disposal system at which an operator makes connections and disconnections

3.5
AGSS type 1L terminal unit
terminal unit to be used in low-flow disposal systems

3.6
AGSS type 1H terminal unit
terminal unit to be used in high-flow disposal systems

3.7
AGSS type 2 terminal unit
connection point between the power device or the disposal hose and the remainder of the disposal system at which an operator makes connections and disconnections

3.8
AGSS type-specific
having characteristics which prevent interchangeability and thereby allow assignment to one AGSS type only

3.9
AGSS type-specific connection point
that part of the AGSS socket which is the receptor for an AGSS type-specific probe

3.10
air compressor system
source of supply with compressor(s) designed to provide air for breathing and/or air for driving surgical tools

3.11
anaesthetic gas scavenging system
AGSS
complete system which is connected to the exhaust port(s) of a breathing system or other equipment for the purpose of conveying expired and/or excess anaesthetic gases to an appropriate place of discharge

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NOTE Functionally, an AGSS comprises three different parts: a transfer system, a receiving system and a disposal system. These three functionally discrete parts may be either separate or sequentially combined in part or in total. In addition, one or more parts of an AGSS may be combined with a breathing system or other equipment .

3.12
commissioning
proof of function to verify that an agreed specification is met and is accepted by the user or the representative of the user

3.13
design capacity
total flow of an AGS disposal system taking into account the diversity factor, i.e. the number of AGSS terminal units which may be in use at the same time

3.14
disposal hose
that part of an AGSS which transfers expired and/or excess gases from the power device to the probe of an AGSS type 2 terminal unit

3.15
disposal system
means by which the expired and/or excess anaesthetic gases are conveyed from the receiving system to an appropriate place of discharge

NOTE A place of discharge may be, for example, the exterior of a building or a non-recirculating extract ventilation system.

3.16
high-flow disposal system
disposal system that generates extract flows not lower than 75 l/min from transfer and receiving systems complying with ISO 8835-3

3.17
low-flow disposal system
disposal system that generates extract flows not more than 50 l/min from transfer and receiving systems complying with ISO 8835-3

3.18
manufacturer
natural or legal person with responsibility for the design, manufacture, packaging and labelling of a device before it is placed on the market under his own name, regardless of whether these operations are carried out by that person himself or on his behalf by a third party

3.19
maximum operating pressure
maximum pressure at which a terminal unit is designed to operate

NOTE Operating pressure for a type 1 terminal unit is negative, and for a type 2 terminal unit it is positive.

3.20
maximum test pressure
maximum pressure to which a terminal unit is designed to be subjected during pipeline pressure testing

3.21
non-return valve
valve which permits flow in one direction only

3.22
placing on the market
making available for the first time, in return for payment or free of charge, a device other than a device intended for clinical investigation, with a view to distribution and/or use

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3.23
power device
that part of a disposal system of an AGSS which provides the gas flow for scavenging

3.24
probe
non-interchangeable male component designed for acceptance by, and retention in, a socket

3.25
quick-connector
pair of type-specific components which can be easily and rapidly joined together by a single action of one or both hands without the use of tools

3.26
receiving hose
that part of an AGSS which transfers expired and/or excess gases from the receiving system to the disposal system

3.27
receiving system
that part of an AGSS which provides an interface between the transfer system and the disposal system

3.28
shut-off valve, isolating valve
manual or automatic valve which prevents flow in both directions when closed

3.29
single fault condition
condition in which a single means for protection against a safety hazard in equipment is defective or a single external abnormal condition is present

3.30
terminal unit check valve
valve which remains closed until opened by insertion of an appropriate probe and which then permits flow in either direction

3.31
transfer system
that part of an AGSS which transfers expired and/or excess anaesthetic gases from the exhaust port of the breathing system to the receiving system

3.32
transfer tube
that part of an AGSS which transfers expired and/or excess gases from the breathing system to the receiving system

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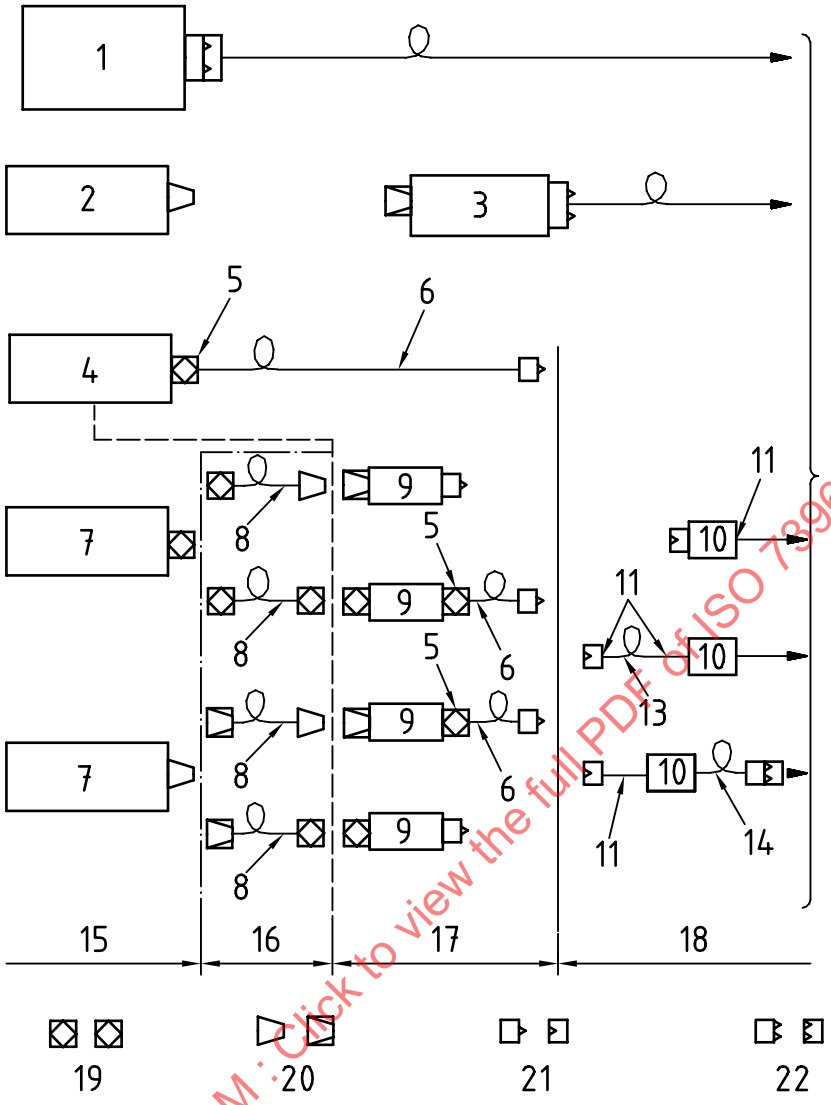

Key

1 Apparatus including breathing system and integral transfer/receiving system and power device
2 Apparatus including breathing system
3 Transfer/receiving system and power device
4 Apparatus including breathing system and integral transfer/receiving system
5 Permanent or proprietary connector
6 Receiving hose
7 Breathing system or anaesthetic ventilator
8 Transfer tube
9 Receiving system
10 Power device
11 Permanent connection
12 Discharge
13 Flexible hose or pendant
14 Disposal hose
15 Limit of breathing system
16 Limit of transfer system
17 Limit of receiving system
18 Limit of disposal system
19 Proprietary connection (functionally specific)
20 30 mm conical connection
21 Type 1 terminal unit probe/socket
22 Type 2 terminal unit probe/socket

NOTE 1 Type 1 terminal unit probe/socket is for negative pressure. Type 2 terminal unit probe/socket is for positive pressure.

NOTE 2 The limit between the receiving system and the disposal system as shown may not coincide with an actual physical limit such as a wall.

Figure 1 — Schematic diagram of typical AGSS connections

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4 General requirements

4.1 Safety

AGS disposal systems shall, when installed, commissioned, operated in normal use and maintained according to the instructions of the manufacturer, cause no safety hazard which could be foreseen using risk analysis procedures in accordance with ISO 14971 and which is connected with their intended application, in normal condition and in single fault condition.

4.2 R Alternative construction

AGS disposal system installations and components or parts thereof, using materials or having forms of construction different from those detailed in this part of ISO 7396, shall be accepted if it can be demonstrated that an equivalent degree of safety is obtained.

Such evidence shall be provided by the manufacturer.

4.3 Materials

4.3.1 The materials used for pipelines and other components of the disposal system shall be corrosion resistant and compatible with anaesthetic gases and vapours under the operating conditions specified by the manufacturer.

Evidence shall be provided by the manufacturer.

4.3.2 R If copper pipes are used, they shall comply with the requirements for copper tubing for pipelines given in ISO 7396-1.

NOTE The requirement in 4.3.2 allows the use of the same stock of copper pipes as is used for the installation of pipeline systems for compressed medical gases and vacuum in accordance with ISO 7396-1.

Evidence shall be provided by the manufacturer.

4.3.3 R All components of the system which come in contact with anaesthetic gases and vapours shall be cleaned in accordance with ISO 15001.

4.3.4 R If lubricants are used, they shall be compatible with anaesthetic gases and vapours at the operating conditions.

Evidence shall be provided by the manufacturer.

4.3.5 All precautions shall be taken to maintain cleanliness during transportation, storage and installation.

5 Power device

5.1 The power device shall be used solely to power the AGS disposal system.

5.2 The power device shall be one of the following:

a) an exhaust ejector, for each type 1 terminal unit, driven by compressed air from an air compressor system and a pipeline system complying with ISO 7396-1, provided with a means of adjusting the flow from the receiving system through the type 1 terminal unit to meet the requirements specified in 8.1 a) or b); see Figure 2a);

b) an exhaust ejector for each type 2 terminal unit, driven by compressed air from an air compressor system and a pipeline system complying with ISO 7396-1, provided with a means of adjusting the flow from the receiving system to meet the requirements specified in 8.1 c); see Figure 2b);

c) one or more fans, blowers or dedicated vacuum pumps, provided with means of adjusting and controlling the vacuum level in the pipeline system and therefore the flow through each type 1 terminal unit within the limits specified in 8.1 a) or b), regardless of the number of terminal units in use; see Figure 2 c).

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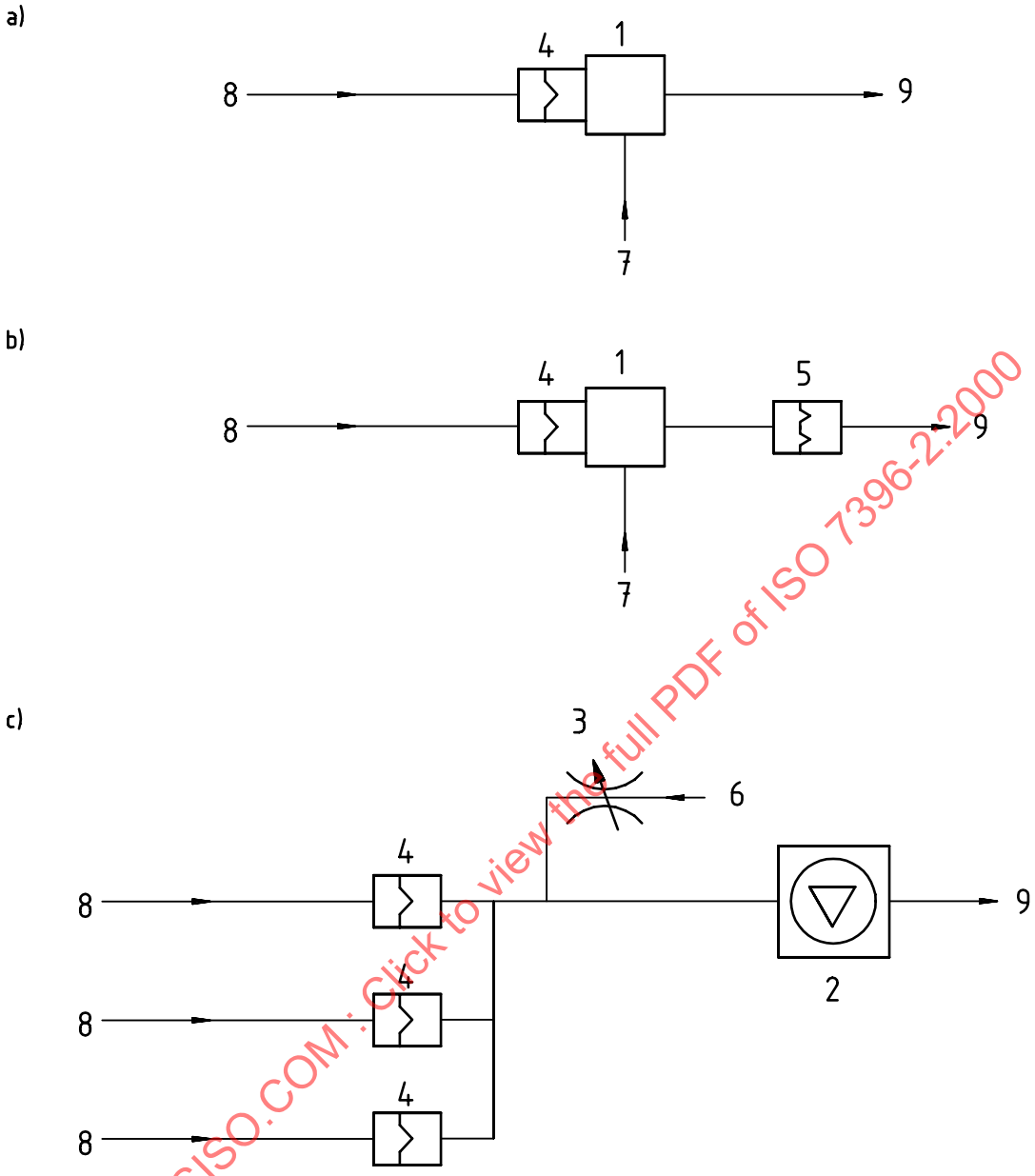

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Key

1	Compressed-air-driven power device	6	Ambient air
2	Vacuum pump/fan/blower power device	7	Compressed medical air
3	Flow regulating valve	8	Receiving system
4	Type 1 terminal unit	9	Discharge
5	Type 2 terminal unit		

Figure 2 — Typical examples of power devices

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6 Indicating systems

Means shall be provided to indicate to the operator that the power device is operating.

7 Pipelines, connecting assemblies and disposal hoses

7.1 If the connecting assemblies or disposal hoses are readily accessible to the operator, the connecting assembly or the disposal hoses shall be type-specific and the dimensions of its connectors shall not comply with ISO 5359.

NOTE Examples of assemblies and hoses readily accessible to the operator are those in a ceiling flexible pendant or a rigid ceiling column with access panels.

7.2 If the connecting assemblies or disposal hoses are not readily accessible to the operator without significant disassembly of fixed equipment, the connectors of the assembly need not be type-specific.

NOTE Examples of assemblies and hoses not readily accessible to the operator are those in hinged-arm booms, tracks and pendants.

7.3 If the connecting assemblies are not normally replaced during their life, the assembly need not be type-specific.

NOTE Examples of such assemblies are those used for isolation of vibration, building movement and relative movement of the pipelines.

7.4 Means shall be provided to prevent backflow of waste gas to terminal units.

NOTE This may be achieved by, for example, individual piping or non-return valves.

8 Disposal system characteristics

8.1 Requirements

The characteristics of the AGS disposal system shall be as follows.

a) The flowrate through each type 1L terminal unit or, if not provided, at the interface point upstream of the power device (see Figure 1) shall not exceed 50 l/min when the resistance to flow which is provided to simulate the resistance of the receiving system is such as to produce a pressure drop of 1 kPa at 50 l/min, and shall not be lower than 25 l/min when the resistance to flow is such as to produce a pressure drop of 2 kPa at 25 l/min (see also ISO 8835-3:1997, subclause 9.3). The results shall be recorded on a form such as Form C.6/1 (see annex C).

   The test method for compliance is given in 8.2.

b) The flowrate through each type 1H terminal unit or, if not provided, at the interface point upstream of the power device (see Figure 1) shall be (75^{+5}_{0}) l/min when the resistance of the receiving system is such as to produce a pressure drop of 2 kPa at 75 l/min (see also ISO 8835-3:1997, subclause 9.4). The results shall be recorded on Form C.6/1 (see annex C).

   The test method for compliance is given in 8.2.

c) With a flowrate of 50 l/min through the socket of each type 2 terminal unit, if provided, the pressure drop shall not exceed 7,5 kPa.

The test method for compliance is given in 8.2. The results shall be recorded on a form such as Form C.6/2 (see annex C).

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8.2 Test method for flowrate and pressure drop

8.2.1 General

8.2.1.1 All flow control valves (if fitted) shall be adjusted for the purpose of controlling the flow at each terminal unit. Each terminal unit on the system shall be tested as follows:

a) with only the terminal unit under test in use;

b) for systems with more than one terminal unit, with all terminal units in use which are specified to operate at the same time.

8.2.1.2 Testing shall be performed using ambient air.

8.2.1.3 The resolution of all pressure measuring devices shall be at most 10 % of the specified values to be measured.

8.2.2 Test methods for disposal systems fitted with type 1 terminal units

8.2.2.1 Test devices

8.2.2.1.1 In order to simulate the resistance to flow of a low-flow receiving system complying with ISO 8835-3, test devices which are fitted with type 1L probes and produce a pressure drop of 1 kPa at a flowrate of 50 l/min (test device 1/50) and 2 kPa at a flowrate of 25 l/min (test device 2/25) shall be used. Typical test devices are shown in Figure 3.

8.2.2.1.2 In order to simulate the resistance to flow of a high-flow receiving system complying with ISO 8835-3, a test device which is fitted with a type 1H probe and produces a pressure drop of 2 kPa at a flowrate of 75 l/min (test device 2/75) shall be used. Typical test devices are shown in Figure 3.

8.2.2.2 Procedure

8.2.2.2.1 If the test devices are not precalibrated, the flowrate and the pressure drop of each test device shall be checked to make sure that they are in accordance with the specified values (1 kPa at 50 l/min and 2 kPa at 25 l/min or 2 kPa at 75 l/min) when connected to a suitable source of suction.

8.2.2.2.2 The power device on the AGS disposal system to be tested shall be activated.

8.2.2.2.3 The test device fitted with type 1L probe which produces 1 kPa at 50 l/min shall be inserted into each type 1L terminal unit in turn with all the other terminal units closed. The flowrate on the test device at each terminal unit shall be recorded.

8.2.2.2.4 The test device fitted with type 1L probe which produces 2 kPa at 25 l/min shall be inserted into each type 1L terminal unit in turn with all the other terminal units closed. The flowrate on the test device at each terminal unit shall be recorded.

8.2.2.2.5 Test devices fitted with type 1L probes which produce 1 kPa at 50 l/min shall be inserted into each of several type 1L terminal units up to the design capacity of the AGS low-flow disposal system with all the other terminal units closed. The flowrate on each test device shall be recorded at the same time.

8.2.2.2.6 A test device fitted with type 1L probes which produce 2 kPa at 25 l/min shall be inserted into each of several type 1L terminal units up to the design capacity of the AGS low-flow disposal system with all the other terminal units closed. The flowrate on each test device shall be recorded at the same time.

8.2.2.2.7 The test device fitted with a type 1H probe which produces 2 kPa at 75 l/min shall be inserted into each type 1H terminal unit in turn with all the other terminal units closed. The flowrate on the test device at each terminal unit shall be recorded.

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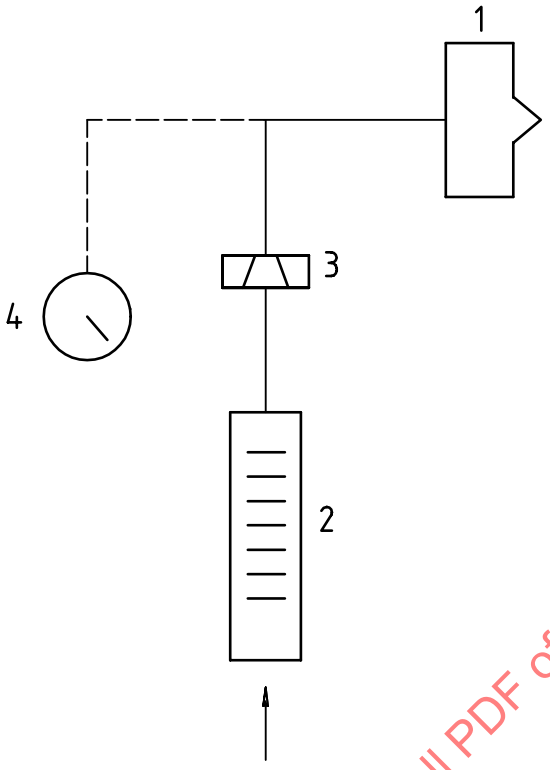

Key

1	Type 1 probe	3	Fixed orifice
2	Flowmeter	4	Pressure measuring device (for calibration only)

Figure 3 — Typical test device for AGS disposal system characteristics (with type 1 terminal units)

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8.2.2.2.8 Test devices fitted with type 1H probe which produce 2 kPa at 75 l/min shall be inserted into each of several type 1H terminal units up to the design capacity of the AGS high-flow disposal system with all other terminal units closed. The flowrate on each test device shall be recorded at the same time. Each flowrate shall be $(75\,^{+5}_{0})$ l/min. The results shall be recorded on a form such as Form C.6/1 (see annex C).

8.2.3 Test method for disposal systems fitted with type 2 terminal units

8.2.3.1 Test devices

Test devices fitted with a type 2 probe and providing flowrates up to 50 l/min shall be used.

8.2.3.2 Procedure

8.2.3.2.1 The power device on the AGS disposal system to be tested shall be activated.

8.2.3.2.2 The test device shall be inserted into each terminal unit in turn with all the other terminal units closed. The flowrate shall be adjusted to (50 ± 5) l/min. The pressure shall be recorded at the inlet to the terminal unit.

8.2.3.2.3 A test device shall be inserted into each of several terminal units up to the design capacity of the AGS disposal system with all the other terminal units closed. Each flowrate shall be adjusted to (50 ± 5) l/min. The pressure at the inlet to each terminal unit shall be recorded. The results shall be recorded on a form such as Form C.6/2 (see annex C).

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9 Terminal units

Terminal units shall comply with ISO 9170-2.

10 Marking

10.1 Pipelines shall be marked “AGSS” or national equivalent and shall have arrows denoting the direction of flow adjacent to valves, if fitted, at junctions and changes of direction, before and after walls and partitions, etc. at intervals of no more than 10 m and adjacent to terminal units.

10.2 Connecting assemblies and disposal hoses shall be marked “AGSS” or national equivalent.

10.3 Marking shall be:

a) durable;

b) with letters not less than 6 mm high for the pipelines and not less than 2,5 mm high for connecting assemblies and disposal hoses.

10.4 If colour coding is used, it shall be red magenta or in accordance with the national standard.

NOTE An example of red magenta is 3050-R40B in accordance with SS 01 91 02.

10.5 Colour coding shall be durable.

10.6 The test for durability of marking and colour coding is given in 12.4.10.

11 Pipeline installation

11.1 Pipelines and electrical services shall be either

a) run in separate compartments; or

b) separated by more than 50 mm.

11.2 The pipelines, if metallic, shall be bonded to an earth terminal as near as possible to the point at which the pipeline enters the building. The pipelines shall not be used for earthing the electrical equipment. The relevant parts of national regulations for electrical installations in buildings shall apply.

11.3 Pipelines shall be protected from physical damage.

EXAMPLES Damage which might be sustained from the movement of portable equipment such as trolleys, stretchers and trucks in corridors and other locations.

11.4 Unprotected pipelines shall not be installed in areas of special hazard. If installation of pipelines in such a location is unavoidable, the pipeline shall be protected by an enclosure which will prevent the liberation of anaesthetic gas within the room should leaks occur in the pipeline system installed in the area.

Attention is drawn to national building requirements and fire regulations.

EXAMPLE An area where flammable materials are stored is an example of an area of special hazard.

11.5 If pipelines are placed in the same tunnel, trench or duct with fuel pipelines, steam lines or other services, they shall be separated by more than 50 mm. Ducts in which pipelines are installed shall be ventilated.

11.6 Pipelines shall not be installed in elevator shafts.

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11.7 Damage due to contact with corrosive materials shall be prevented.

11.8 Allowances shall be made for expansion and contraction of pipelines.

11.9 Means shall be provided to remove condensation from the system.

11.10 Pipelines shall be supported at intervals to prevent sagging or distortion.

Recommended intervals for rigid metallic pipes are given in Table 1.

Table 1 — Recommended intervals between supports for rigid metallic pipes

Outside diameter mm	Maximum intervals between supports[a] m
⩽ 15	1,5
22 to 28	2,0
35 to 54	2,5
Greater than 54	3,0
[a] Shorter intervals may be required when using rigid non-metallic pipes.	

The supports shall ensure that the pipeline cannot be displaced accidentally from its position.

The supports shall either be of corrosion-resistant material, or shall be treated to prevent corrosion. Means shall be provided to prevent electrolytic corrosion.

Where pipelines cross electric cables, the pipes shall be supported adjacent to the cables.

Pipelines shall not be used as support for, nor shall they be supported by, other pipelines or conduits.

11.11 Except for threaded or special joints used in valves, terminal units and where plastic materials are used, all pipeline joints shall be brazed or welded. The methods used for brazing or welding shall permit the joints to maintain their mechanical characteristics up to an ambient temperature of 450 °C.

11.12 The exhaust from the disposal system shall be piped to the outside or into the exhaust conduit of a non-recirculating ventilation system and shall be provided with a means to prevent the ingress of insects, debris and precipitation.

The exhaust shall be located remote from any air intakes, doors, windows or other openings in buildings.

Consideration should be given to the potential effects of prevailing winds when considering the location of the exhaust.

12 Testing, commissioning and certification

NOTE The aim of testing and commissioning of AGS disposal systems is to verify that all safety aspects and performance requirements of the systems are met.

12.1 General

An example of a procedure and test method for testing and commissioning is given in annex B. Tests after completion of installation should be carried out by the manufacturer and witnessed by an authorized person

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qualified in the testing of medical gas pipeline systems, who should certify the results of the tests to the owner or client. The authorization may be given within a certified quality system complying with ISO 9001.

The results of tests showing details of the services and areas tested should be part of the permanent record of the healthcare facility.

12.2 General requirements for tests

12.2.1 Testing shall be carried out with ambient air.

12.2.2 Before any testing is carried out, every terminal unit in a system under test shall be labelled to indicate that the system is under test and shall not be used.

12.2.3 The resolution of all pressure measuring devices shall be at most 10 % of the specified values to be measured.

12.3 Tests to be carried out

12.3.1 Tests and procedures after complete installation and before use of the system

The following tests and procedures shall be carried out:

a) inspection and tests for leakage;

b) inspection for marking and support intervals of the pipeline systems;

c) check of mechanical function and inspection for cleanliness of the terminal units;

d) inspection for cross-connection;

e) functional tests of power devices;

f) tests of flow and pressure drop;

g) check of the indicating system;

h) verification of the AGS disposal system exhaust;

i) check of identification and labelling of the terminal units.

12.4 Requirements for tests listed in 12.3.1

12.4.1 Leakage

12.4.1.1 Pipelines downstream of the power device shall be visually inspected for the integrity of all connections.

12.4.1.2 Pipelines between a type 1 terminal unit and a power device shall be tested at a pressure of 70 kPa ± 10 %. The pressure drop in these sections, after a test period of 15 min, shall be less than 10 kPa with the terminal units blanked off.

12.4.2 Marking and support intervals of the pipeline systems

The marking of the pipeline system shall meet the requirements of clause 10 and the support intervals shall meet the requirements of 11.10.

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12.4.3 Mechanical function and inspection for cleanliness of terminal units

It shall be demonstrated for each terminal unit that the appropriate probe can be inserted, captured and released. All terminal units shall be inspected for the absence of visible particulate matter.

12.4.4 Cross-connections

There shall be no cross-connection to any other pipeline system.

12.4.5 Function of power devices

All power devices shall operate according to the manufacturers' manuals and specifications.

12.4.6 Flowrate and pressure drop

It shall be demonstrated that the flowrate and pressure drop at each terminal unit are in accordance with clause 8 when the AGS disposal system is operating at the design flow.

12.4.7 Indicating systems

The indicating system shall comply with clause 6.

12.4.8 Disposal system exhaust

The exhaust from the disposal system shall comply with 11.12.

12.4.9 Identification and labelling of the terminal units

On satisfactory completion of the tests and procedures described in 12.4.1 to 12.4.8, the labels indicating that the system is under test shall be removed. At the same time, the correct identification and labelling of each terminal unit shall be checked.

12.4.10 Durability of markings and colour coding

Rub markings and colour coding by hand, without undue pressure, first for 15 s with a cloth rag soaked with distilled water, then for 15 s with a cloth rag soaked with ethanol, and then for 15 s with a cloth rag soaked with isopropanol. Carry out this test at ambient temperature. The markings shall remain legible.

12.5 Certification of the system

12.5.1 Before an AGS disposal system is used, it shall be certified in writing that all the requirements of 12.4 have been met.

12.5.2 The manufacturer shall certify that all drawings and manuals, as specified in clause 13 have been supplied to the owner or client.

12.6 Extensions or modifications

When extensions or modifications are made to the system, the appropriate tests in 12.3.1 shall be carried out before the system is returned to service.

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13 Information to be supplied by the manufacturer

13.1 Instructions for use

The manufacturer shall provide to the owner instructions for use of the complete system.

Particular attention shall be paid to:

— the power device;

— the indicating system;

— the danger of fire or explosion due to the use of oil and grease in oxygen-enriched atmospheres.

13.2 Maintenance schedules

The manufacturer shall provide to the owner instructions for recommended maintenance tasks and their frequency and a list of recommended spare parts.

13.3 “As-installed” drawings

13.3.1 A set of “as-installed” mechanical drawings which show the actual location and the diameters of the pipeline systems shall be maintained during construction, and shall be brought up to date as variations are made. These drawings shall include details which will enable buried or concealed pipelines to be located.

13.3.2 Complete “as-installed” drawings as specified as in 13.3.1 shall be supplied to the owner of the pipeline system as a set of drawings, marked “as installed”, for inclusion as part of the permanent record of the pipeline system.

If a pipeline system is altered subsequent to the transfer of the drawings to the owner, then the “as-installed” drawings specified in 13.3.2 should be brought up to date.

13.4 Electrical diagrams

Electrical diagrams for the complete installation shall be provided by the manufacturer to the owner.

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Annex A
(informative)

Guidelines for power devices

A.1 Only nominated persons should be authorized to operate and attend the plant.

A.2 Services containing combustible gases or liquids should not be permitted within the power device area.

A.3 Any heating system may be used to heat the power device room, provided that no part of the heating system which is in contact with the air within the room exceeds a temperature of 225 °C.

A.4 All electrical fittings in power device rooms should be located in fixed positions to minimize the risk of physical damage.

A.5 Fire fighting equipment should be provided.

A.6 The room should be well ventilated to the open air, and ducting for such ventilation should not be connected to ducting servicing any other building.

A.7 The doors or gate should be capable of being locked. An emergency exit should be provided which should be free from obstructions at all times. At any time all doors should be capable of being opened from the inside without a key. All doors should open outwards.

A.8 Power device rooms should

a) comply with local building codes;

b) have concrete floors;

c) have a warning notice “NO SMOKING”, or similar, clearly displayed on both sides of each door or gate.

A.9 The inlet of an air compressor should be located in a position where there is minimal contamination from internal combustion engine exhaust, vacuum systems, anaesthetic gas scavenging systems, ventilation system discharge and other contaminants. The air intake should be provided with means to prevent the ingress of insects.

A.10 The exhaust from fans, blowers or vacuum pumps should be piped to the outside and should be provided with a means to prevent the ingress of insects. It should be in a position where risk of contamination of occupied buildings is minimized.

A.11 Clauses A.1 to A.10 apply to power devices which are centrally located. Power devices that are not centrally located and may or may not be connected to a pipeline system should be installed and serviced in accordance with the instructions supplied by the manufacturer.

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Annex B
(informative)

Example of procedure for testing and commissioning

B.1 General

This testing procedure is given as an example of how the requirements of clause 12 may be verified so that the system may be commissioned and certified. Other procedures may be devised which validly test this specification. If this procedure is used, it is important that the given sequence of tests be followed and the procedures for each test be carefully observed. The general requirements of 12.2 shall be followed.

Typical forms for certification of the system are given in annex C. A summary of the required tests which lists the specification, procedure and report form for each test is given in Table B.1.

B.2 Inspection and test method for leakage

B.2.1 Inspection

Visually inspect the exhaust pipeline system for the integrity of all connections.

B.2.2 Test methods for leakage

B.2.2.1 General conditions

Fit all terminal units and valves. Isolate the power device from the pipeline. Open the valves and blank off the type 1 terminal units.

B.2.2.2 Procedure

Connect a suitable pressure measuring device to the system under test. Fill the system with clean, oil-free, dry compressed gas at a pressure of 70 kPa ± 10 %. Record the pressure and, after a period of 15 min, record the pressure again. The pressure drop shall not exceed 10 kPa.

NOTE There is no allowance for temperature variation in this test.

B.2.2.3 Results

Record the results on a form such as Form C.1.

B.3 Inspection for marking and support intervals of the pipeline system

B.3.1 Procedure

Visually inspect that marking has been correctly placed on the pipeline system, especially adjacent to T-connections and where the pipeline system passes through walls or partitions. Check that the marking complies with clause 10 and that the support intervals comply with 11.10.

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B.3.2 Results

Record the results on a form such as Form C.2.

B.4 Test method for mechanical function and cleanliness of terminal units

B.4.1 Procedure

B.4.1.1 Inspect the test probes to ensure they conform with ISO 9170-2**.** Insert a test probe into each terminal unit in turn. Check that the probe can be inserted, captured and released.

B.4.1.2 Check each terminal unit for the absence of visible particulate matter.

B.4.2 Results

Record the results on a form such as Form C.3.

B.5 Inspection for cross-connection

B.5.1 Procedure

Visually inspect the pipeline system of the AGS disposal system for cross-connection to any other pipeline system.

B.5.2 Results

Record the results on a form such as Form C.4.

B.6 Test method for function of power devices

B.6.1 Procedure

Test all power devices for operation according to the manufacturers' manuals and specifications.

B.6.2 Results

Record the results on a form such as Form C.5.

B.7 Test methods for flowrate and pressure drop

B.7.1 Procedures

Procedures for testing for flowrate and pressure drop are given in 8.2**.**

B.7.2 Results

Record the results on forms such as Forms C.6/1 and C.6/2.

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B.8 Check of indicating systems

B.8.1 Procedure

Check that the means provided to indicate to the operator that the power device is operating is functioning.

B.8.2 Results

Record the results on a form such as Form C.7.

B.9 Verificiation of AGS disposal system exhaust

B.9.1 Procedure

Verify that the exhaust from the AGS disposal system

— is piped either to the outside or into the exhaust conduit of a non-recirculating ventilation system;

— is provided with a means to prevent the ingress of insects; and

— that the exhaust is in a position where the risk of contamination of occupied buildings is minimized.

B.9.2 Results

Record the results on a form such as Form C.8.

B.10 Check of identification and labelling of the terminal units

B.10.1 Procedure

Check that the tests in B.2 to B.9 have been completed satisfactorily.

Remove the label on each terminal unit which indicates that the system is not to be used. Do not remove these labels unless all preceding tests have been completed satisfactorily. At the same time, check the correct identification and labelling of each terminal unit.

B.10.2 Results

Record the results on a form such as Form C.9.

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B.11 Summary of tests

Table B.1 lists the tests to be applied to AGS disposal systems and gives the recommended test procedure and form for recording the results of each test.

Table B.1 — Summary of tests

Test	Description	Specification subclause	Procedure subclause	Form
	Summary of tests done			C.0
1	Leakage	12.4.1	B.2	C.1
2	Marking and support intervals	12.4.2	B.3	C.2
3	Mechanical function and cleanliness	12.4.3	B.4	C.3
4	Cross-connection	12.4.4	B.5	C.4
5	Power devices	12.4.5	B.6	C.5
6	Flowrate and pressure drop — for type 1 terminal units — for type 2 terminal units	 12.4.6 12.4.6	 8.2.2 8.2.3	 C.6/1 C.6/2
7	Indicating systems	12.4.7	B.8	C.7
8	Disposal system exhaust	12.4.8	B.9	C.8
9	Identification and labelling of terminal units	12.4.9	B.10	C.9

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Annex C
(informative)

Typical forms for use in testing and commissioning of AGS disposal systems in accordance with annex B

Anaesthetic gas scavenging disposal system

Form C.0 (Sheet of)

Summary of tests

This is to certify that the following tests and procedures have been carried out satisfactorily on the anaesthetic gas scavenging disposal system at ..... healthcare facility.

Test No.	Description	Form	Test completed on _____ (date)
1	Leakage	C.1	
2	Marking and support intervals	C.2	
3	Mechanical function and cleanliness	C.3	
4	Cross-connection	C.4	
5	Power devices	C.5	
6	Flowrate and pressure drop — for type 1 terminal units — for type 2 terminal units	 C.6/1 C.6/2	
7	Indicating system	C.7	
8	Disposal system exhaust	C.8	
9	Identification and labelling of terminal units	C.9	
	Construction labels removed	C.9	

Manufacturer's representative

Status_____ Signed_____

Date _____ Name_____

Healthcare facility representative

Status_____ Signed_____

Date _____ Name_____

Authorized person

Status_____ Signed_____

Date _____ Name_____

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Anaesthetic gas scavenging disposal system

Form C.1 (Sheet of)

Healthcare facility _____

Scheme _____

Test for leakage

This is to certify that the pipeline system was tested for leakage and meets the requirements of 12.4.1. At a test pressure of 70 kPa the pressure drop after 15 min was ..... kPa (maximum permitted 10 kPa).

Manufacturer's representative

Status _____ Signed _____

Date _____ Name _____

Healthcare facility representative

Status _____ Signed _____

Date _____ Name _____

Authorized person

Status _____ Signed _____

Date _____ Name _____

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Anaesthetic gas scavenging disposal system

Form C.2 (Sheet of)

Healthcare facility _____

Scheme_____

Inspection for marking and support intervals of the pipeline system

This is to certify that the pipeline system was inspected for marking and support intervals and meets the requirements of 12.4.2.

Manufacturer's representative

Status_____ Signed_____

Date _____ Name_____

Healthcare facility representative

Status_____ Signed_____

Date _____ Name_____

Authorized person

Status_____ Signed_____

Date _____ Name_____

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Anaesthetic gas scavenging disposal system

Form C.3 (Sheet of)

Healthcare facility _____

Scheme _____

Test of mechanical function and inspection for cleanliness of terminal units

This is certify that all terminal units were checked for mechanical function and inspected for cleanliness and meet the requirements of 12.4.3.

Manufacturer's representative

Status _____ Signed _____

Date _____ Name _____

Healthcare facility representative

Status _____ Signed _____

Date _____ Name _____

Authorized person

Status _____ Signed _____

Date _____ Name _____

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Anaesthetic gas scavenging disposal system

Form C.4 (Sheet of)

Healthcare facility _____

Scheme_____

Inspection for cross-connection

This is to certify that the pipeline system was inspected for cross-connection to any other pipeline system and meets the requirements of 12.4.4.

Manufacturer's representative

Status_____ Signed_____

Date _____ Name_____

Healthcare facility representative

Status_____ Signed_____

Date _____ Name_____

Authorized person

Status_____ Signed_____

Date _____ Name_____

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Anaesthetic gas scavenging disposal system

Form C.5 (Sheet of)

Healthcare facility _____

Scheme _____

Functional tests of power devices

This is to certify that all power devices have been tested in accordance with the manufacturer's manuals and specifications and meet the requirements of 12.4.5.

Manufacturer's representative

Status _____ Signed _____

Date _____ Name _____

Healthcare facility representative

Status _____ Signed _____

Date _____ Name _____

Authorized person

Status _____ Signed _____

Date _____ Name _____

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Anaesthetic gas scavenging disposal system

Form C.6/1 (Sheet of)

Healthcare facility _____

Scheme_____

Tests of flow and pressure drop for type 1L terminal units

This is to certify that the type 1L terminal units were tested in accordance with 8.2 (with test device 1/50, pressure drop 1 kPa, maximum flowrate 50 l/min; with test device 2/25 pressure drop 2 kPa minimum flowrate 25 l/min) and meet the requirements of 12.4.6.

One terminal unit in use				**... terminal units in use** [1)]			
Terminal unit number	Room number	Flowrate measured		Terminal unit number	Room number	Flowrate measured	
		Test device 1/50	Test device 2/25			Test device 1/50	Test device 2/25

1) Number to correspond to design capacity of the system.

OR

Test for flowrate and pressure drop for type 1H terminal units

This is to certify that type 1H terminal units were tested in accordance with 8.2 (with test device 2/75, pressure drop 2 kPa, minimum flowrate (75^{+5}_{0}) l/min and meet the requirements of 12.4.6.

One terminal unit in use			**... terminal units in use** [1)]		
Terminal unit number	Room number	Flowrate measured	Terminal unit number	Room number	Flowrate measured

1) Number to correspond to the design capacity of the system.

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Manufacturer's representative

Status _____ Signed _____

Date _____ Name _____

Healthcare facility representative

Status _____ Signed _____

Date _____ Name _____

Authorized person

Status _____ Signed _____

Date _____ Name _____

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Anaesthetic gas scavenging disposal system

Form C.6/2 (Sheet of)

Healthcare facility _____

Scheme_____

Tests of flow and pressure drop for type 2 terminal units

This is to certify that the type 2 terminal units were tested in accordance with 8.2.3 (test flowrate 50 l/min, maximum pressure drop 7,5 kPa) and meet the requirements of 12.4.6.

One terminal unit in use			**... terminal units in use**[1)]		
Terminal unit number	Room number	Pressure drop	Terminal unit number	Room number	Pressure drop

[1)] Number to correspond to design capacity of the system.

Manufacturer's representative

Status_____ Signed_____

Date _____ Name_____

Healthcare facility representative

Status_____ Signed_____

Date _____ Name_____

Authorized person

Status_____ Signed_____

Date _____ Name_____

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