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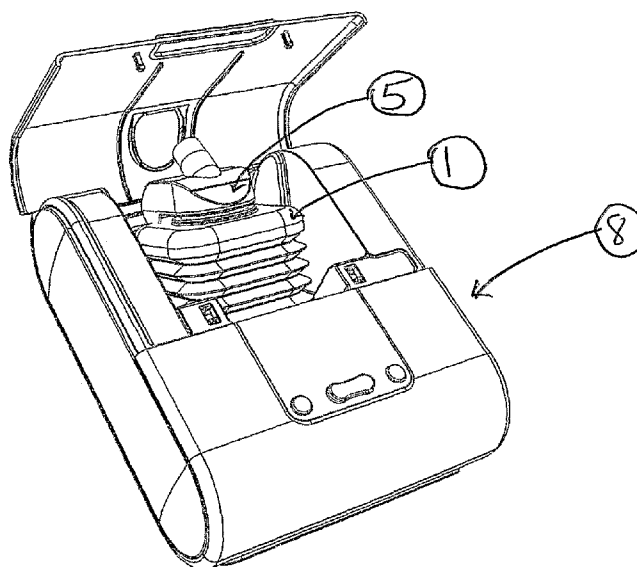
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(54) Title: HUMIDIFICATION VESSEL



(57) Abstract: The present invention provides a vessel for humidifying the delivered air of a gas-delivery system for positive airway pressure delivery. The vessel incorporates at least one extendable wall for changing the volume of the vessel and an aperture for forming a gas pathway with the gas-delivery system. The at least one extendable wall may incorporate folds for deforming and extending the walls. The vessel may be made from plastic material that is lightweight and transmits light for easy determination of the water level. The invention includes a method for inserting a collapsible humidification vessel into a gas-delivery system. The invention further includes a method of providing humidified air in a gas-delivery system.

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**Title**

Humidification Vessel

**Field of the Invention**

- 5 The present invention relates to water vessels for humidifying gases, in particular air delivered with pressurised air delivery devices, and more particularly, in air delivery devices for supplying pressurised air for treatment of breathing disorders.

**Background**

- 10 A proportion of the population suffers from sleep disordered breathing (SDB) such as sleep apnoea (SA), which has many potentially serious health consequences if not treated. A number of products can be found which are used to treat SA by delivering pressurised air to the nose and airways of a sufferer. Delivering air to the airways of an SA sufferer with a gas-delivery system can be very beneficial to maintain  
15 appropriate respiration and to maintain good health. However, the air must be suitably humidified to optimise comfort and sleep for a patient to enjoy relatively long uninterrupted periods of sleep.

- Recent models of air-delivery systems, such as CPAP (Continuous Positive Airway  
20 Pressure) or APAP (Automatic Positive Airway Pressure) systems, used for the treatment of SA often include a water vessel to function as a humidification reservoir for air for pressurised delivery to the airways of a patient. Inclusion of such water vessels into air-delivery systems requires a number of considerations, such as volume, materials, and contamination and cleaning. The volume of a water vessel  
25 must be adequate to maintain a suitable humidity of pressurised delivery air over long periods without requiring recharging, usually with tap water, particularly in a home treatment situation. The water reservoir is often heated to maintain a desired humidity of the air delivered to the user.

- 30 A heated reservoir may provide a suitable solution for growth and contamination by various organisms, such as bacteria, and their undesired side effects. Avoiding this growth requires frequent cleaning or replacement of water vessels in known gas-delivery systems. Cleaning may be difficult or insufficient to remove all the contamination that could build up in a water vessel over long periods of repeated  
35 use. This may make compliance with treatment using gas-delivery systems by patients at home less effective if the contamination leads to unintended contraction of disease or the system is simply not used because the water vessel requires regular

cleaning to avoid distasteful smells and the like. Ideally, to minimise the contamination of water vessels, the vessels will be disposable. To make disposal of water vessels economical in the use of gas-delivery systems the vessels must be simple to manufacture from inexpensive materials. What is needed is a disposable water vessel that is easy to manufacture from inexpensive, light materials. Such a water vessel would enable minimal packaging and handling costs per unit to ensure that a gas-delivery system that uses disposable water vessels is easy and economical to use in long-term treatment.

## 10 **Brief Description of the Drawings**

Figure 1 shows a side view of a vessel constructed according to the invention.

Figure 2 shows in side view vessels in expanded and compressed states.

Figure 3 shows a perspective view of a vessel in engaged with a lid in operative position within a gas-delivery system.

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## **Summary of the Invention**

In one aspect, the invention provides a humidification vessel for incorporation in a gas-delivery system, the vessel comprising a first wall defining an aperture; and at least one extendable wall. Preferably, the humidification vessel includes a sealing means for forming a seal with the gas-delivery system. Preferably, the humidification vessel is comprised of a plastic material. Preferably the extendable wall incorporates folds. Preferably the vessel is comprised of light-transmitting material. Preferably the at least one extendable wall is comprised of deformable material.

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In another aspect, the invention provides a method for incorporating a humidification vessel into a gas-delivery system including the steps of extending the walls of the humidification vessel from a first configuration to a second configuration and inserting the humidification vessel into a gas-delivery system. Preferably the method includes the step of placing in fluid communication the air in the humidification vessel with the gas stream of the gas-delivery system. Preferably, the method includes the step of sealing the humidification vessel by engaging an engagement means with the gas-delivery system.

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In another aspect, the invention provides a method for humidifying air of a gas-delivery system including the steps of extending the walls of a vessel having an aperture and extendable walls into a fluid receiving position, inserting the vessel into

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a humidification device, charging the vessel with fluid, and directing gas for humidification through the charged vessel.

### **Detailed Description of the Drawings and Most Preferred Embodiment**

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It is an object of the invention to provide a vessel having variable volume for holding liquids. It is a further object of the invention to provide a vessel that has extendable walls to facilitate the reduction in volume. It is a further object of the invention to provide a vessel that is made of lightweight material that functions to hold liquids but facilitates easy handling and transport, making it very cost effective to manufacture and sell.

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The invention provides a vessel having extendable walls, constructed of at least portions of deformable material, allowing the vessel to be extended or compressed along an axis so as to occupy a reduced volume when in an unextended configuration. Preferably, the extendable walls of the vessel include deformable portions. Preferably, the deformable portions incorporate moulded-in geometry. In operation, in one orientation, said deformable portions increase the volume of the vessel from an unextended or compressed configuration to an extended configuration. Preferably the deformable portions of the vessel are comprised of a plastic material. A plastic material advantageously confers lightweight properties on the vessel.

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Being lightweight and having compressible walls enables a number of vessels to occupy a relatively small volume, enabling reduced transportation costs. Reduced shipping and handling costs enable the vessel to be priced less than larger non-collapsible vessels of the same material. Being comprised of a lightweight plastic material allows for further savings in transport costs.

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In extended configuration, the vessel most advantageously operates as a humidification vessel for gas-delivery systems, such as CPAP or APAP devices.

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The most preferred embodiment of the invention is illustrated in the accompanying figures. It will be understood that the scope of the invention is not limited to the preferred embodiment illustrated herein and that other embodiments will achieve the objects of the invention.

Figure 1 shows an embodiment of the vessel 1 according to the invention. The vessel 1 is preferably comprised of a blow-moulded plastic shell with no seams or joints, although other suitable materials may be used. At least a portion of the vessel 1 defines an aperture 2 through which a liquid, particularly water, can be delivered to charge the vessel. Said apertures may be located in either of a top-forming portion and/or another portion of the vessel 1, such as a side portion. Said aperture is preferably defined by engagement means 3 for engaging a lid 5 as shown in Figure 3. Figure 1 illustrates an embodiment of an engagement means, preferably being a ridge conveniently moulded into the periphery of the top wall forming the aperture 2.

Figure 3 shows a vessel constructed according to the invention in operative position in a gas-delivery system, the engagement means engaged with a suitably defined surface of a lid 5. Engagement of the lid 5 with the engagement means 3 seals the vessel and defines the pathway of gases introduced into the vessel. The preferred embodiment described herein has a rectangular box shape with a plurality of folds 4 in the walls. However, it will be understood that the scope of the invention includes other shapes such as cylinders, square boxes, spheres and the like. It will be further understood that the extendable walls include walls extendable in any direction such as horizontal, vertical and angles therebetween.

Preferably, the vessel walls contain at least portions of materials having light transmission properties that enable visibility of the interior of the vessel and its contents. An example of such material is transparent or translucent plastic material that is light and easy to mould and to deform, thus achieving the extended configuration of the vessel.

In the preferred embodiment, the extension of the walls of the vessel is accomplished by the extending operation of a series of "bellows type" ribs 4 moulded into the walls. The configuration of these ribs allows them to hold an open or closed position until force is applied in the opposite direction. This type of vessel geometry is commonly known as an "accordion bellows". It will be understood that the scope of the invention includes other types of extending operations, the only requirement being that the vessel remain leak-proof when the walls are in extended configuration and when positioned for operation in the gas-delivery system.

In operation, when a force is applied to the extendable walls of the vessel in the correct direction, the walls will deform and extend or compress according to the accordion bellows configuration and remain in the compressed configuration 6 as

illustrated in Figure 2a. Alternatively, when a force is applied to the extendable walls of a vessel in the collapsed state in the opposite direction, the vessel will expand into the extended configuration and remain in the extended configuration 7 illustrated in Figure 2b.

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The advantageous incorporation of the extendable feature herein described enables a larger number of vessels to occupy a given volume in the compressed configuration than in the extended configuration. This advantage can reduce the cost of transport of vessels, the cost often being determined by volume. Similarly, the use of lightweight plastic material in the construction of a vessel reduces the weight per vessel, likewise reducing the cost of transport. In turn, the reductions in cost makes it more economical for a user to dispose of a vessel after a period of use, thus reducing the possibility of build-up of contamination on the walls of the vessel, leading potentially to the transmission of disease to a user of a gas-delivery system.

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Installation of a vessel construction according to the invention into a gas-delivery system may be conveniently achieved by extending the walls of the vessel to the maximum extended position then installing it into the gas-delivery system 8 as shown in Figure 3. When removed, the vessel can remain in the extended configuration or compressed configuration for ease of storage or disposal.

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**Claims**

1. A humidification vessel for incorporation in a gas-delivery system, the vessel comprising:  
5 a first wall defining an aperture; and  
at least one extendable wall.
- 2 The humidification vessel of claim 1 further comprising sealing means for forming a seal with the gas-delivery system.  
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- 3 The humidification vessel of claim 1 wherein the vessel is comprised of a plastic material.
- 4 The humidification vessel of claim 1 wherein the at least one extendable wall  
15 incorporates folds.
- 5 The humidification vessel of claim 1 further comprised of light-transmitting material.
- 20 6 The humidification vessel of claim 1 wherein the at least one extendable wall is comprised of deformable material.
- 7 A method for incorporating a humidification vessel into a gas-delivery system including the steps of:  
25 extending the walls of the humidification vessel from a first configuration to a second configuration; and  
inserting the humidification vessel into a gas-delivery system.
- 8 The method of claim 7 further comprising the step of placing in fluid  
30 communication the air in the humidification vessel with the gas stream of the gas-delivery system.
- 9 The method of claim 8 further comprising the step of sealing the humidification vessel by engaging an engagement means with the gas-delivery system.  
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- 10 A method for humidifying air of a gas-delivery system including the steps of:

extending the walls of a vessel having an aperture and extendable walls into a fluid receiving position;

inserting the vessel into a humidification device;

charging the vessel with fluid; and

5 directing gas for humidification through the charged vessel.



Figure 1

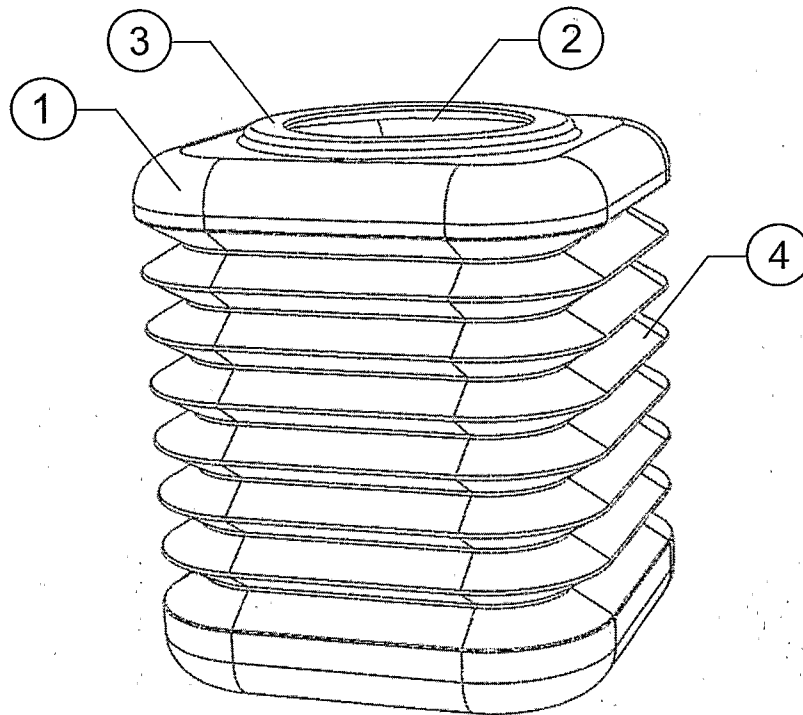


Figure 2

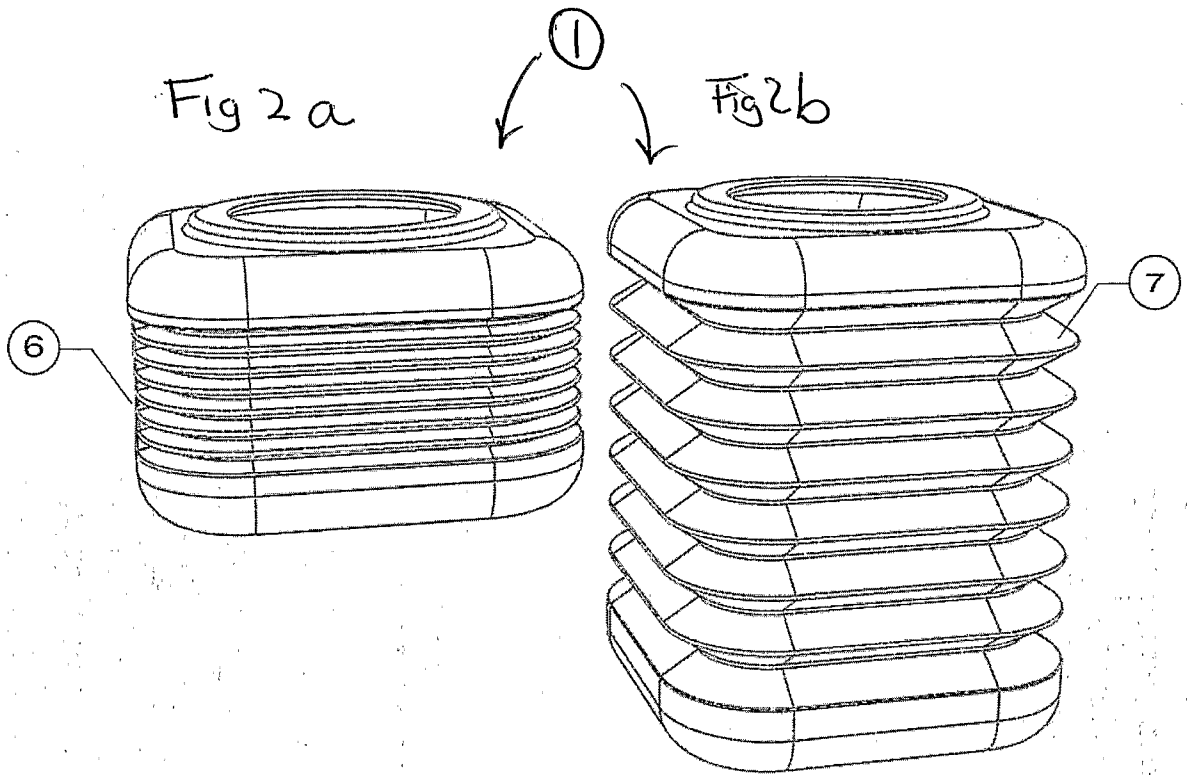
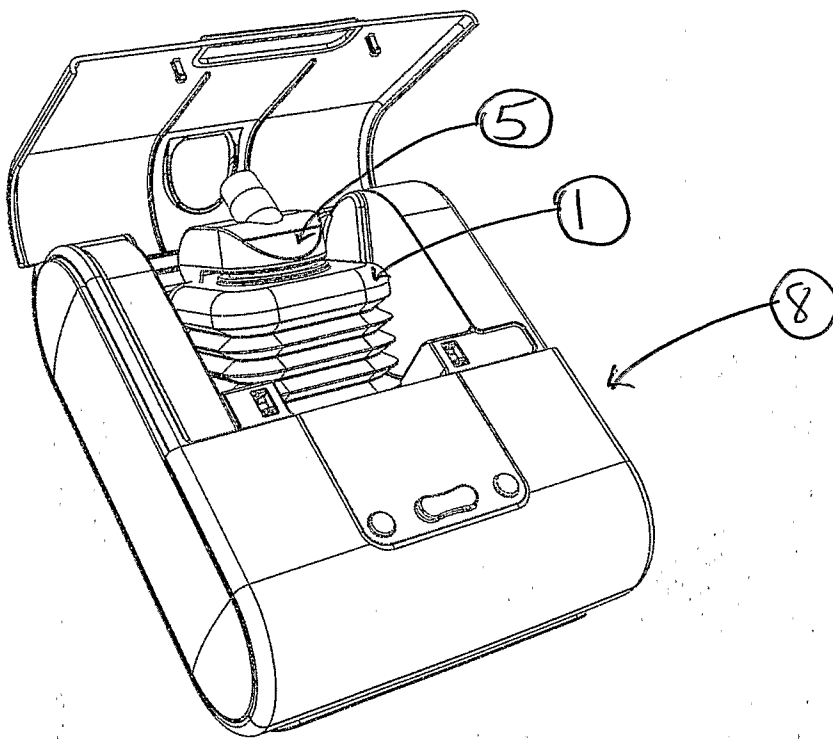


Figure 3



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2007/000988

## A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

*A61M 16/16* (2006.01)*B01F 3/04* (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
 DWPI: IPC A61M 16/- and B01F 3/- and keywords and phrases (humidifier, humidification, moist, water, wet, damp, air, oxygen, fluid, gas, gas delivery, air conditioning, delivery, CPAP, vessel, container, tank, reservoir, casket, cartridge, repository, jacket, receptacle, aperture, hole, nozzle, orifice, outlet, slit, inlet, slot, wall, partition, side, extendable, deformable, flexible, expandable, collapsible) and like terms. USPTO database and 'Google Patents' search engine with keywords (humidification, vessel, collapsible, expandable) and similar terms; ESP@CENET with keywords (humidification, vessel) and IPC A61M 16/00.

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6019355 A (BIRDSELL ET AL.) 1 February 2000 Abstract, Figure 9 and related text; Figures 1-8; column 1, lines 20-44; column 2; esp. column 2, line 57- column 4, line 45; column 3, lines 8-34;	1-2, 4, 7-10



Further documents are listed in the continuation of Box C



See patent family annex

* Special categories of cited documents:		
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family	
"P" document published prior to the international filing date but later than the priority date claimed		

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2007/000988

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3864437 A (BLASZKOWSKI) 04 February 1975 Abstract, Figures 1-3, 9 and related text; column 1, lines 32- column 2, line 28; column 2, line 57- column 4, line 45.	1, 3, 4, 6
Y	Abstract, Figures 1-3, 9 and related text.	2, 7-10
X	US 4540529 A (KOSZYK) 10 September 1985 Abstract, Figures 1-3, 9 and related text; columns 1 and 2, especially column 2, lines 14-43.	1, 3, 5-6
X	US 4624806 A (KOSZYK) 25 November 1986 Abstract, Figures 6-7 and related text; columns 1 -5.	1, 3, 5-6
X	US 4734561 A (MILLER) 29 March 1988 Abstract, Figures 1-3 and related text; columns 1 -3.	1, 3-4
X	US 4882096 A (RUEBEN) 21 November 1989 Abstract, Figures 1-3 and related text; columns 1-3.	1, 4
Y	WO 2005/011785 A1 (FISHER AND PAYKEL HEALTHCARE LIMITED) 10 February 2005 Abstract; Figures 1-4 and related text; pages 1-6, pages 10-11.	2, 7-10
A	US 5373841 A (KYLLOLONEN ET AL.) 20 December 1994 Entire document.	1-10
A	WO 2002/089886 A1 (LIFEVENT LIMITED) 14 November 2002 Entire document.	1-10
	NOTE: With relevance to claims 2, 7-10 for Y documents, US 3864437 A (BLASZKOWSKI) can be combined with WO 2005/011785 A1 (FISHER AND PAYKEL HEALTHCARE LIMITED).	

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2007/000988

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report	Patent Family Member
US 6019355	
US 3864437	
US 4540529	CA 1240919 US 4624806
US 4624806	CA 1240919
US 4734561	
US 4882096	
WO 20050011785	
US 5373841	
WO 20020895886	

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX