

Pump models  
TU53 TU203  
TU103 TU403

Pharmaceutical series

English

# CE **Instruction manual**

## Air operated diaphragm pumps

**topflo**<sup>®</sup> USP VI approved pumps for  
pharmaceutical and biotech  
industries



- ▶ Instructions for installation, start up, operation, maintenance and repair
- ▶ Spare parts



**Read this instruction manual carefully, before you install and operate the pump**

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## **Declaration of conformity**

**Machinery directive 89/392/EEC, Annex 2A**

Tapflo AB declares that:

Product name: **Air operated diaphragm pumps**  
Models: **TU53, TU103, TU203 and TU403**

Is in conformity with the essential health and safety requirements and technical construction file requirements of the EC Machinery directive 89/393/EEC with amendments 91/368/EEC, 93/94 EEC and 93/68 EEC.

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**Tapflo AB**, february 15:th 2006



Börje Johansson  
Managing director

# ▶ 0. GENERAL

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## 0.1 Introduction

The Tapflo Air Operated Diaphragm Pump range is a complete series of pumps for industrial applications. The pumps are designed to be safe simple and easy to use and maintain. The construction is sealless and without rotating parts. The pumps are suitable for almost all different chemicals used by the industry today.

We are proud to introduce our USP VI approved (United States Pharmacopoeia) hygienic PE pump. This series is developed in co-operation with one of the world leading supplier to the biotech market. It is produced to serve the biotech- and pharmaceutical industries in numerous applications.

With proper attention to maintenance, Tapflo Pumps will give efficient and trouble free operation. This instruction manual will familiarise operators with detailed information about installing, operating and maintaining the pump.

## 0.2 The warning symbols

The following warning symbols are present in this instruction manual. This is what they say.



This symbol stands next to all safety instructions in this instruction manual where danger to life and limb may occur. Observe these instructions and proceed with utmost caution in these situations. Inform also other users of all safety instructions. In addition to the instructions in this instruction manual, the general safety and accident prevention regulations must be observed.



This signal stands at points in this instruction manual of particular importance for compliance with regulations and directives, for correct work flow and for the prevention of damage to and destruction of the complete pump or its subassemblies.

# ▶ 1. INSTALLATION

## 1.1 Receiving inspection

Although precaution is taken by us when packing and shipping, we urge you to carefully check the shipment on receipt. Make sure that all parts and accessories listed on the packing list are accounted for. Immediately report any damage or shortage to the transport company and to us.

## 1.2 Storage



If the equipment is to be stored prior to installation, place it in a clean location. Do not remove the protective covers from the suction, discharge and air connections which have been fastened to keep pump internals free of debris. Clean the pump thoroughly before installation.

## 1.3 Foundation



The pump is furnished with vibration absorbing rubber feet. The pump will operate properly without being fixed to a foundation. If fixation is needed for an installation, make sure the foundation is able to absorb vibrations. It is essential for the operation of the pump to mount the pump with the feet in a downward direction (see sketch).

## 1.4 Suction and discharge pipings

Suction and discharge piping should be fully supported and anchored near to but independent of the pump. The piping to the pump should be a flexible pipe, to prevent undue stress and strain on the pump connections and the pipings.

### 1.4.1 Turnable connections

The suction and discharge connections are turnable 180°. This simplifies the assembling and installation considerably.

### 1.4.2 Connection of suction pipe

Remember that the suction pipe/connection is the most critical point, especially if the pump is priming. Just a small leakage will dramatically reduce the suction capability of the pump. When connecting the suction pipe, following is recommended.

- 1) The internal diameter of the pipe should be the same as on the suction connection (at the bottom of the pump) to have best suction capability.
- 2) Make sure that the connection pipe - pump is completely tight, otherwise the suction capability will be reduced.
- 3) Always use as short suction pipe as possible. Avoid air pockets which can arise with long pipings.

### 1.4.3 Connection of discharge pipe

For this connection it is only recommended a simple and positive flow connection. Use a flexible piping (minimum one meter) between the discharge connection and any rigid fixed piping. All components (hose, pipe, valves etc) on the discharge piping must be designed for minimum PN 10.



## 1.5 Air connection

Screw the air hose into the air intake on the center block of the pump with for example a bayonet coupling. For best efficiency, use the same hose diameter as the internal diameter of the connection on the air intake.

# ▶ 1. INSTALLATION

## 1.5.1



### Air treatment system

The air valve is constructed for oilfree air. Lubrication of the air is **not allowed**. However, if the air is **very dry** (laboratory air), the air may be lubricated with water. Maximum air pressure is 8 bar. As prevention purpose, a filtration of the air by means of a 5 micron filter or finer is recommended. Dirt in the air can under unfortunate circumstances be the cause of breakdown.

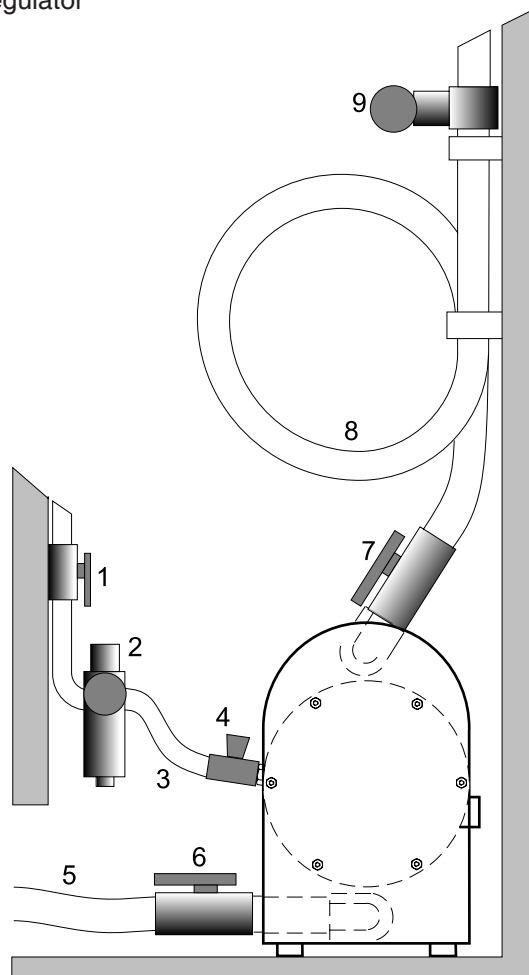
To facilitate the operation of the pump we recommend an air treatment system connected to the air supply. These components should be included:

- 1) Regulator to adjust the air pressure
- 2) Manometer to read the actual pressure
- 3) Needle valve to adjust the air flow
- 4) Filter

These components are included in Tapflos **Air treatment system** which can be ordered from us.

## 1.6 Example of installation

- 1) Gate valve compressed air
- 2) Filter and pressure regulator
- 3) Flexible pipe
- 4) Needle valve
- 5) Flexible pipe
- 6) Gate valve suction
- 7) Gate valve discharge
- 8) Coiled flexible piping
- 9) Flow gauge



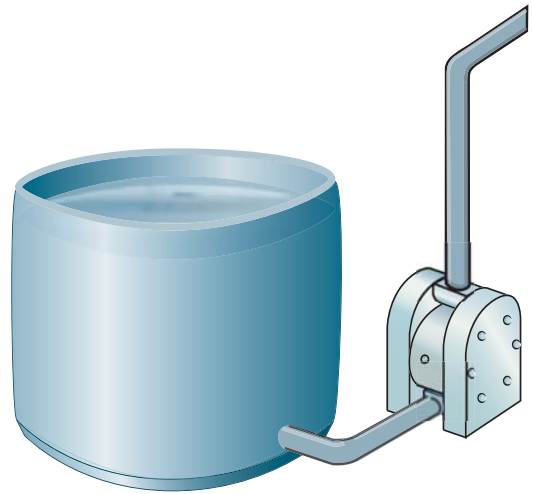
# ▶ 1. INSTALLATION

## 1.7 Recommended installations

The Tapflo pump is flexible in the way you are able to install it. The in- and outlet ports are infinitely turnable more than 180° to fit various piping systems.

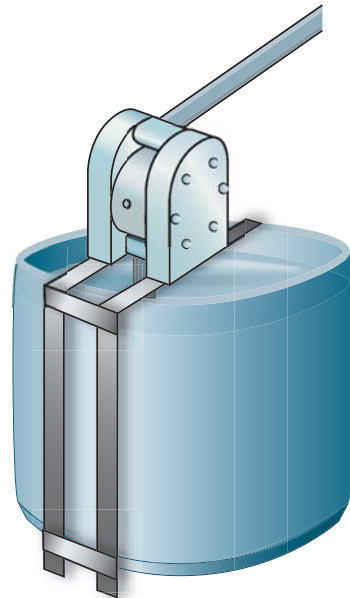
### 1.7.1 Flooded

The piping system is designed with a positive suction head. This is the best way of installation where it is necessary to completely evacuate all liquid from the container, or where viscous (thick) products are transferred.



### 1.7.2 Selfpriming

The Tapflo pump is designed to pull a high vacuum. It is able to evacuate an empty suction pipe without any damage to the pump.



## ▶ 2. OPERATION

### 2.1 Health and safety

The pump must be installed according to local and national safety rules.



**The pumps are constructed for particular applications. Do not use the pump on applications different from that for which it was sold without consulting us to ascertain its suitability.**

#### 2.1.1 Protection



In the interest of health and safety it is essential to wear protective clothing and safety goggles when operating, and/or working in the vicinity of Tapflo pumps.

#### 2.1.2 Environments in danger of explosion



The standard Pharmaceutical series pumps are not allowed to operate in environments in danger of explosion. Static electricity may occur in the pump under operation, which may cause explosion and injury. us for further information. Follow the explosion safety rules applicable at the location for the pump.

#### 2.1.3 Air pressure

The maximum air pressure for Tapflo pumps is 8 bar. Higher air pressure than 8 bar can damage the pump and may cause injury to personel in vicinity of the pump. If you intend to apply a higher air pressure than 8 bar, please consult us.

#### 2.1.4 Noise level



At tests, the noise level from a Tapflo pump has not exceeded 80 dB(A). Under some circumstances, for example if the pump is operating under high air pressure at low discharge head, the noise can be inconvenient or hazardous for personel staying for long periods in vicinity of the pump. This hazard can be prevented by:

- using suitable ear protection
- lower the air pressure and/or raise the discharge head
- lead the outcomming air from the place by connecting a hose from the muffler connection of the pump.

#### 2.1.5 Temperature hazards

Raised temperature can cause damage on the pump and/or pipings and may also be hazardous for personel in the vicinity of the pump/pipings. Avoid quick temperature changes and do not exceed the maximum temperature specified when the pump was ordered. See also general max temperatures based on water in chapter 5 "Data".

### 2.2 Before starting the pump



- Make sure the pump is installed accordning to the installation instruction (section 1).
- Filling of the pump with liquid before start is not necessary.
- When installation is new or reinstalled, a test run of the pump with water should be conducted to make sure the pump operates normally and does not leak.



## ▶ 2. OPERATION

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### 2.3 Starting and operating

- Open the discharge valve.
- *Note! Considering the suction capacity when air is still in the suction pipe, it is recommended to start with low air pressure/flow in the beginning. This is not necessary if the pump is filled with liquid before start.*
- When the pump has been filled with liquid, the air pressure/flow may be raised to increase the suction capacity of the pump.
- The performance of the pump can be adjusted through the air supply by using a needle valve and a pressure regulator. The performance can also be adjusted by normal flow control on the discharge side of the system.

#### 2.3.1 Dry running

The pump may run dry without any problem.

#### 2.3.2 Optimizing the pump lifetime

Running at full frequency (maximum air pressure/flow) continuously will cause premature wear of the components. As a general rule, we recommend to run at half of the maximum capacity of the pump. For instance, a T103 pump should run continuous maximum at ~50 l/min.

### 2.4 Pump stopping

The pump can be stopped in two ways:

- 1) Close the discharge valve. The pressure from the system will stop the pump automatically. This will not do any damage to the pump. The pump restarts easy when the valve is opened again.
- 2) Stop the air supply.

## ▶ 3. MAINTENANCE

### 3.1 Performance test

When installation is new, a test run of the pump should be conducted. Gauge the capacity at specific air pressure/flow. This information is for use in checking performance as wear takes place. You will be able to set schedules for maintenance of the pump and to select spare parts to be kept on stock.

### 3.2 Service intervals



The intervals for service depend upon the operation conditions for the pump. The characteristics of the liquid, temperature, materials used in the pump and running time decide how often the service intervals are necessary.

If a problem has occurred, or if the pump is in need of service, see later this chapter. You are of course warmly welcome to consult us for further help.

#### 3.2.1 General service intervals

We recommend two kind of spare part sets to be replaced in two time intervals:

- Spare part set No 1, every 6 months
- Spare part set No 2, every 1 year

Please find the contents of the spare part sets in chapter 4.1.

### 3.3 Location of faults

Problem	Possible fault
The pump does not run	The air pressure is too low The air connection is blocked Muffler is blocked Air valve is defect Dirt in the pump chamber Diaphragm breakdown
The suction is bad	Suction connection is not tight Suction connection is blocked Muffler is blocked Valve balls are blocked Valve balls are damaged
The pump runs irregularly	Valve balls are blocked Sealings are defect in air valve or center block Diaphragm breakdown
Bad flow/pressure	Pressurefall in incoming air Suction or air connection blocked Muffler is blocked Air valve is defect Valve balls worn out/broken Air in liquid Diaphragm breakdown
Liquid leaks from the pump	Screws on the housing not properly fastened
Liquid comes out of the muffler	Diaphragm breakdown

## ▶ 3. MAINTENANCE

### 3.4 Dismantling and assembly of the pump

The numbers put in brackets, refer to the part numbers in the spare part drawings and spare part lists in chapter 4. Please see recommended tightening torques in chapter 3.5.

#### 3.4.1 Before you start the maintenance procedure



Be sure to drain all liquid from the pump. Cleanse or neutralize the pump thoroughly. Disconnect the air connection and then the suction and discharge connections.

#### 3.4.2 Valve ball replacement

- 1) Unscrew the plug (33) by means of a screw tool. Carefully turn the pump upsidedown and let the valve ball (23) come out. Do the same procedure on the other housing assembly.
- 2) Unscrew the socket head cap screws (371) in order to separate the upper and lower housing. Take out the valve ball (23). Do the same procedure on the other housing assembly.



**Check the valve balls (23) and O-rings (431 + 432) and replace if they are worn or damaged.**

- 3) Put the valve ball in the upper housing (11). Place the O-ring (431) in the groove on the plug (33) and fasten the plug carefully by means of the screw tool. Fasten carefully until the plug is seated towards the housing. Do the same procedure on the other housing assembly.
- 4) Place the O-ring (432) in its groove on the lower housing. Put the valve ball (23) in the seat. Carefully fit the pump assembly onto the lower housing. Be careful so that the O-ring will stay in the groove. Fasten the socket head cap screws (371) with washers (381) equally. Do the same procedure on the other housing assembly (see recommended tightening torques in chapter 3.5).

#### 3.4.3 Diaphragm replacement

- 1) Pull off the nut covers (57) and unscrew the nuts (37) on one side of the pump.
- 2) Carefully put the pump on the housing which still has the nuts on. Lift off the housing assembly (11 + 112).
- 3) Carefully lift up the in/outlet connections (13) from the housing. Take care of the O-rings (181 + 184). Now, you have the centre block assembly and one of the housing assembly with pin screws left.
- 4) Upend the pump and carefully pull out the pin screws (14). Be careful with the diaphragms (15) that easily can be damaged by the threads of the pin screws.
- 5) Press the diaphragms (15) to their neutral position (both have the same distance to the center block).
- 6) Hold one of the diaphragms (15) and unscrew the other. Then pull out the remaining diaphragm with the diaphragm shaft (16). Unscrew the other diaphragm. If you can not unscrew by hand, fix the diaphragm shaft in a vice (the face in contact with the shaft, should be made from a softer material such as plastic) and unscrew the diaphragm.



**Check the diaphragms (15) and O-rings (181 + 184), and replace if they are worn or damaged.**

- 7) Put the diaphragm (15) with shaft (16) into the center block. Screw the next diaphragm (15) onto the shaft (16) and fix the holes. Sometimes you have to turn the diaphragms a little back to get the holes fixed.
- 8) Make sure to have one nut (37) with washer (38) on each pin screw and put them into one of the housing assemblies (11 + 112). Lay the housing assembly on the side where the nuts (37) are.

## ▶ 3. MAINTENANCE

- 9) Carefully push the centre block assembly onto the pin screws (14). Be careful so that you do not damage the diaphragms.
- 10) Put the O-rings (181) in their seats in the upper housings (11) and the lower housings. Put a O-ring (184) in the groove on one side of the in/outlet connections (13). Carefully put the in/outlet connections in their seats on the upper (11) and lower (112) housing.
- 11) Make sure to have O-rings (181 + 184) placed on the remaining housing assembly. Carefully push down this housing assembly onto the pin screws (14) and make sure that the in/outlet connections (13) will fit into the seats, still with O-rings (181 + 184) in place.
- 12) Fasten the nuts (37) with washers (38) alternately by hand. Place the pump on the feet (17) and continue to fasten the nuts alternately. See recommended tightening torques in chapter 3.5. After a few weeks operation a follow up draft of the nuts is recommended.

### 3.4.4 Dismantling and assembly of the air distribution system

The air distribution system is placed in the centre block (12) of the pump.

- 1) Follow the steps 1-6 in chapter 3.4.3, so that you have the centre block assembly in your hands.
- 2) Dismantle the circlips (27) by means of a circlip plier which keep the air valve (61) on it's place, press out the air valve with for instance by means of a pressing device. Always be careful, so that you do not damage the sealing edges towards the diaphragm or the air valve.
- 3) If the shaft sealings (36) seem to be worn out (by internal leakage of air), carefully remove them with a pointed tool. During this operation, the sealing (36) and backup o-ring (47) usually get destroyed, so make sure to have replacement spares available.



**Check all components and replace if they are worn or damaged. If the internals of the air valve (61) are worn, replace the entire air valve.**

- 4) Mount the circlip (27) on one side. Put some soft soap solution on the air valve o-rings (30) and then carefully push the air valve (61) into the housing. For best result, use a pressing device for this operation. Make sure that the o-rings (30) remain in the right position. Put the circlip (27) on the other side.
- 5) Carefully place the sealings (36) with backup O-ring (47) in the centre block.
- 6) Proceed with the steps 7-12 in chapter 3.4.3.

### 3.4.5 Test run

We recommend you to conduct a test run of the pump before installing it to the system so no liquid gets wasted if the pump leaks or perhaps does not start according to wrong assembling of the pump.

## 3.5 Recommended tightening torques

Please have in mind that never use too much force when you assemble the nuts, screw and plugs, since plastic components are involved.

Pos	Description	Recommended tightening torques in Nm			
		T53	T103	T203	T403
37	Nut	8	16	20	23
371	Socket head cap screw		6		
33	Plug		20		

## ▶ 4. SPARE PARTS

### 4.1 Stocking recommendation

Even at normal operation of the pump, some parts can wear down. This is a reason, why we recommend two kinds of spare part sets to be replaced in two time intervals. Note that this is only a recommendation. The characteristics of the liquid, temperature, materials used in the pump and running time decide how often the service intervals are necessary.

#### Set No 1 (every 6 months)

Qty	Description	Pos
2	Diaphragm	15
4	Valve ball	23
1	Muffler	25
4	O-ring	181
4	O-ring	184

#### Set No 2 (every 1 year)

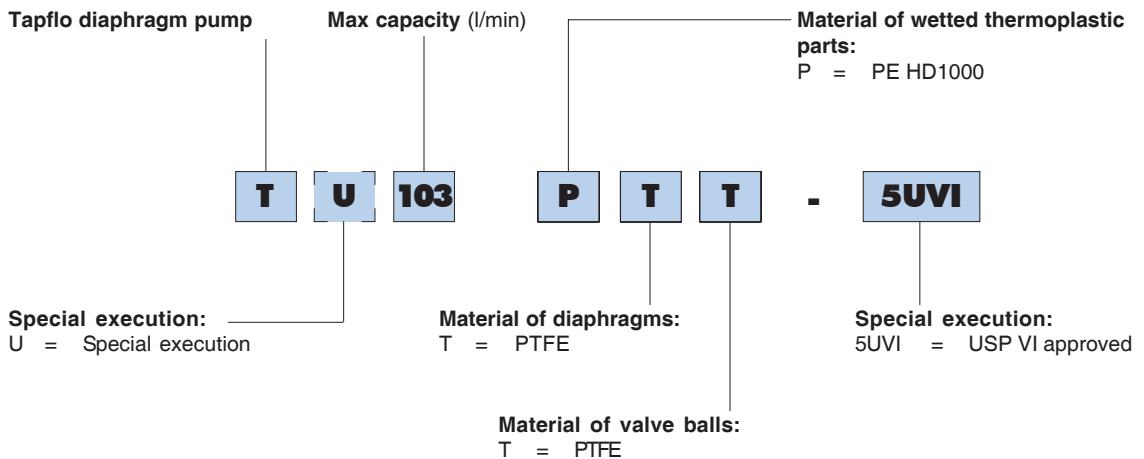
Qty	Description	Pos
1	Spare part set No 1	-
1	Diaphragm shaft	16
2	Circlip	27
2	Center block seal	36
4	O-ring	47
2	O-ring	431
2	O-ring	432
1	Air valve complete	61

### 4.2 How to order parts

When ordering spare parts for Tapflo Pumps, please let us know the **model number** from the nameplate of the pump. Then just indicate the part numbers (referred to the spare part list) and quantity of each item.

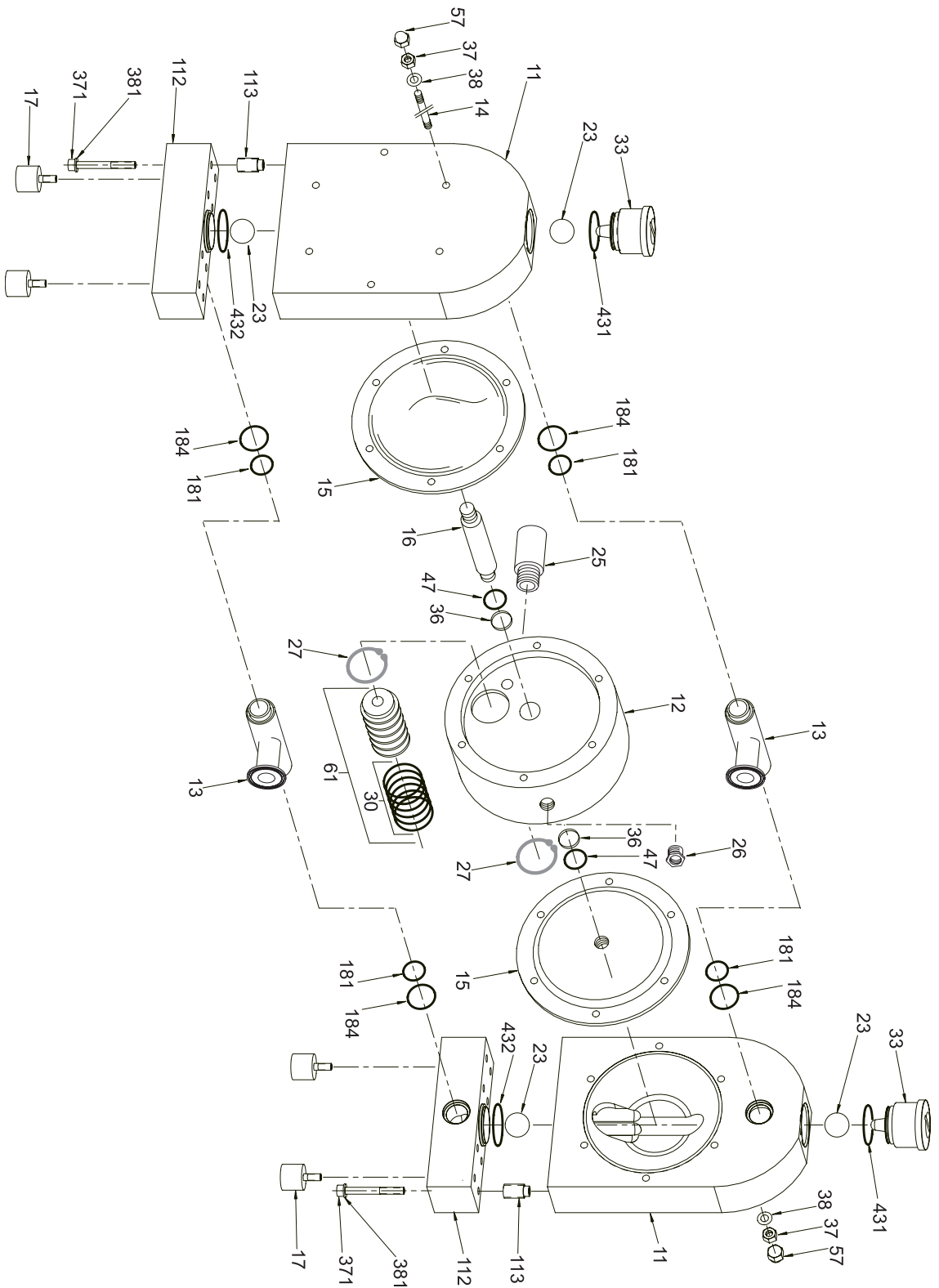
### 4.3 Pump code

The model number on the pump tells the pump size and material of the pump components.



# ▶ 4. SPARE PARTS

## 4.4 Spare part drawing



## ▶ 4. SPARE PARTS

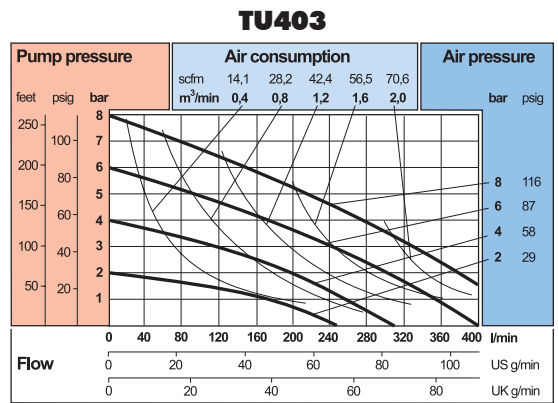
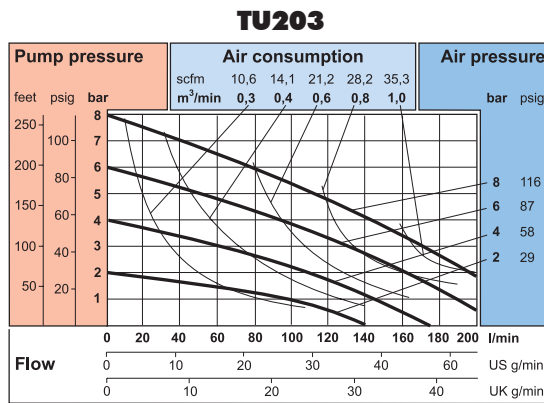
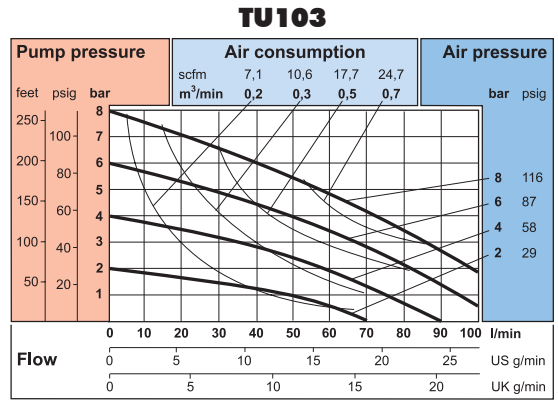
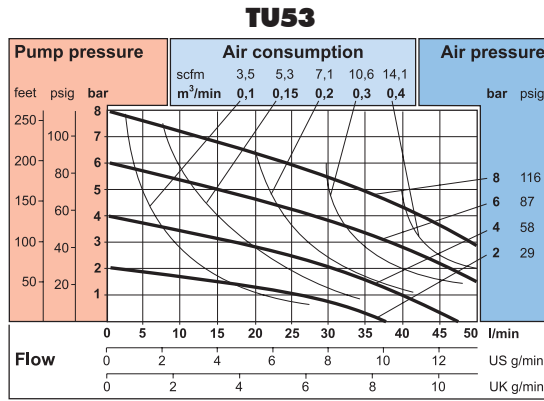
### 4.3 Spare part list

Pos	Description	Quantity			
		T53	T103	T203	T403
11	Upper housing	2	2	2	2
112	Lower housing	2	2	2	2
113	Insert	16	16	28	28
12	Center block	1	1	1	1
13	In/outlet connection	2	2	2	2
14	Pin screw	6	6	8	8
15	Diaphragm	2	2	2	2
16	Diaphragm shaft	1	1	1	1
17	Rubber foot	4	4	4	4
181	O-ring	4	4	4	4
184	O-ring	4	4	4	4
23	Valve ball	4	4	4	4
25	Muffler	1	1	1	1
26	Air intake adapter	1	1	1	1
27	Circlip	2	2	2	2
30	O-ring	6	6	6	6
33	Plug	2	2	2	2
36	Center block sealing	2	2	2	2
37	Nut	12	12	16	16
371	Socket head cap screw	16	16	28	28
38	Washer	12	12	16	16
381	Washer	16	16	28	28
431	O-ring	2	2	2	2
432	O-ring	2	2	2	2
47	O-ring (back up for 36)	2	4	2	2
57	Nut cover	12	12	16	16
61	Air valve complete	1	1	1	1

# 5. DATA

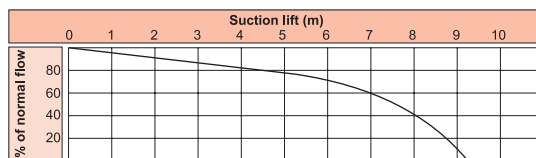
## 5.1 Capacity curves

The performance curves are based on water at 20°C. Other circumstances might change the performance. See below how the capacity will change at different viscosities and suction lifts.

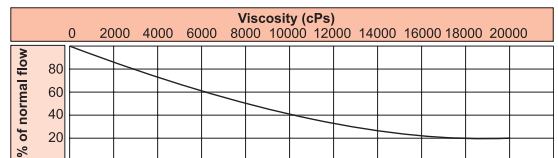


## 5.2 Capacity changes

Capacity changes at different suction lifts



Capacity changes at different viscosities





## ▶ 5. DATA

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### 5.3 Technical data

#### 5.3.1 General characteristics

Max discharge pressure (bar) / (psi)	8 / 116
Max air pressure (bar) / (psi)	8 / 116
Max temp (°C) / (°F)	70 / 158
Min temperature (°C) / (°F)	-20 / -4

#### 5.3.2 Material of components

Pump housing and all wetted thermoplastic details	PE (special USP VI approved)
Centre block (not wetted)	PP
Diaphragms	PTFE TFM (USP VI approved)
Valve balls	PTFE TFM (USP VI approved)
Air valve	Brass / NBR or optional AISI 316L / FKM
O-rings (wetted)	EPDM (USP VI approved)
Housing pin screws	Stainless steel AISI 316L
Diaphragm shaft	Stainless steel AISI 316L

## ▶ 6. WARRANTY & REPAIR

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### 6.1 Returning parts

When returning parts to us please follow this procedure:

- Consult us for shipping instructions.
- Cleanse or neutralize and rinse the part/pump. Make sure the part/pump is completely empty from liquid.
- Pack the return articles carefully to prevent any damage under transport.

***Goods will not be accepted unless the above procedure has been complied with.***

### 6.2 Warranty

We warrants products\* of it's own manufacture will be free from defects in raw material and manufacture under normal use and service for a period of not more than one year. Our obligation under this warranty being limited to repair or replacement of its products which shall be returned to us. Follow the procedures above "returning parts". If a pump or part is received defected, report to us immediately. Parts returned to our company must have written authorisation from us. This warranty will not apply to any of our products which shall have been used other than for their intended use.

***\* Even when products such as diaphragm pumps operate under normal conditions, some parts are subject to wear and may have to be replaced within one year. Examples of such parts in Tapflo diaphragm pumps are; diaphragms, valve balls, o-rings and gaskets etc. This warranty will not apply to these parts being subject to wear.***





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