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TUBULAR DIAPHRAGM PUMPS

INSTRUCTIONS FOR INSTALLATION, START-UP, OPERATING AND MAINTENANCE

FOREWORD

This manual enables the operator to understand the operating principles of the pump, the installation and maintenance procedures. It is very important that you carefully read this manual before you install and operate your pump.
The instructions contained in the manual will ensure safety practices, provided that they are followed correctly.
The user must employ trained personnel for the operation, maintenance and for any repair work on the pump.

WARNING : ***Incorrect installation, use, maintenance or parts replaced wrongly can cause damage to the pump and sometimes severe personal injures.***
All operations should be performed by qualified personnel.

If you need some further technical information or assistance from the Codip distributor, please mention the model and the serial number of the pump which you can find in the identification plate on the pump, in the Manual of Instructions and in the Declaration of Conformity that are an integral part of the documentation supplied with the pump. This shall allow to go back confidently to the constructional features of the pump.

In this manual you be warned for remaining hazards or you get to know about some suggestions to help you in the pump operations ; this kind of attention points are described as follows.

WARNING : your own or others safety or health may be in danger

CAUTION : draws your attention to possible problems or damages

NOTICE : gives you suggestions how to semplify certain tasks

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1. INTRODUCTION

This chapter explains the operating principle and mechanics of the air-operated tubular diaphragm pump. It is required that the reader has some basic knowledge of chemical processes in general, physics in general. And if the pump is remote operated or controlled basic knowledge of instrumentation in general is required.
ATTENTION : if the pump is intended for use in potentially explosive atmospheres, the applicable regulations (ATEX Directive) in general and the risk assessment relating to the use of the pump have to be studied first.

WARNING : the pump is not to be used in potentially explosive atmospheres pumping acetylene, hydrogen, carbon disulphide, hydrogen sulphide and ethylene oxide gases.

7.1 Product description

The CODIP air operated tubular diaphragm pump is a reciprocating, positive displacement type with double containment shell for maximum safety.
NOTICE : the compressed air can be replaced by nitrogen if preferred to drive the pump.

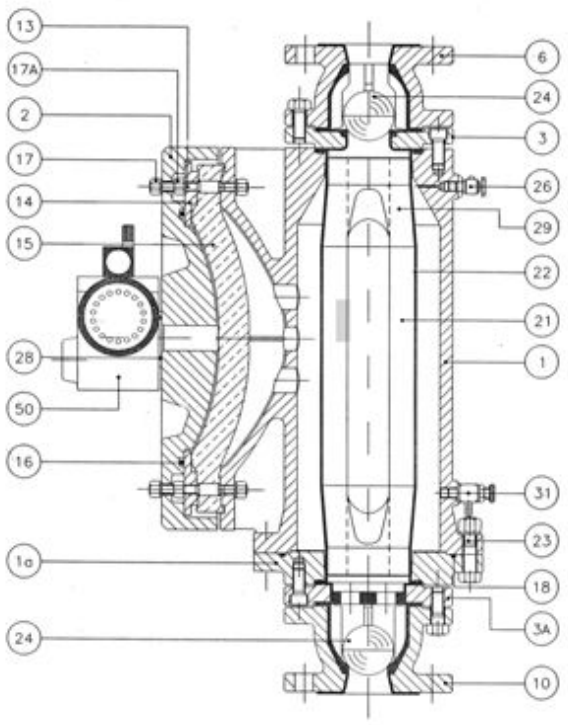
Engineered for maximised safe handling of the most aggressive and abrasive chemicals, they are used for a very wide range of applications in which it may have an arduous duty : fluids of all types, viscous (up to 25.000 cps), abrasive, corrosive often at high temperatures (up to 180°C).
Maximum operating pressure : 10 bar(150 psi).

WARNING : Do not exceed 10 bar air supply pressure and 180°C operating temperature.

The main components of the pump are shown in the following **Sectional Drawing No. 0226** including **Part List**, titled with the pump model, as well as the Drawing No. 1955 for pneumatic distributor **(ATTACHED I)**

RP 20/60 PTFE
PART LIST

(1) PUMP BODY
(1A) LOWER COVER
(2) COVER
(3) DISCHARGE FLANGE
(3A) SUCTION FLANGE
(6) DISCHARGE VALVE
(10) SUCTION VALVE
(13) COVER BOLTS
(14) PRESSURE RING
(15) RUBBER AIR DIAPHRAGM
(16) O-RING GASKET
(17) CUP NUTS
(17A) NUTS
(18) O-RING GASKET
(21) PTFE SPACER
(22) PTFE TUBULAR DIAPHRAGM
(23) LOWER COVER BOLTS
(24) PTFE BALLS/SHUTTLES
(26) BLEEDER VALVE
(28) O-RING GASKET
(29) PTFE RING SPACER
(31) INERT LIQUID VALVE
(50) AIR DISTRIBUTOR



7.1 Operating principle

The CODIP pump is operated by compressed air supplied through an independent automatic air distributor to one side of a flat rubber air-diaphragm. The diaphragm is deflected, thus displacing the inert liquid inside the pump casing. In its turn the inert liquid transmits the pressure uniformly to the PTFE tubular diaphragm without any mechanical stress.
The rubber air diaphragm therefore operates with an air pressure on one side and an equally and opposite fluid pressure on the other side. Therefore this diaphragm is hydraulically balanced.

Similarly, the tubular diaphragm (which is the heart of the system) operates with medium inside and inert liquide outside, at the same internal and external pressure also this diaphragm is hydraulically balanced. This means that the differential pressure acting on the tubular diaphragm walls is always zero, therefore completely eliminating any diaphragm stress for which resulting an extremely long tubular diaphragm life.

In the CODIP pump, all components that come into contact with the pumped medium are isostatically moulded from pure virgin PTFE. The pump has no mechanical seal, packing or O-rings that seal the pumped fluid from the environment, and it is therefore virtually impossible that the CODIP pump leaks any pumped liquid into environment. The fact that the process fluid is prevented from entering an exhaust port by means of a secondary containment and ensures a supplementary barrier in the event of a diaphragm failure.

7.2 Intended use

The CODIP pumps can safely handle most corrosive, abrasive, viscous fluids, both hot and cold ; for this reason, at the purchase time, a suitable pump model shall be selected on the basis of the compatibility of the materials of construction with the pumping fluid and the working conditions.

ATTENTION : check for compatibility of the pump wetted parts with the pumping liquid if the pump is to be used for a different or optional service compared with the application for which it was bought. Check for suitability of the new installation. If you are in doubt, please consult your authorized Codip distributor or directly the manufacturer's Technical Office.
The CODIP s.a.s. cannot be held responsible for injures to persons and property caused by the non observance of the above precautions.

WARNING : some materials such as halogenated hydrocarbon solvents should not be pumped with an aluminium construction pump due to a possible explosive reaction.

7.3 Area classification

WARNING : when the pump is to be installed in potentially explosive atmosphere, the final user/buyer is obliged to point out in the Purchase Order the Classification of the zone and the corresponding Group-Category in accordance with Atex Directive for which the conformity of the pump is required.

2.1 General

The installation, start-up, operation and maintenance of the pump must take place in accordance with work safety regulations in force.
The owner or the holder is responsible for its maintenance, which is essential for safe operations. All worn, faulty or damaged safety related parts must be replaced immediately.

WARNING : the installation, operation and maintenance must be carried out by authorized, qualified and adequately trained personnel.

In case of differences between the instructions in this manual and the current safety regulations, the most restrictive shall be applied.

2.2 Main safety aspects

The CODIP pump has been engineered with in mind a concept to manufacture a heavy-duty robust pump for extremely long life cycle, and minimum maintenance, maximum efficiency and last but not least a maximum safety for handling corrosive, ultra clean, explosive liquids.
The main safety aspects concern the several varied possibilities of installation, the prevalent use with the most aggressive and corrosive chemicals requiring for careful operations of disassembly/re-assembly and maintenance.
Some generic directions for safe operation have been advanced in the Foreword and in Chapter 1.Introduction, while the following § 2.3 comprises the main safety measurements required from CODIP pump.

2.3 Safety measurements

Pre- installation check list

WARNING : verify pump model received against purchase order or specification sheet.
Verify the identification data plate.

WARNING : remove shipping flange covers. Do not remove or tamper with tools leaden seals on bleeder and inert liquid valves (item 26 & 31).

WARNING : blow out air line for 10 to 20 seconds before connecting to pump to make sure all pipe line debris is clear.

Installation and start-up

WARNING : all suction and discharge piping/hoses should be designed to withstand the pressure and temperature of the specific application.

WARNING : ensure proper ventilation of tanks/vessels that house liquid supply. Due to the pump's vacuum ability, improper ventilation of these supply tanks can lead to implosion of tanks when fluid is completely evacuated.

WARNING : air supply pressure cannot exceed 10 bar (150 psi). Temperature limits are stated from the pump's material of construction.

CAUTION : due to the reciprocating action of the pump, lateral instabilities and water hammer can occur during the normal operation, thus the foundation should be substantial in order to absorb any vibration and to form a permanent rigid support for the pump legs.

CAUTION : when the pump is used for fluids with solids suspended, the size of particles has not to exceed the maximum solids pump capability ; whenever the possibility exists that larger solid objects may be sucked into the pump, a strainer should be used on the suction line to prevent damage to the pump and subsequent risk to the operator.

\ ING : take action to prevent electrostatic charging because fire or explosion can result ; the pump and the pumping system must be properly grounded. For some applications, wetted parts manufactured in conductive PTFE will provide a more adequate dispersal of static electricity. This op- tion is recommendable when the pumping fluid is not a good conductor and/or the pump is intended for use in potentially explosive atmosphere.

\ ING : do not use quick operating valves (f.i. ball valves) in potentially explosive zone for avoiding overpressures of the pumping system.

\ ING : the discharge/suction connection has to be equipotential due to the possibility that travelling electric current could cross the pump on the plant.

\ ING : pumping system will be provided with a proper lightning protection.

WARNING : check to make sure all flanged connections are air tight and locked properly to avoid any leakage.

Operating

\ ING : in case of electro-magnetic waves field due to radio frequency, with long piping acting such as antenna, take action to signal the safety distances to the personnel.

\ ING : take action to prevent any injury to the operators due to the contact with the overheated pump surfaces caused from the high temperature of the pumped liquid.

\ ING : pumping system will be provided with a proper lightning protection

WARNING : take action to avoid any risk to operator due to the dripping of handled liquid from pipe and tank/vessel overhanging the pump.

WARNING : in case of both diaphragms (tubular and rubber flat) failure, fluid being pumped may be forced out the air exhaust, in which case contact with the hazardous material is possible ; take action to prevent this event when the pump doesn't correctly work and decreased performance occurs.

CAUTION : the CODIP pumps are supplied with mufflers on the air distributor's air exhaust (item 89 and 93) ; do not remove them to avoid hazard to operators working in proximity to the pumps.
Use proper hearing protection devices if you need to replace the muffler during the pump operation. Pump noise could occur under certain operating conditions, f.i. high air pressure supply against little or no discharge head. Reduce the air pressure supply.

Maintenance (disassembly/reassembly)

WARNING : take action to avoid unintended mechanical sparks due to friction, impact or rubbing between the pump and tools utilized during the maintenance operations.

WARNING : before disconnecting the pump , wear safety glasses and gloves. Use isolation valves to avoid product spillage from pipe.

WARNING : before starting disassembly, all wetted parts must be washed and neutralized because it is impossible drain completely the pump making it dry run so that a minimum quantity of pumped liquid will be trapped by valve balls.

WARNING : when the maintenance is due to a misfunctioning of the pump, the operator must expect the tubular diaphragm failure and take action to avoid any risk or damage.
In this case the inert liquid mixes, at concentration growing, with the pumped product ; therefore the handler should obtain Material Safety Data Sheet from the chemical supplier for all materials being pumped for appropriate handling instructions.

WARNING : the same safety precautions should be taken when the pump has to be repaired at the local distributor or the manufacturer ; before shipping the pump, wash and neutralize all wetted parts and drain the pump emptying it from the inert liquid.

3. TRANSPORT, HANDLING AND STORAGE

3.1 General

Take care when handling, lifting, transporting the machine, to avoid damages and injures.
Check the weight of the machine and use a suitable lift truck whenever the manual lifting is not allowed or advisable.

3.2 Dimensions table and moving istructions

Model	Weight(kg)	Dimensions mm(HxLxD)	Lifting
RP 20 (aluminium)	27(PTFE) 28(rubber)	670x260x312 680x260x312	Weight, dimensions and packing allow hand-moving through only one operator.
RP 20 (ductile iron)	46	670x260x312	The hand-moving should carried out from two operators at least ; two hook holes on the pump legs allow the lifting of the pump when using a fork truck. The same practice is possible also for the aluminium casing assembled with similar legs.
RP 60 sx (aluminium)	66(PTFE) 71(rubber)	965x385x425 1057x385x425	Weight, dimensions and packing allow hand-moving through two operators at least ; otherwise use the fitting hook holes on the pump legs.
RP 60 sx (D.I.)	112	965x385x425	Proper lifting devices must be used to pick up the pump by the lifting point on the pump legs.
RP 60 dx (aluminium)	116(PTFE) 126(rubber)	965x700x330 1057x700x330	Proper lifting devices must be used to pick up the pump by the lifting point on the pump legs.
RP 60 dx (D.I.)	210	965x700x330	Proper lifting devices must be used to pick up the pump by the lifting point on the pump legs.
RP 150 simplex	129	1400x510x525	Proper lifting devices must be used to pick up the pump by the lifting point on the pump legs.
RP 150 duplex	245	1400x814x545	Proper lifting devices must be used to pick up the pump by the lifting point on the pump legs.

NOTICE : All models can be horizontally secured on a pallet for its moving by a fork truck although the pumps are supplied with to legs for a vertical installation.

3.3 Storage

The pump is protected against corrosion and deterioration by an outer and inner coating of epoxy-polyester resins. The pump has a six-months warranty of storage as well the period of one year from date of start-up.
Check the efficiency of the rubber air diaphragm by a running test if the pump was stored for a longer period.
In case of wet climate, keep the pump in an enclosed and heated ambient.

4. INSTALLATION

4.1 Pump location

Pumping unit should be placed as close as practical to the source of supply with vertical axis. Head room and floor space allotted to the pumping unit should be sufficient for inspection and maintenance.
Verify the pump dimensions on the Dimensional Drawing No. 203 **(Attached II)**
CAUTION : pumps could be horizontally installed due to the plant requirements, **only when the suction is flooded** ; under these working conditions the flow rate is slightly reduced and the check valves, operating under an improper position, must be always controlled to ensure a perfect tightness of the valve balls and seats.
Think of this possibility only as an exception.

4.2 Pump foundation

The foundation should be substantial in order to absorb any vibration and to form a permanent rigid support for the pump legs. A concrete foundation poured on a solid footing is satisfactory.
For mounting the pump on the floor, the pump legs should be attached vertically to the corresponding lugs on the center of the pump body.

4.3 Piping - General

1) The pump should not be used as a support mechanism for the piping system. The piping should always “line- up” with the pump flanges.
2) Avoid short radius elbows.
3) Due to the pulsating flow rate, short sections of flexible hose should be installed between the pump and the piping when installations of rigid piping is required.
4) A pulsation dampener (air chamber) is recommended to further reduce pulsation in flow ; it should be installed on the discharge piping as close to the pump as possible and the following capacities are suggested :

- RP 20 pumps : 5 - 10 litres
- RP 60 pumps : 20 - 25 litres
- RP 150 pumps : 50 - 60 litres

Select a pre-charged gas dampener with a bladder or bellows to isolate the gas cushion from the process when the use of an air-chamber of the size as recommended in this manual is not allowed.

NOTICE : a pulsation dampener is recommended when a) the suction pipework is unduly long or tortuous : reciprocating pumps must alternately accelarate and decelerate the pumped liquid column and an unsuitable pump flow reduction occurs ; b) a continuous pulsation-free flow is required to overcome such problems as pipe vibration-noise, fluctuating instrumentation, damage to instruments, water-hammer and shock.

4.4 Suction piping

1) The suction piping should be sized in order to allow a flow of liquid at least the triple of the pump capacity :

Model RP 20 :	**Ø 1” (DN 25)**
Model RP 60 and RP 60 Duplex :	**Ø 2” (DN 50)**
Model RP 150 and RP 150 Duplex :	**Ø 3” (DN 80)**

A smaller size of piping than the above recommended diameters doesn’t affect the pump working but it will reduce the maximum flow rate of the pump and increases friction losses.

2) Installation with pump above source of supply (self-priming application)

a) Keep suction pipe free from air or vapour pockets which are eliminated with difficulty by reciprocating. Piping should slope upwards from source of supply and no portion of piping should extend above the pump suction flange. When

emptying carboys or drums, pump should be installed above the same and no portion of suction pipe shall be below the drum inlet. Air pocket in the suction line (syphon break effect) cannot be eliminated. Result : pumping capacity drastically reduced.
b) It is critical that all fittings and connections are airtight.
c) The suction pipe should always be submersed into the suction tank/vessel.
d) Suction strainers when used should have a net free area of at least four times the suction pipe area.

3) Positive suction head (flooded)

a) A valve should be installed in the suction line to permit closing the line for pump inspection and maintenance. If a diaphragm valve is used be sure that the diaphragm is rigid enough, so that it can never reduce liquid flow through the valve.
b) For PTFE pumps a strainer should be installed in the suction line (see 2-d) to prevent the accumulation of solids in the check valves and to avoid damages to the PTFE parts of pump.

4) Outdoor installation (or unheated ambient)

When the pump works outdoor or in an unheated room and sub-zero temperatures are possible during the winter months, the following precautions are recommendable :

1) Operate at the lowest possible air pressure supply.

2) Push the air distributor (50) off of its seating using a threaded 50/100 cm pipe fitting to avoid the icing of the muffler (93), causing the pump to cycle erratically or stop operating.

3) A drip feed lubricator should be installed on the compressed air line filled with monoethylene glycol antifreeze (see § 4.6) at minimum setting (1-2 drops/15-20 min). **CAUTION :** DON'T USE LUBE OILS**.**

4) **CAUTION :** When the pump must be stopped and the handling liquid can freeze, it is necessary the pump dry runs to empty the tubular diaphragm ; of course also piping should be drained when the pump doesn't work.

5) If disassembly/re-assembly is required, make to be sure the inert liquid for filling the pump is antifreeze.

6) The pump can be supplied with a stainless steel AISI 316 heating coil inside the pump to heat the inert liquid ;
otherwise the pump can be externally traced to avoid the freezing. When icing affects also the internal parts of the air distributor , especially the shuttles (79) and (81) in the pilot valve, it will be sufficient to preheat the compressed air or jacketing the air distributor and use a steam jet blower to avoid the pilot valve blockage.

4.5 Discharge piping

1. A valve should be installed in the discharge line. The valve is required for regulation of flow capacity (control of driving air input into the distributor valve should be however preferred) and for inspectionand maintenance of the pump.

2. The discharge piping must be sized in order to allow a flow of liquid at least the triple of the pump capacity (such as suction pipe : see § 4.4-1).

3. Do not attempt to self-prime when the discharge pipe is filled with liquid (this is impossible if static head is more than 2 meters H2O because the pump can't compress the air from suction pipe suffi ciently to overcome the large static volumetric head. Arrange recirculation from discharge line to suction line (by-pass) using a foot valve on suction line

4.6 Air supply piping

Recommended size : **Ø ½"** for RP 20 and RP 60.
Ø 1" for RP 150 and Duplex pumps.

CAUTION : A pressure regulating valve should be installed to insure air supply pressure does not exceed recommended limits. Always blow out air line before connecting to air distributor, to remove dirt or rust. Clean out screen at air connection as needed.

Driving air should be **no lubricated,** clean, possibly dry and filtered.

CAUTION : water in the compressed air supply can create problems such as icing or freezing of the exhaust air, causing the reduction of the pump flow or stop operating. Water in the air supply can be reduced by using a point-of-use air dryer to supplement the user's air drying equipment. This device removes water from the compressed air supply and allievates the icing or freezing problems.
CAUTION : the air distributor and the pilot valve are designed to operate without lubrication.
When the air distributor may "freeze up" due to moisture in air or to the low tmperatures, install in the air line a drip feed lubricator filled with **monoethylene glycol** antifreeze at minimum setting **(1-2 drops/15-20 min).**

AIR PRESSURE SUPPLY : should be kept 1 or 3 bar higher than the pump discharge pressure and, in any case, it should never drop below 2,5 bar or exceed 10 bar.

AIR FLOW : make sure that flow of compressed air is sufficient, checking that pressure read at the pressure regulator gauge never drops below the total dynamic head of pump.

NOTICE : Make sure that effective passageway of pressure regulator, filter, etc. is not inferior to cross-sectional area of air pipe. The air filter should be cleaned out regularly to avoid pump flow reduction.

EXHAUST SILENCER : pneumatic air distributor is supplied with exhaust silencer (item 93); the silencer disc should be cleaned out regularly with gasoline and blown out with cleaned compressed air or, if necessary, replaced by a new disc.

5. START - UP

5.1 Checks before starting-up

a) Air supply line

Adjust the pressure regulator so that the driving air pressure is equal to the total discharge head plus 1 to 3 bar.

WARNING : Do not exceed 10 bars air supply pressure.

When total discharge head is negligible (0-15 m W.C.) avoid to drive the pump with an excessive air pressure (max. 3,5 bar) because it could be possible to meet the following undesired effects :

a) excessive stress and wear of the diaphragms
b) high noise level due to the balls in the check valves for lack of counterpressure on the discharge side
c) anti-economic waste of compressed air

b) Shut-off valve

Check to be sure that shut-off valve on the suction piping is completely open..

c) Inert liquid valves

The bleeder (26) and inert liquid (31) valves must be closed since a leakage of inert liquid or an air blow-in may reduce drastically the pump capacity. When a new pump comes out from the factory, these valves are always sealed and no further control is required. If the inert liquid is to be changed for process requirements, check to be sure that the replacing liquid will not damage the rubber flat membrane or the pump body.
Refer to Section 7 **§ 7.1-**3) for specific detailed instructions to re-fill the pump with a new inert liquid.

5.2 Start-up of the system

Open the throttle valve of air distributor allowing air to enter into the pump : the air distributor (50) starts immediately its pulsations. By adjusting the frequency regulator (85), keep the pulsation frequency between :

30 and 120 cycles/min for RP 20 and RP 60 pumps -
30 and 100 cycles/min for RP 150 and duplex pumps -

CAUTION : when the air driving pressure is changed, the strokes frequency proportionally increases or decreases so that a re-adjustment of frequency of cycles is required for desired performance..

Block frequency regulator with its blocking nut (86) when the required strokes frequency is set up.

6. OPERATING

6.1 Adjustment

a) Normal operation

When the pump in service under normal operating conditions, the valve installed in the discharge line must be kept completely open. If flow capacity must be regulated, adjust the throttle valve of the air distributor and/or the pilot valve.

b) Operation at reduced capacities

Do not operate the pump at greatly reduced capacities with discharge valve completely open, because the air distributor does not work regularly when the driving pressure is too low (minimum air supply pressure : 2,5 bar). In this case throttle with the pump discharge valve to reduce the flow rate..

6.2 Between uses

When the pump is used for materials that tend to settle out or solidify when not in motion, the pump should be flushed after each use to prevent damage. Product remaining in the pump between uses could dry out or settle out. This could cause problems with the tubular diaphragm and the check valves at restart.

7. *MAINTENANCE*

Preliminary notes comprising instructions for safe maintenance practice

The maintenance is very simple but special attention and precautions are required when the chemical properties of the pumped fluid are such as to cause injures to the health of the users, workmen or third persons and to cause damages to property or enviroment.
Maximum caution shall be used from the operator in charge of the removal of the pump because the handling liquids are often hazarduos media (potential explosive, firespreading, inflammable), strongly toxic if touched or inhaled.

CAUTION : before any maintenance or repair is attempted, the compressed air line to the pump should be disconnected and all air pressure allowed to bleed from the pump.

WARNING : before starting disassembly of the pump, clean and neutralize all wetted parts , being a minimum volume of pumped liquid left inside the pump, especially in the suction valve, even if the pump is allowed to dry run for draining.
Wear always safety glasses and gloves.

When the maintenance is due to a misfunctioning (loss of performance) of the pump, the operator must expect the tubular diaphragm failure and take action to avoid any risk or damage.

WARNING : when tubular diaphragm failure occurs, the inert liquid mixes, at concentration growing, with the pumped product ; therefore the handler should obtain Material Safety Data Sheet from the chemical supplier for all materials being pumped for appropriate handling instructions.

The possibility that the inert liquid can be turn into a potential source of hazard displays the reason for which the bleeder valve (26) and the inert liquid valve (31) must be always sealed ; in fact a dripping of contaminated liquid could cause phisical injury or damage to health or property.

CAUTION : the same safety precautions should be taken when the pump has to be maintened and repaired at the local distributor or at the manufacturer ; before shipping the pump, wash and neutralize all wetted parts and drain the pump emptying it from the inert liquid.

7.1 P.T.F.E. tubular diaphragm replacement

1) Proper tubular diaphragm (item 22) replacement is critical to pump performance. Great care must be taken to ensure that tubular diaphragm is properly placed. Open the valve (item 31) and bleeder (item 26), discard the inert liquid, remove the two check valves by slackening bolts of (item 6) and (item 10) from the pump body (item 1). Remove the lock flange (3) from the pump body, disconnect the lower cover (1A) and remove the tubular diaphragm from it.

2) Before mounting the new tubular diaphragm, make sure that it is fitted with the inside PTFE spacers (item 21) and (item 29). Enter one end of the new tubular diaphragm into the lower cover, making sure that it is properly flared : heat

one end with hot air to facilitate this operation , utilizing a thermic pistol ; the temperature should be from 140 and 180° (280/355°F), otherwise the PTFE tubular diaphragm loses its proper shape for a perfect working.
Do not heat all the PTFE tube !
To reach a correct centering, the tubular diaphragm must be coaxial at lower cover (item 1A). Bolt and tighten firmly the lock flange (item 3A). Replace the O-ring (item 18) with a new one. Introduce the diaphragm assembly inside the pump body and make sure that the end of the tubular diaphragm is properly flared and fitted in its original position. Fix the cover to pump body tightening bolts (item 23). Heat and flare the upper end of the tubular diaphragm; mount the lock flange (item 3) and firmly tighten the corresponding bolts.

3) Now the replacement of inert liquid, between the flat diaphragm (15) and the tubular diaphragm (22), is to be carried out ; the pump is standardly supplied filled with monoethylene glycol based antifreeze mixture which allows operation up to -20°C. The pump can be filled with only water if this is accepted for the operating conditions. Some further liquids are available, that is glycerin, liquid paraffin (vaseline oil), silicone oil and other usual lubricants ; any kind of liquid can be required from the user if it is compatible with the materials of the pump body and rubber air diaphragm, besides with the working conditions. When high temperature duty is required, verify the coefficient of thermal expansion of the filling liquid in order to calculate the its correct volume.

NOTICE : verify the inert liquid used for the original filling in the cover of this manual where the pump's material of construction are listed. When the inert liquid is to be modified, report this changing on the manual.

Estimated inert liquid quantity :

Pump RP 20 :	1,8 lit. (± 3%)	Pump RP 150 :	10 lit. (± 5%)
Pump RP 60 :	4,8 lit. (± 3%)	Pump RP 150 duplex :	20 lit. (± 5%)
Pump RP 60 duplex :	9,6 lit. (± 5%)		

To achieve correctly this operation, proceed as follows :

a) Open bleeder valve (item 26) and inert liquid valve (item 31).

b) Introduce inert liquid through valve (31) lifting the pump in vertical position.

c) Close the inert liquid valve (31), when liquid starts leaking from the bleeder valve (26) that is to be open.

d) Send low pressure (0,5 bar) compressed air on flat diaphragm (15), closing the air exhaust port of the pilot valve or, in case of doubt, removing the air distributor and send compressed air directly through the connection on the cover (item 2). The inert liquid starts leaking from bleeder valve and the tubular diaphragm (22) starts gradually closing.

CAUTION : The distance between tubular diaphragm internal walls and spacer (21) must be kept always equal 2 mm (3 mm for RP 150 simplex and duplex).

A lower distance could be cause the failure of the PTFE tube while an higher one should reduce pump flow.

Increase slowly air pressure checking that inert liquid is leaking from vent cock; when, in spite of the continuous and slow air pressure increase, the distance between the opposite internal walls starts to increase, close immediately the bleeder valve (26).

A bench test is advisable to verify the required distance between tubular diaphragm walls and spacer.

Then mount the suction check valve (10) below the lower cover and the discharge chech valve (6) above the pump body.

Bleeder and inert liquid valves should be sealed.

RP 150 simplex and duplex pumps

Prior to effect operations a).....d), make sure that the position of the flat diaphragm (15) corresponds to maximum opening of tubular diaphragm (suction phase). In case of doubt, remove air distributor and send compressed air at 2-3 bar through the connection corresponding to piston (RP 150 SX) or to the opposite body (duplex pumps).

7.2 Flexible rubber diaphragm replacement

The rubber diaphragm (15) has a double function : it separates driving fluid (compressed air or nitrogen) from inert liquid, which transmits power to tubular diaphragm (22), and allows its complete opening of during the suction phase.
Rubber flexibility and elasticity are therefore essential requirements for a correct service, so that the rubber diaphragm should be replaced when a loss of elasticity causes decreased performance.
Several elastomers are available to mould air diaphragm : natural rubber, neoprene, EPDM, reinforced silicone, HNBR and Viton® backed neoprene. Make sure of the elastomer compatibility with the inert liquid and with handling liquid temperature.

CAUTION : when the pump is to be used for a different application compared with the specifications for which it was bought, check air diaphragm rubber is compatible with the new operating conditions.

RP 20 and RP 60 simplex pumps

Remove cover (2), nuts (17A) and pressure ring (14). Mount the new rubber diaphragm, the pressure ring, tightening firmly against it the nuts. The O-ring gasket (16) should be replaced with a new one. The cover can then be mounted and nuts (17) tightened firmly.

Follow the istructions for refilling the pump with inert liquid stated in § 7.1-3) for tubular diaphragm replacement.

RP 150 simplex and duplex pumps

Remove the rubber diaphragm, take away the bushings (15H), inspecting shaft (15D) and cup ring gasket (15F) : if they are worn or damaged, replace with new ones. Mount the shaft and cup ring gaskets, checking correct location of the O-ring (15E). Turn the rubber diaphragm support (15B), mount a new rubber diaphragm with bushings (15H), the support (15A) and (only for RP 150 DX) the O-ring (15G).
Bolt nut (15C) tightening until the pin locks the shaft, mount cover (2) and tighten firmly.

7.3 Check valves

When balls (24) or PTFE (24S) shuttles are excessively worn or damaged from abrasion , replace them with new genuine CODIP ones. When seats of suction valve (10) or discharge flange (3) are damaged and unable to grant a perfect tightness, repairing could be tried with manually rotating a grinding ball about 90° clockwise and alternatively anti-clockwise. Replace worn parts for reliable performance.

7.4 Compressed air distributor (Sectional Dwg. No. 1955 – Attached I)

The wear on the distributor assembly is almost entirely confined to the plug (71), the gasket (75) and (76) of piston (74) and the shuttles (79) and (81) of pilot valve ; they form a close fitting seal which prevent air losses. As the wear increases after a long period of operation, the operation of distributor is inefficient and all the a.m. items must be replaced.
Open the air distributor, clean and degrease all its metallic parts and blow out with clean air. If internal cylindrical surfaces are scratched they should be rectified or replaced by new ones. When replacing plug (71) and shuttles (79) and (81) replace also springs (73), (78) and (80), filters (84) and (87) and the complete frequency regulator (85-86).

Prior to mount the plug, the gaskets, the shuttles and all the static gaskets make sure they are properly coated with silicone grease.

8. TROUBLESHOOTING

The following is a concise set of troubleshooting suggestions.

a) Air distributor does not work

a) Check to be sure that driving air is correctly supplied to distributor. See § 4.6

b) Check to be sure tha tair exhaust muffler (item 93) is not plugged ; clean out its disc with gasoline and blow out with clean compressed air. Repeat checking for pilot valve 1/8" silencer (item 89).

c) Close the air supply valve and open it quickly two or three times

d) Open the distributor assembly as stated in § 7.4.

b) Pump runs but no liquid flows

a) Check to be sure that driving air pressure is sufficient. See § 5.1 a)

b) Check to be sure that pump body is filled with inert liquid and that valve (31) and bleeder (26) are tight closed (sealed).
Avoid this control in case of new pumps due to the original leaden seals of the two inert liquid valves.

c) Check to be sure that check valves are not plugged or damaged. See § 7.3

d) Check to be sure that suction pipe is not plugged and air-tight. See § 4.4

c) Pump runs but little liquid flows

Check all points stated in the above section and then :

a) check for pump cavitation ; reduce the air supply pressure to allow liquid to enter pumping tube. Increase air pressure accordingly.

b) Regulate stroke frequency till the maximum flow is obtained

c) Remove the discharge valve (6) and its ball (24) or shuttle (24S), make sure that the motion of the tubular diaphragm (22), being pump operated at 60-80 cy./min, is correct as stated in § 7.1 - 3).

d) Inspect rubber air diaphragm (15) and replace it if worn excessively or not sufficiently flexible and elastic. See § 7.2 for detailed replacement instructions.

e) Check to be sure that the quantity of inert liquid is sufficient .If necessary fill again as stated in § 7.1-3) .

d) Air distributor freezes

Check for excessive moisture in compressed air. Install either a dryer or a hot air generator for compressed air.

e) Air bubbles in pump discharge

Check for diaphragms rupture (tubular and rubber flat) and check to make sure all flanged connections are air tight.