OPERATING, SAFETY AND MAINTENANCE INSTRUCTIONS

MONO STAGE CENTRIFUGUAL EXTRACTOR

BXP-800

Customer: VIRDIA

Serial No. 800344-800349

Revision Date: August 28, 2015

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1 IMPORTANT SAFETY INFORMATION

1.1 INTRODUCTION

This manual provides installation, operating, safety, and maintenance information for your **ROUSSELET ROBATEL** centrifuge. This manual is intended as a supplement to the safety training provided by the employer who must ensure that all personnel who will use the **ROUSSELET ROBATEL** centrifuge are trained in its safe operation.

This centrifuge must be operated only by qualified personnel who have read and understood this entire operating and safety manual. Be sure that all operators know how to shut down the centrifuge in case of an emergency. If there are any questions concerning the safe operation of this centrifuge, please call **ROBATEL INC** immediately at 413-499-4818.

Correct centrifuge performance depends upon proper installation and maintenance. It is the responsibility of the user to install, maintain, and operate the centrifuge according to the instructions provided in this manual and the operating manuals of any sub-systems that may be included in the **Appendix of this ROUSSELET ROBATEL operating manual.**

Do not remove, destroy, or paint over the warning labels on the equipment. If the warning labels become damaged and need to be replaced, contact ROBATEL INC immediately.

1.2 TYPICAL LOCATION OF SAFETY LABELS ON BXP EXTRACTORS

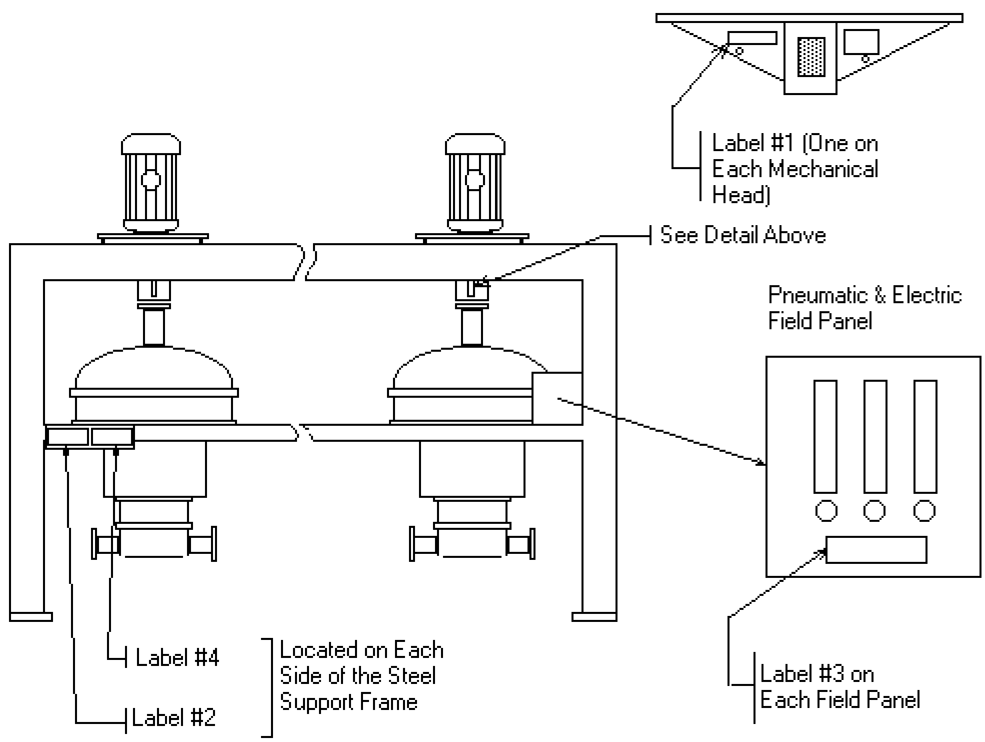


Diagram 1. Safety Label Location.

Label No. 1: Crush and pinch points

Label No. 3: Hazardous voltage inside

Label No. 2: Rotating parts inside

Label No. 4: Read and understand operator's manual

1.3 BEFORE STARTING THE EQUIPMENT

1. Read the entire system manual(s) before attempting installation, start-up, operation or maintenance of this centrifuge. Do not operate the centrifuge without having read the entire operating manual.
2. Customers must pour conduit seal fittings before system operation in a hazardous area.
3. The machine should be connected to a proper venting system as this connection can likely contain flammable vapors.
4. The machine should be connected to an "earth ground" by less than one ohm prior to being powered.
5. Personal safety equipment should always be worn while the machine is being worked on or while the machine is in operation.
6. A local emergency stop button should be provided.
7. Do not operate the centrifuge unless the oxygen content inside the centrifuge is safe for the products being processed.
8. Do not process flammable, explosive, toxic, or otherwise hazardous material without first performing a hazard analysis.

1.4 GENERAL OPERATION

1. Never remove the guards or attempt to access the motor and drive assembly while the centrifuge is in operation.

2. Never feed product to the centrifuge unless the centrifuge atmosphere has been inerted to a point, which is considered safe for the solvents being processed.

3. Do not defeat, bypass, or modify the vibration monitoring system or any other safety interlocks provided with the machine.

4. Do not increase the centrifuge's rotational speed above the maximum value imprinted on the centrifuge's nameplate. ⚠ **WARNING!** Operating the centrifuge above its maximum rotational speed could cause mechanical damage, which could result in personal injury or death.

5. Do not replace components with parts, which are unequal in quality or type.

6. Be sure that the personnel operating the centrifuge know the risks and correct procedures associated with processing the specific products to prevent fire, explosion, and exposure to hazardous materials.

7. Do not adjust the programming or any programmed parameters without **ROUSSELET ROBATEL's** written authorization.

8. Disconnect and lock out the power supply before working with components mounted on the machine rotor.

9. Be sure that all fasteners on the rotor are tightened properly.

10. Pressure above **16" W.C.** is considered dangerous and creates a risk of vapor out-leakage and/or mechanical damage to the equipment.

11. Do not operate the machine if the guards have been defeated, removed or modified.

12. Do not operate the machine for a prolonged duration while experiencing high vibration.

13. Care should be taken to prevent operator exposure to harsh chemicals, solvent vapors and/or nitrogen that may accumulate within the machine casing.

14. Do not operate the machine with a corroded or damaged rotor.

15. Any oxygen monitor must be checked and calibrated at regular intervals to be sure that the atmosphere within the centrifuge is safe.

1.5 WHILE SERVICING ELECTRICAL COMPONENTS

1. Do not touch anything within the cabinets until you have verified that it is neither thermally or electrically "hot."

2. Do not assume that switching the circuit breakers off removes all voltage from inside the cabinets. Voltage is still present on the input circuit breaker and there may be voltages present from an external source.

3. Do not connect or disconnect any meters, wiring, or printed circuit boards while the components are powered.

4. Do not connect any grounded (non-isolated) meters or oscilloscopes to the equipment.

5. Do not remove safety shields (marked with a high voltage sign) or attempt to measure points under the shields.

6. Do not store any flammable material in, around, or on the electrical enclosures. This includes equipment drawings.

7. Use extreme caution when handling or measuring components within the enclosures.

8. Take care that meter leads do not short together or to other terminals.

9. Work with one hand and wear insulated or rubber shoes.

10. Wear safety glasses when working on the equipment.

11. Always work with another person present.

12. Any electrical work should be performed by qualified personnel.

13. Any cabinets which can easily be opened should be locked to prevent unauthorized access.

14. Any enclosure which has a power switch interlocked with the closed door should not be defeated.

15. If it is necessary to open the electrical enclosures while the system is powered, confirm that the atmosphere is safe to do so. Normal precautions should be taken whenever servicing electrical components.

1.6 Mono-Stage Extractor Specifications:

Please refer to the below table for Rousselet Robatel Mono-Stage extraction equipment specifications. This table shows the machine models available. The model supplied as described in this manual is our **Model No. BXP-800.**

TECHNICAL CHARACTERISTICS – METALLIC CONSTRUCTION

Model	Bowl Diameter mm (inches)	Bowl Capacity liters (Gallons)	Maximum Speed (RPM)	G-force (x G)	Combined Throughput Liters/hr (GPM)	Motor Power kW (HP)
BXP 012	12 (0.47)	0.0022 (0.0005)	10000	671	2 (0.009)	0.025 (0.033)
BXP 025	25 (1)	0.019 (0.005)	4000	223	10 (0.044)	0.041 (0.055)
BXP 040	40 (1.6)	0.11 (0.03)	3600	290	60 (0.26)	0.025 (0.033)
BXP 080	80 (3.15)	0.3 (0.08)	3600	580	140 (0.61)	0.12 (0.16)
BXP 190	190 (7.5)	4.2 (1.1)	3600	1377	3500 (15.4)	1.1 (1.5)
BXP 320	320 (12.6)	17 (4.5)	3600	2318	7000 (30.8)	5.5 (7.5)
BXP 360	360 (14.2)	29 (7.6)	3600	2608	12000 (52.6)	5.5 (7.5)
BXP 520	520 (20.5)	110 (29)	1750	890	30000 (132)	7.5 (10)
BXP 800	800 (31.5)	320 (84)	1300	756	55000-70000 (241-307)	18.5 (25)

Table 1. Rousselet Robatel Mono-stage extractor specifications.

1.7 Features & Advantages of Monostage Centrifugal Extractor Model BXP:

- ✓ DIRECT MOTOR COUPLING TO THE MAIN SHAFT
- ✓ SHORT RETENTION TIME AND LOW LIQUID HOLDUP
- ✓ WELL ADAPTED TO BATCH AND CONTINUOUS OPERATION
- ✓ NO BOTTOM BEARING IN PROCESS AREA
- ✓ EFFICIENT PHASE SEPARATION UTILIZING CENTRIFUGAL FORCE
- ✓ UNATTENDED OPERATION
- ✓ HIGH THROUGHPUTS ACHIEVED IN COMPACT UNIT
- ✓ HIGH EXTRACTION EFFICIENCY DUE TO THOROUGH MIXING.
- ✓ EACH BXP EXTRACTOR NEARLY CORRESPONDS TO A THEORETICAL EXTRACTION STAGE.
- ✓ CAN BE CONNECTED IN SERIES TO ACHIEVE THE REQUIRED NUMBER OF STAGES.
- ✓ NO INTERSTAGE PUMPS ARE REQUIRED.
- ✓ RAPID OPERATIONAL EQUILIBRIUM
- ✓ CAN SERVE AS LIQUID / LIQUID SEPARATOR AND/OR LIQUID / LIQUID EXTRACTOR

2 TECHNICAL CHARACTERISTICS

IDENTIFICATION	
Machine :	Mono-Stage Centrifugal Extractors
Type :	BXP-800
Identification n° :	800344-800349
Number of stages :	6
Number of Frames :	Two - 3 stage frames
RANGE OF USE	
Possible uses for this machine :	- Liquid/Liquid Separation/Extraction
Environment :	- Operation possible in Class 1, Division 1, Group C&D area - ambient temperature : 0 to 80° C
Products treated by this machine	- multi-product use - chemically compatible with materials listed below - temperature : 0 to 80° C
Serial No. vs. Customer No.:	800344 (CF-2401A) 800345 (CF-2400A) 800346 (CF-2402) 800347 (CF-2401B) 800348 (CF-2400B) 800349 (CF-2403)
Special Features :	Heavy Phase Recycling on SN. 800346 (CF-2402)
Special Features :	Bowl CIP on SN. 800346 (CF-2402) & 800349 (CF-2403)
Special Features :	Special Mixing Chamber on SN. 800346 (CF-2402)
Special Features :	Intersatge Piping for both phases on SN. 800345 (CF-2400A) & 800344 (CF-2401A)
Special Features :	Intersatge Piping for both phases on SN. 800348 (CF-2400B) & 800347 (CF-2401B)
Special Features :	Intersatge Piping for light phase on SN. 800345 (CF-2400A) & 800346 (CF-2402)
Special Features :	Customer Supplied valves on light phase outlets on SN. 800345 (CF-2400A) & 800348 (CF-2400B)
Special Features :	Flexible connection only supplied with Rousselet Robatel supplied interstage piping. All other piping supplied by Customer.
Special Features :	Fleixble connection on extra mixing chamber inlet SN. 800346 (CF-2402)
Materials in contact with the product treated:	
. metals	316L Stainless Steel
. O-ring seals \ lip seals :	Kalrez \ FEP coated \ PTFE \ PTFE graphite
Internal diameter of the bowl :	800 mm
Light phase overflow weir diameter :	350 mm
Heavy phase overflow weir diameters :	420 mm (Installed), 410 mm (Spare) 800344 (CF-2401A) 420 mm (Installed), 410 mm (Spare) 800345 (CF-2400A) 420 mm (Installed), 410 mm (Spare) 800346 (CF-2402) 420 mm (Installed), 410 mm (Spare) 800347 (CF-2401B) 420 mm (Installed), 410 mm (Spare) 800348 (CF-2400B) 420 mm (Installed), 410 mm (Spare) 800349 (CF-2403)

Bowl volume :	320 liters
Nominal Throughput (Total Both Liquids) :	55-75 m³/hour (240 – 330 gpm)
Nominal bowl speed :	1200 rpm (Depending on Product Density)
Maximum bowl speed :	1400 rpm (Depending on Product Density)
Min\Max. pressure inside the machine :	Atmospheric pressure - 0 \ + 50 mbar
ELECTRICAL EQUIPMENT	
Motor . type :	40 HP, Baldor - Reliance, 364TD, 1200 rpm
Protection:	Class 1 Division 1, Groups C&D
thermal protection :	T3C
Control panel :	Not applicable to this machine
AC drive :	Not applicable to this machine
Braking :	Not applicable to this machine
Vibration sensor :	Metrix, Item No. ST5484E-123-020-00
Vibration Monitor :	Not applicable to this machine
Bearing Temperature :	Pyromationn, Item No. 99-226-20
Oxygen analyzer / N2 blanketing system :	Not applicable to this machine
Other equipment in area (solenoid valves, sensors,)	See Appendix
MISCELLANEOUS	
Lubrication of bearings :	PETAMO GHY133N or equivalent
Airborne noise emitted (acoustic pressure) :	< 75 dBA (measurement taken 1 meter from the machine at ground level)
CONNECTIONS	
Process connections :	see Installation drawing and connection summary
Instrument Air supply :	Not applicable to this machine
Nitrogen supply :	20” W.C. (within casing)
Electricity cabinet supply :	Not applicable to this machine
Grounding	maximum 1 ohm impedance
WEIGHTS AND DIMENSIONS	
Mass \ electric cabinet size:	Not applicable to this machine
Mass one stage for weir replacement :	1900 kg (Empty)
Mass of one 3 stage assembly :	9000 kg (Empty)
Dimensions of one 3 stage assembly :	5320 x 1780 x 4006 mm

Table 2. Technical Characteristics (Limit of supply summary).

3 GENERAL DESCRIPTION:

3.1 LIQUID / LIQUID EXTRACTION INTRODUCTION:

Liquid - liquid extraction, also called solvent extraction, is a process that allows the separation of two or more components due to their unequal solubilities in two immiscible liquid phases.

A feed solution initially containing one or more solutes is thoroughly mixed with an immiscible solvent having a different density. The mixing provides a large interfacial area so that efficient mass transfer of the desired solute can occur between the two immiscible liquids.

The liquid-liquid dispersion created during the mixing is then separated by gravity or by centrifugal force depending upon the type of extractor selected. The mixing and separation steps constitute one stage of extraction. All of our extractors are stage-wise contactors rather than differential contactors.

The solvent is chosen to selectively extract certain components from the feed solution. Depending upon the selectivity of the solvent and the amount of mass transfer required to achieve the desired solute recovery, several stages of extraction may be required. In this case, counter-current contact is the most efficient extraction method.

Depending upon the process parameters (mass transfer, kinetics, density difference, etc...), two extraction technologies are available from Rousselet Robatel : Mixer-Settlers and Centrifugal Extractors. We offer Monostage and Multistage Centrifugal Extractors, also called Centrifugal Contactors. **Please refer Section 1.6 for our full range of Mono stage offerings and/or visit our website (www.rousselet-robatel.com).**

3.2 LIQUID / LIQUID EXTRACTION TERMINOLOGY:

Please refer to the liquid - liquid extraction glossary in Section 14 of the Operating Manual for a list of commonly used terms, many of which are used in this Operating Manual.

3.3 LIQUID / LIQUID CENTRIFUGAL SEPARATOR INTRODUCTION:

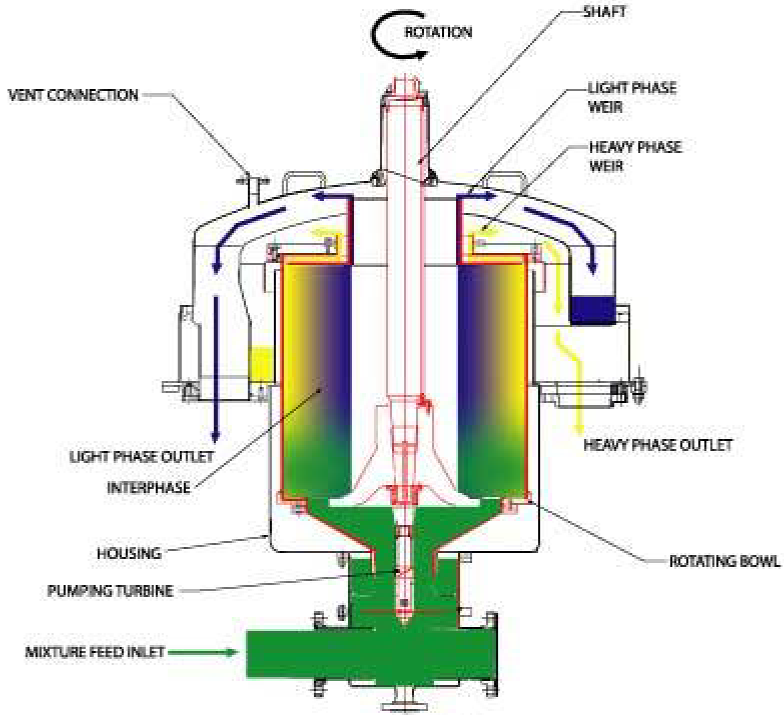


Figure 1. Single stage Rousselet Robatel BXP centrifugal separator.

When operating as a liquid / liquid centrifugal separator, a mixture of two immiscible liquids with different densities is fed to the bottom of the centrifuge housing. The liquid / liquid mixture is aspirated into the centrifuge bowl.

The liquids are separated by the centrifugal force generated by the rotating bowl. The heavier liquid **(shown in Figure 1)** occupies the outer portion of the bowl. The light liquid occupies the inner portion of the bowl.

The position of the liquid / liquid interphase is regulated by a heavy phase weir. Interchangeable heavy phase weirs of different diameters accommodate a wide range of density ratios. The heavy phase underflows to a static receiving chamber. The light phase overflows to a separate static receiving chamber.

The liquids are discharged by gravity to downstream equipment. Low mix pumping turbines are available for shear sensitive applications.

3.4 LIQUID / LIQUID CENTRIFUGAL EXTRACTOR INTRODUCTION:

The **ROUSSELET ROBATEL BXP-800** is a mono-stage centrifugal extractor. The liquid to be extracted and the solvent contact are mixed and separated in the centrifugal field. The solutes initially in feed solution are efficiently extracted by the solvent.

⚠**CAUTION!** Be sure that the personnel operating the centrifuge know the risks and correct procedures associated with processing the specific products to prevent fire, explosion, and exposure to hazardous materials.

⚠**WARNING!** Never feed product to the centrifuge unless the centrifuge atmosphere has been inerted to a point, this is considered safe for the solvents being processed. Failure to do so could result in fire, explosion, injury or death.

⚠**WARNING!** Operation at a temperature above that which is allowed for the hazardous area is considered dangerous and could cause fire or explosion resulting in serious personal injury or death.

⚠**CAUTION!** Personal safety equipment should always be worn while the machine is being worked on or while the machine is in operation.

It is **obligatory** to install the **BXP-800** assembly at a higher level (ex. on a metallic support) than the receiving tanks because the liquids are discharged from the extractor by gravity.

⚠**WARNING! Never obstruct the liquid outlets from the machine. The backup of liquid could result in excessive vibration or mechanical damage to the rotor or bearings.**

When operating as a centrifugal extractor for performing liquid-liquid extractions, a feed solution, containing one or more solutes (shown in Yellow), and an immiscible solvent (shown in Blue) with a different density than that of the feed solution are fed to the mixing chamber located on the bottom of the centrifuge housing. As shown in **Figures 2 & 3**.

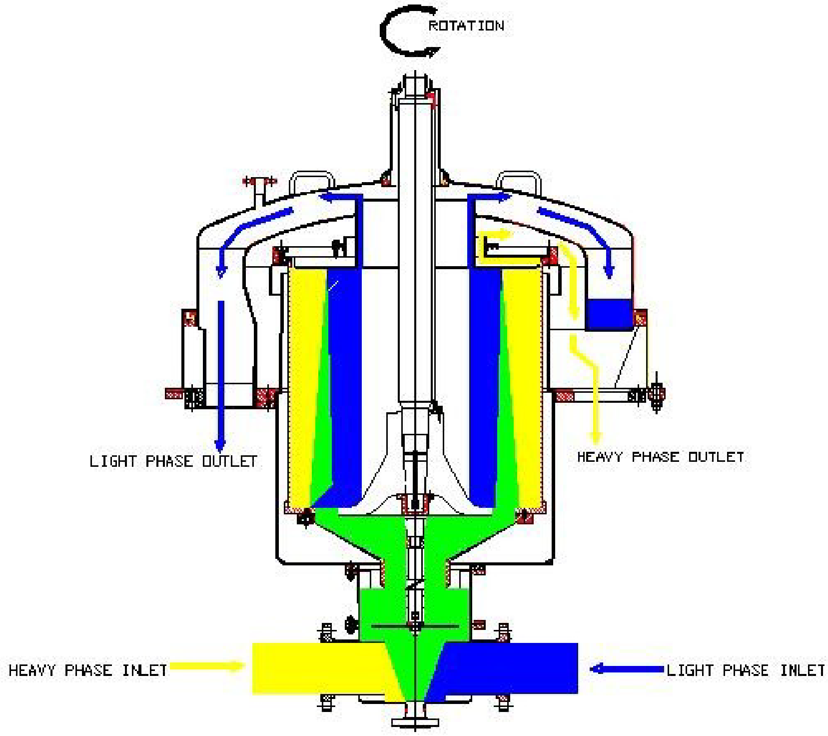


Figure 2. Single stage Rousselet Robatel BXP extraction flow diagram.

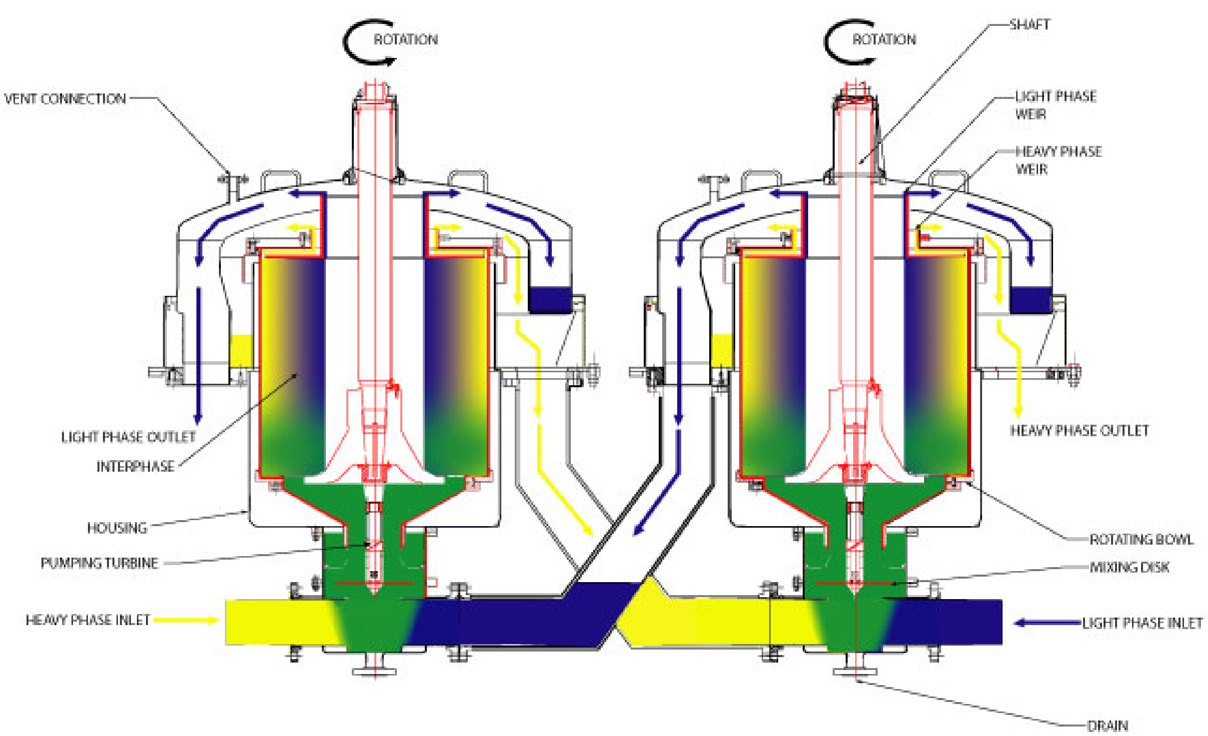


Figure 3. Rousselet Robatel BXP 2 stage counter current extraction liquid flow diagram.

The liquids are mixed as they flow between the feed chamber and the rotating bowl. The mixing disc and turbine at the bottom of the casing create a dispersion (shown in green). The efficient mixing creates a large interfacial area between the two liquids to ensure maximum mass transfer of the solutes.

The dispersion is aspirated into the centrifuge bowl through a hole in the bottom of the bowl. The liquids are separated by the centrifugal force generated by the rotating bowl. The heavier liquid (shown in Yellow) occupies the outer portion of the bowl. The light liquid (shown in Blue) occupies the inner portion of the bowl.

The position of the liquid / liquid interphase is regulated by a heavy phase weir. The heavy phase weir accommodates a wide range of density ratios. The heavy phase underflows to a static receiving chamber. The light phase overflows to a separate static receiving chamber.

The liquids are discharged by gravity to the next BXP centrifugal extractor or to downstream equipment. For multi-stage extraction processes, Rousselet Robatel Model BXP centrifugal extractors can be installed in series to provide the required number of stages. No inter-stage pumps are required between the extractors.

However, it is possible to use the extractor alone, and in this case, it is then installed on a support especially dedicated to receive it and ensure the various process connections.

A vent connection is located on the top portion of the casing **(refer to installation drawing). Please verify that this connection is not obstructed by any solids and is free flowing.**

4 GENERAL INFORMATION

4.1 GENERAL DESCRIPTION

A battery of **ROUSSELET ROBATEL BXP-800** centrifugal extractors consists of several mono-stage units.

All wetted parts are made from **316L Stainless Steel.**

All O-rings and gaskets are **PTFE, Kalrez, or Teflon Encapsulated**.

All fasteners are metric and should not be replaced with American standard fasteners.

⚠**WARNING!** Replacing components with parts, which are unequal in quality or type, could result in mechanical damage that could result in personal injury or death.

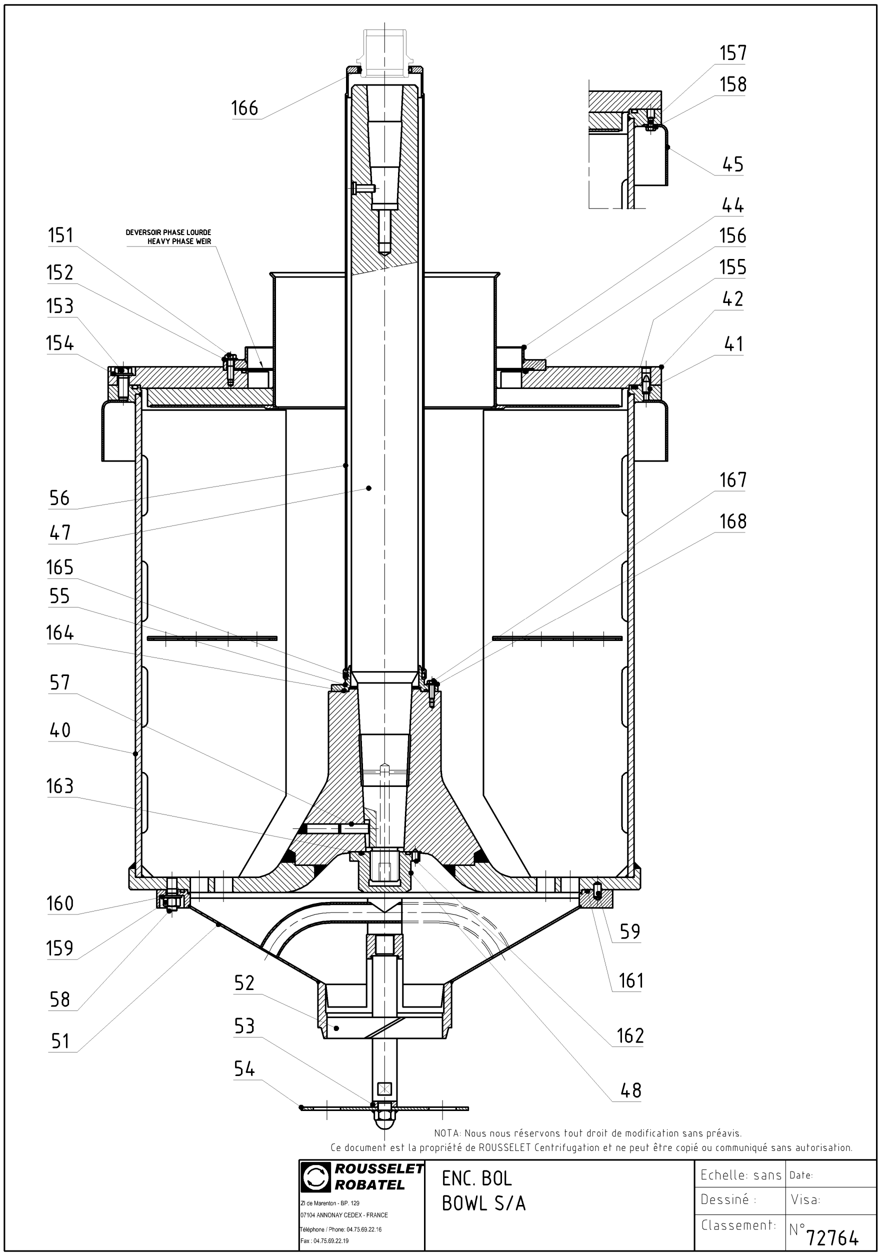
Each stage consists of a casing and a bowl driven by a motor directly coupled to the extractor's pendular shaft. The individual casings will be connected by external pipes **provided by the customer.**

The **BXP-800** extractors, **Serial # 800344 (CF-2401A), 800345 (CF-2400A), 800346 (CF-2402), 800347 (CF-2401B), 800348 (CF-2400B) and 800349 (CF-2403)** consists of:

- Two three-stage batteries for a total of 6 extractors

5 DESCRIPTION OF THE MAIN PARTS

5.1 Bowl



The bowl **(ITEM NO. 40, DRAWING NO. 72764)** has an internal diameter of **800 mm**, a useful volume of **320 liters**, and rotates at a speed of **1400 rpm at 70 Hz**.

The motor can be fed by a variable frequency drive **(Supplied by the customer)** to achieve variable speed operation. In this case, the maximum acceptable speed is **1400 rpm**. The specific gravity of the products and the operating temperature determine the maximum rotational speed. The specific gravity of the products being processed should never exceed

1.25 that is the maximum allowable specific gravity for operation at the bowl's maximum speed.

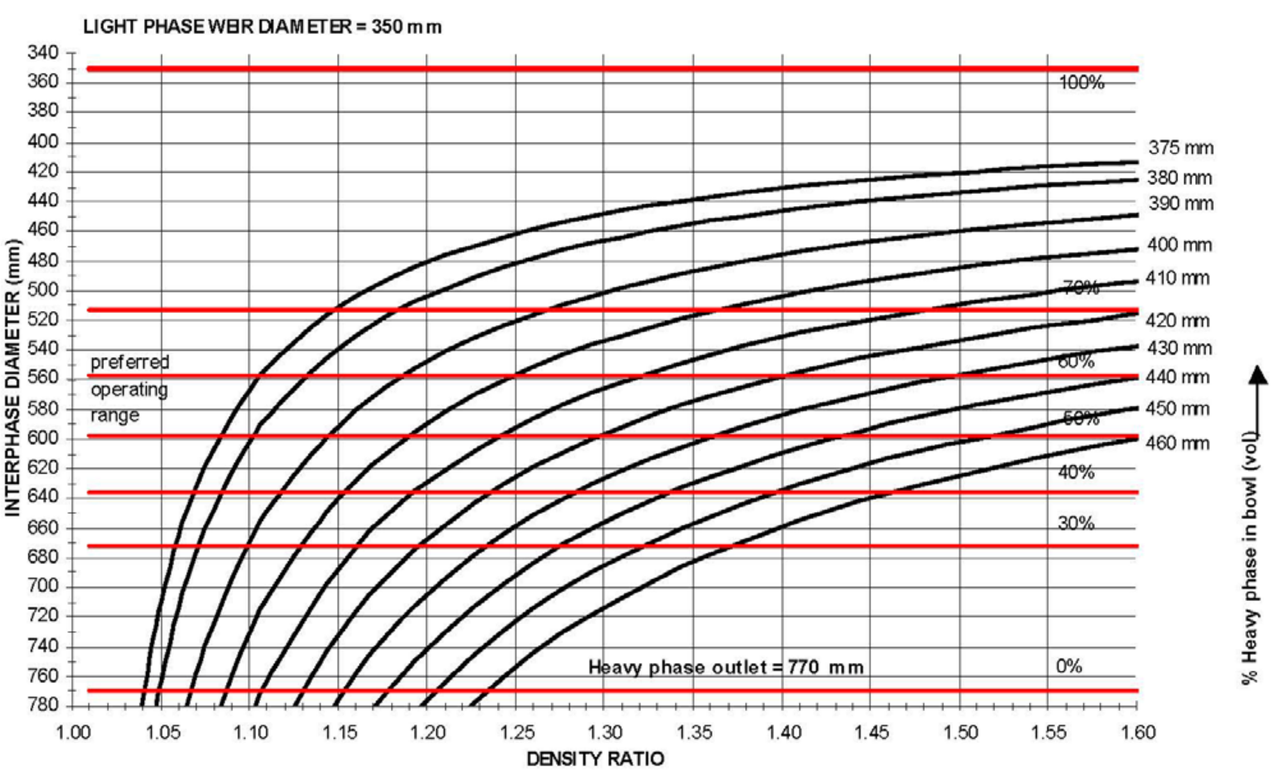
WARNING! Under no circumstances should the maximum rotating speed, the maximum load, or the maximum operating temperature be exceeded. Operation above the rated maximum speed or temperature could result in serious personal injury or death.

CAUTION! Be sure that the personnel operating the centrifuge know the risks and correct procedures associated with processing the specific products to prevent fire, explosion, and exposure to hazardous materials.

CAUTION! Personal safety equipment should always be worn while the machine is being worked on or while the machine is in operation.

The position of the interphase zone (the area in the decanting chamber between the heavy and light phase) is controlled by the inside diameter of the **heavy phase weir** as a function of the liquids' specific gravity ratio. The light phase weir is the inner diameter of the bowl rim **(ITEM NO. 42, DRAWING NO. 72764)** that has a fixed inside diameter **(350 mm).** The diameter of the **heavy phase weir** is selected according to the **Interphase Position Diagram found in Graph 1 below.** This diagram reflects the theoretical position of the interphase as a function of the overflow weir diameters and the liquids' specific gravity ratio.

BXP 800 INTERPHASE POSITION DIAGRAM



Graph 1. Interphase Position Diagram for the BXP-800.

The **heavy phase overflow weir** is removable and is secured to the bowl's upper rim **(ITEM NO. 42, DRAWING NO. 72764)** by the heavy phase deflector **(ITEM NO. 44, DRAWING NO. 72764)**.

The lower shaft **(ITEM NO. 47, DRAWING NO. 72764)** drives the bowl **(ITEM NO. 40, DRAWING NO. 72764)**. The bowl and shaft are connected using a conical fit, alignment pin, and the bowl retaining nut **(ITEM NO. 48, DRAWING NO. 72764)**.

The bowl-retaining nut is locked in position by the screw **(ITEM NO. 162, DRAWING NO. 72764)**. The O-ring **(ITEM NO. 163, DRAWING NO. 72764)** seals between the bowl nut and the bowl.

The top flange of the bowl, the bowl rim, and the heavy phase weir are sealed by the O-rings **(ITEM NO. 155, DRAWING NO. 72764)** and **(ITEM NO. 156, DRAWING NO. 72764)**.

The bottom flange of the bowl and the turbine chamber **(ITEM NO. 51, DRAWING NO. 72764)** are sealed by the O-ring **(ITEM NO. 161, DRAWING NO. 72764)**.

The lower shaft **(ITEM NO. 47, DRAWING NO. 72764)** is martensitic steel (X17 Cr Ni 16.2 NFEN 10088). A protection sleeve **(ITEM NO. 56, DRAWING NO. 72764)** can be provided to help protect the lower shaft from the process.

The rotor assembly is carefully dynamically balanced. The following rotor components are provided with match marks engraved on the sides of the mating flanges, and the match marks must be aligned to assure proper orientation:

- **Bowl (ITEM NO. 40, DRAWING NO. 72764)**
- **Bowl Rim (ITEM NO. 42, DRAWING NO. 72764)**
- **Heavy Phase Deflector (ITEM NO. 44, DRAWING NO. 72764)**
- **Turbine Chamber (ITEM NO. 51, DRAWING NO. 72764)**

The relative angular position of the bowl and the lower shaft is assured by the pin **(ITEM NO. 57, DRAWING NO. 72764)**.

The bowl rim **(ITEM NO. 42, DRAWING NO. 72764)**, the heavy phase deflector **(ITEM NO. 44, DRAWING NO. 72764)**, and the turbine chamber **(ITEM NO. 51, DRAWING NO. 72764)** are equipped with threaded jacking holes to facilitate disassembly of these components. These threaded jacking holes are plugged with the following screws and washers:

- **(ITEM NO. 116, DRAWING NO. 72764) + (ITEM NO. 111, DRAWING NO. 72764) on the bowl rim**
- **(ITEM NO. 112, DRAWING NO. 72764) + (ITEM NO. 101, DRAWING NO. 72764) on the heavy phase deflector**

- **(ITEM NO. 112, DRAWING NO. 72764) + (ITEM NO. 101, DRAWING NO. 72764) on the turbine chamber**

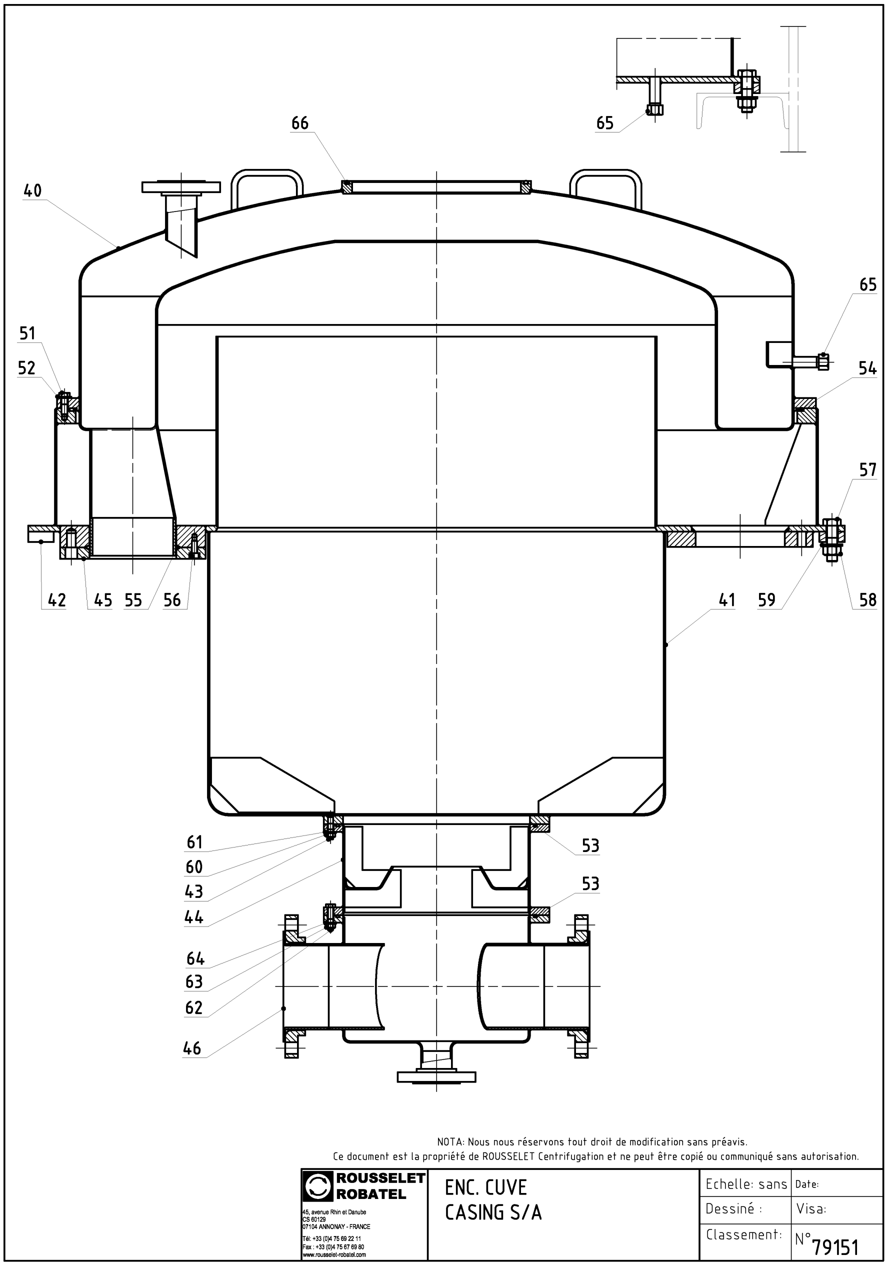
5.2 Turbine & Agitator

The lower portion of the bowl is equipped with a turbine **(ITEM NO. 52, DRAWING NO. 72764)** and a circular agitator **(ITEM NO. 54, DRAWING NO. 72764)** mounted in the turbine chamber **(ITEM NO. 51, DRAWING NO. 72764)**.

The rotation of these pieces inside the casing bottom **(ITEM NO. 44, DRAWING NO. 79151 & 79135)** ensures the thorough mixing of the two liquids and hence, the mass transfer of the desired solute(s) from one liquid phase to the other. These pieces also pump the emulsion created in the mixing zone into the bowl. The spacer **(ITEM NO. 53, DRAWING NO. 72764)** adjusts the position of the agitator with respect to the bottom of the casing.

The agitator **(ITEM NO. 54, DRAWING NO. 72764)** can be removed using a socket on the dome nut. The turbine **(ITEM NO. 52, DRAWING NO. 72764)** can be removed using a **32 mm** open-end wrench.

5.3 Casing



The casing consists of:

- The lower casing **(ITEM NO. 41, DRAWING NO. 79151 & 79135)** receives the heavy phase discharged from the bowl. A flexible connection is mounted between the lower casing's outlet and the heavy phase discharge piping.

- The upper casing **(ITEM NO. 40, DRAWING NO. 79151 & 79135)** receives the light phase discharged from the bowl. The upper casing also includes the vent tube. A flexible connection is mounted between the lower casing's outlet and the heavy phase discharge piping.

- The bottom of the casing **(ITEM NO. 44, DRAWING NO. 79151 & 79135)** serves as the chamber from which the liquid mixture is pumped by the turbine.

- The mixing chamber **(ITEM NO. 46, DRAWING NO. 79151 & 79135)** is mounted beneath the bottom of the casing. The 2 liquid phases are fed into the extractor through the mixing chamber where the rotating agitator ensures thorough mixing. The bottom of the mixing chamber is equipped with a drain valve.

The upper and lower casings are equipped with threaded fittings. The customer can install sampling valves. **(Sampling valves not supplied by ROUSSELET ROBATEL.)**

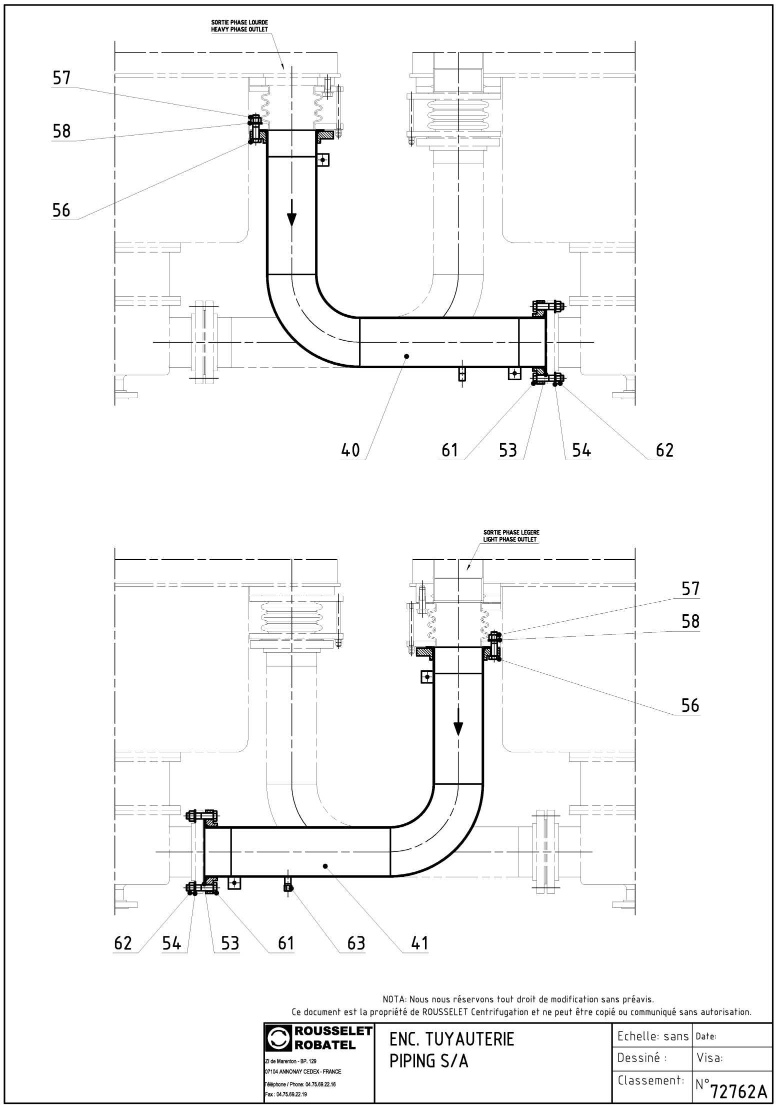
The casing components are sealed by the following O-rings:

- O-ring **(ITEM NO. 53, DRAWING NO. 79151 & 79135)** seals the bottom of the casing **(ITEM NO. 44, DRAWING NO. 79151 & 79135)** and the mixing chamber **(ITEM NO. 46, DRAWING NO. 79151 & 79135)**
- O-ring **(ITEM NO. 54, DRAWING NO. 79151 & 79135)** seals the main flange between the upper casing **(ITEM NO. 40, DRAWING NO. 79151 & 79135)** and the lower casing **(ITEM NO. 41, DRAWING NO. 79151 & 79135)**
- O-ring **(ITEM NO. 55, DRAWING NO. 79151 & 79135)** seals the uppercasing **(ITEM NO. 40, DRAWING NO. 79151 & 79135)** and the lower casing **(ITEM NO. 41, DRAWING NO. 79151 & 79135)** around the light phase discharge pipe. The flange of the light phase discharge pipe **(ITEM NO. 45, DRAWING NO. 79151 & 79135)** compresses the O-ring **(ITEM NO. 55, DRAWING NO. 79151 & 79135)**.

The casing was mounted in our shop using the spacers **(ITEM NO. 42, DRAWING NO. 79151 & 79135)** to compensate for small differences in height of the welded casing.

The casings are connected to the steel support frames by grounding straps.

5.4 Process Piping



The process piping between the extractor(s) are not all supplied by ROUSSELET ROBATEL for this project.

The liquid inlet connections and the liquid outlet connections are equipped with **6” ANSI flanges** and must be connected to the field piping using flexible connections **(not all included with the machine).**

The process piping must be independently supported so that no loads are transmitted to the flexible connections.

WARNING! Never obstruct the liquid discharge from the machine. The backup of liquid could result in excessive vibration or mechanical damage to rotor or bearings.

Piping Connections

- 6” ANSI 150 RF, Inlet/outlet process connections
- 2” ANSI 150 RF, Vent
- 1/8” NPT Female, Bearing & Casing Nitrogen Supply
- 2” ANSI, Casing Drain
- ½” NPT Male, Light Phase Sampling Port
- ½” NPT Male, Heavy Phase Sampling Point
- ½” NPT Female, Bowl CIP

The piping consists of **(if provided):**

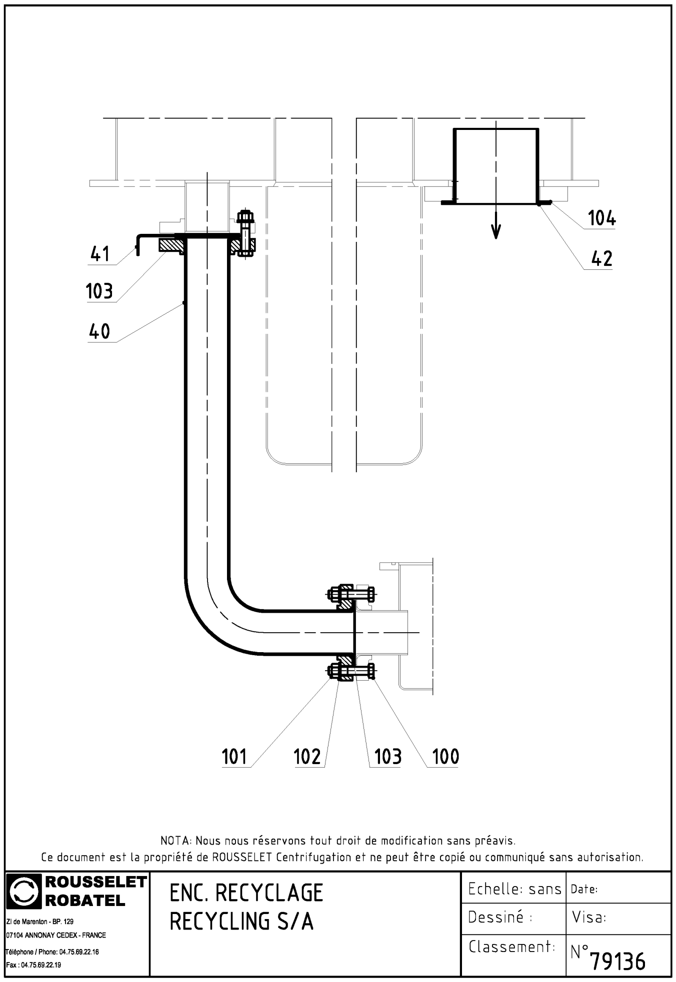
- The heavy phase interstage piping
- The light phase interstage piping

The interstage pipes are attached to the casing using flexible connections.

The pipes are sealed by envelope gaskets and the collars of the flexible connections.

The feed inlets for the process liquids are located on the mixing chamber **(ITEM NO. 46, DRAWING NO. 79151 & 79135)** mounted on the bottom of the casing. The mixing chamber is equipped with a **2" ANSI** flange so that a drain valve can be installed **(drain valves not supplied by ROBATEL).**

5.5 Heavy Phase Recycling Piping



The casing of one stage is equipped with a recycling system for the heavy phase.

The recycled heavy phase flows out of the heavy phase casing through a pipe which is attached to the mixing chamber without flexible connections.

An orifice plate regulates the recycling flow rate, and the stand pipe creates a fixed liquid head upstream from the orifice.

The recycling flow rates for different orifice diameters are as follows:

- 2 to 2.5 m^3/hr with a 20 mm Ø orifice
- 5 to 6 m^3/hr with a 30 mm Ø orifice
- 8 to 11 m^3/hr with a 40 mm Ø orifice
- 18 m^3/hr with a 40 mm Ø orifice

5.6 Labyrinth

The casing is connected to the bearing assembly by a sleeve **(ITEM NO. 22, DRAWING NO. 79133)** that fits into the top of the casing, and around the bottom of the lip seal housing. The sleeve is held in position by the adjustable stop **(ITEM NO. 27, DRAWING NO. 79133)**, and the sleeve is sealed by O-rings **(ITEM NO. 99, DRAWING NO. 79133)** and **(ITEM NO. 100, DRAWING NO. 79133)**.

To protect the mechanical parts of the bearing assembly from the corrosive atmosphere in the casing, air or inert gas is injected between the shaft and the labyrinth **(ITEM NO. 47, DRAWING NO. 79133)** through a 1/8" NPT threaded hole.

A gas flow of **150 liters/hour** is required to ensure efficient protection of the bearing assembly in the event that the lip seal **(ITEM NO. 75, DRAWING NO. 79133)**, which protects the bottom bearing, is damaged. If the machine is to be inerted, flows of nitrogen higher than **150 liters/hour** may be used during the initial purge to expedite the process. Each casing has a volume of **1,300 liters.** In order to ensure a thorough purge, several casing volumes should be exchanged before starting process materials.

⚠**WARNING!** Pressure above 16" W.C. is considered dangerous and creates a risk of vapor outleakage and/or mechanical damage to the equipment.

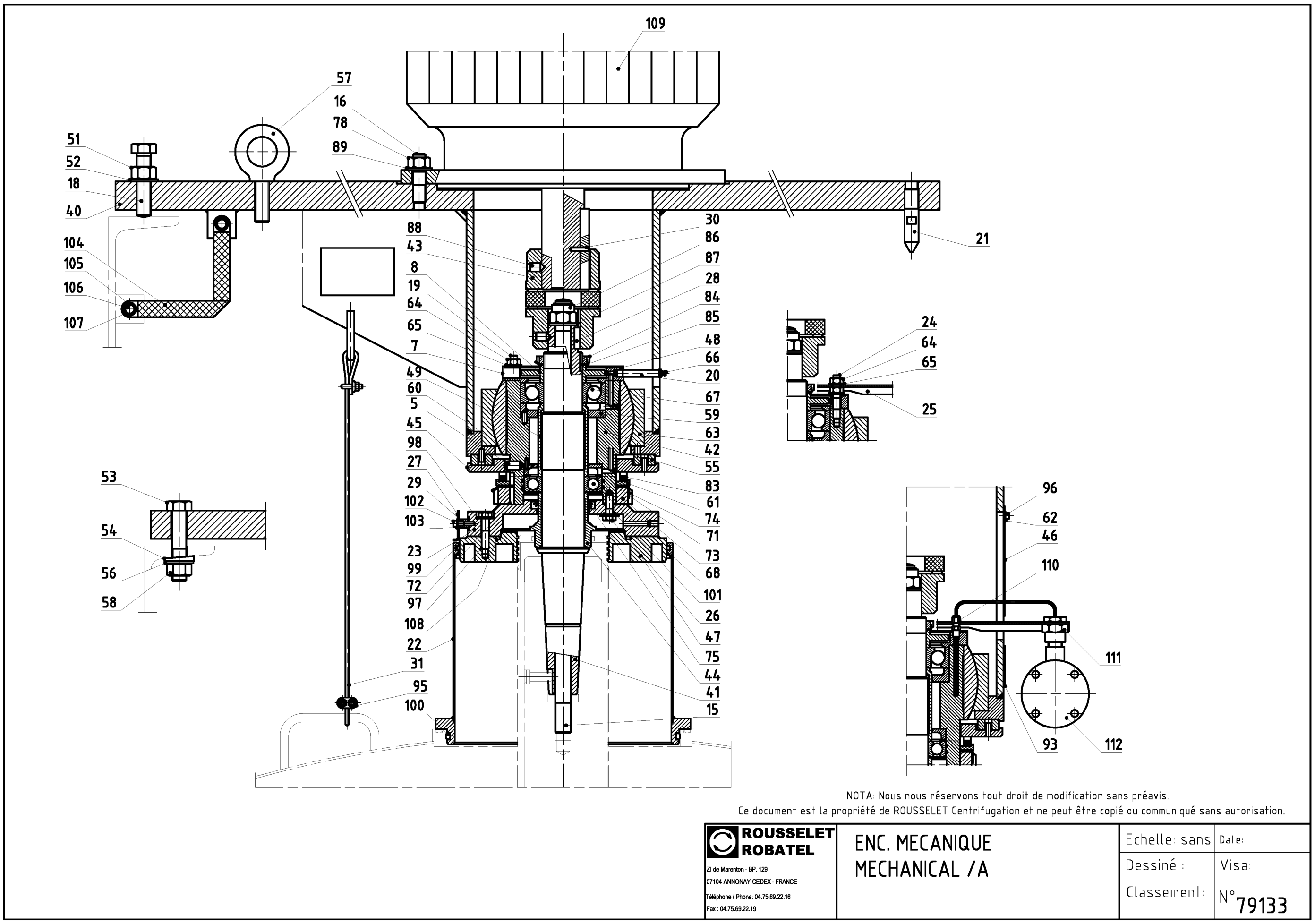
⚠**WARNING!** Never feed product to the centrifuge unless the centrifuge atmosphere has been inerted to a point, which is considered safe for the solvents being processed. Failure to do so could result in fire, explosion, injury or death.

⚠**WARNING!** The oxygen monitor must be checked and calibrated at regular intervals to be sure that the atmosphere within the centrifuge is safe.

⚠**WARNING!** Do not operate the centrifuge unless the oxygen content inside the centrifuge is safe for the products being processed.

A grounding strap connects the mechanical head to the casing assembly.

5.7 Shaft



The shaft is manufactured in two parts to facilitate disassembly:

- A lower shaft **(ITEM NO. 47, DRAWING NO. 72764)** attached to the bowl.
- An upper shaft **(ITEM NO. 41, DRAWING NO. 79133)** supported by the bearing assembly.

The two-part shaft is assembled by a tapered fit, the threaded drawbar **(ITEM NO. 15, DRAWING NO. 79133)**, and the lock nut **(ITEM NO. 86, DRAWING NO. 79133)**.

The relative position of the 2 shafts is indexed by a pin welded to the lower shaft.

The lower shaft is martensitic steel and is protected by a stainless steel sleeve **(ITEM NO. 56, DRAWING NO. 72764).** The O-rings **(ITEM NO. 164, DRAWING NO. 72764), (ITEM NO. 165, DRAWING NO. 72764) and (ITEM NO. 166, DRAWING NO. 79133)** seal the shaft protection sleeve.

5.8 Bearing Assembly

The bearing assembly consists of:

- An upper bearing **(ITEM NO. 67, DRAWING NO. 79133):** angular contact ball bearing that supports the axial load of the rotor.

- A lower bearing **(ITEM NO. 68, DRAWING NO. 79133):** ball bearing preloaded by spring washers **(ITEM NO. 71, DRAWING NO. 79133)** that set the bearing's clearance.

The bearing assembly is mounted on a swivel (spherical plain bearing) **(ITEM NO. 63, DRAWING NO. 79133)** which allows the pendular movement of the entire rotor around the center of the swivel. The swivel also minimizes the transmission of vibrations generated by the movement of the rotor to the bearing support **(ITEM NO. 40, DRAWING NO. 79133)** and the frame.

The oscillations of the rotor are dampened by the rubber buffers **(ITEM NO. 55, DRAWING NO. 79133)** whose compression is determined by the nut **(ITEM NO. 73, DRAWING NO. 79133).** The compressive force is transmitted by a set of spring washers **(ITEM NO. 83, DRAWING NO. 79133).**

The nut **(ITEM NO. 73, DRAWING NO. 79133)** is tightened during factory assembly so that the spring washers **(ITEM NO. 83, DRAWING NO. 79133)** have a total height of **13.5 mm**.

The bearing assembly may be equipped with an optional 100 ohm, 3-wire, Platinum RTD installed in a thermo-well filled with a heat transfer compound. The optional RTD measures the temperature of the bearing assembly during operation.

5.9 Motor

The motor is connected to and drives the upper shaft via a coupling **(ITEM NO. 43, DRAWING NO. 79133).**

The motors' specifications are provided in **Section 2** of this Operating Manual.

⚠**WARNING!** Do not operate the machine if the guards have been defeated, removed or modified. Failure to use safety guards can cause serious injury or death.

⚠**WARNING!** Operation at a temperature above that which is allowed for the hazardous area is considered dangerous and could cause fire or explosion resulting in serious personal injury or death.

The motor will be driven by an AC Variable Frequency Drive **provided by the customer** to achieve optimum processing flexibility.

⚠**WARNING!** Under no circumstances should the maximum rotating speed, the maximum load, or the maximum operating temperature be exceeded. Operating above the rated maximum speed or temperature could result in serious personal injury or death.

⚠**WARNING!** Do not adjust the programming or any programmed parameters without **ROUSSELET ROBATEL's** written authorization. Improperly adjusted set points could cause equipment damage and result in personal injury or death.

⚠**WARNING!** Disconnect and lock out the power supply before working with components mounted on the machine rotor.

⚠**WARNING!** The motor should not operate below **6 Hz** for prolonged periods of time. Operating below the rated minimum speed could cause the motor to overheat. Once the motor temperature rating is reached, the motor should be shut down and allowed to cool.

5.10 Bearing Assembly Support

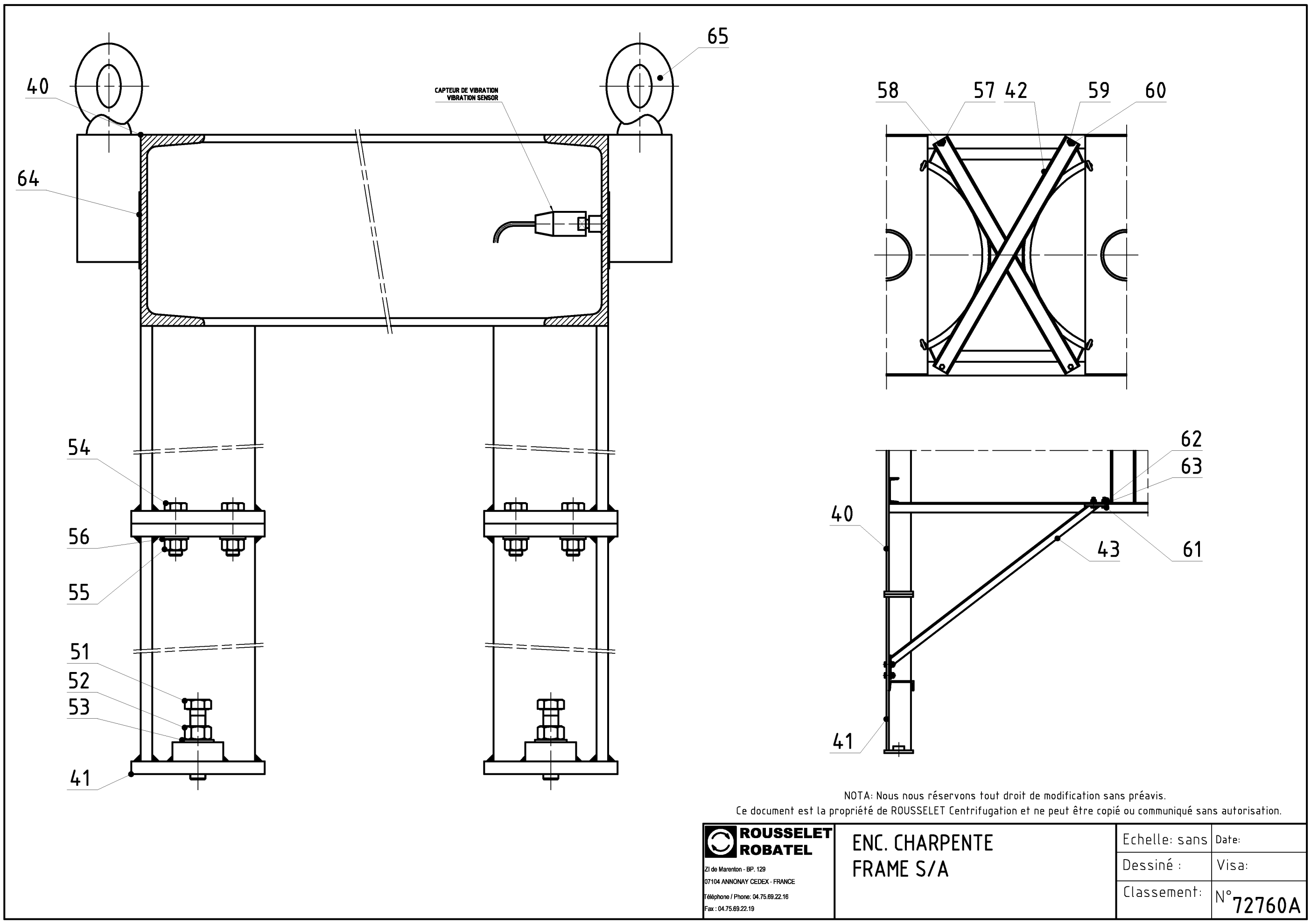
The bearing assembly support plate **(ITEM NO. 40, DRAWING NO. 79133)** is connected to the motor and to the mechanical head. A guard shields the rotating components. The cables **(ITEM NO. 31, DRAWING NO. 79133)** allow the upper casing to be attached to the mechanical head to lift the upper casing at the same time as the rotor.

The support plate **(ITEM NO. 40, DRAWING NO. 79133)** is attached to the support frame by bolts **(ITEM NO. 53, DRAWING NO. 79133),** and the pin **(ITEM NO. 21, DRAWING NO. 79133)** center it. Its horizontal position is adjusted by the leveling screws **(ITEM NO. 18, DRAWING NO. 79133).**

The support plate is leveled in our factory to correctly position the rotor with respect to the casing (approximately **65 mm** between the bottom of the turbine chamber **(ITEM NO. 51, DRAWING NO. 72764)** and the bottom flange of the lower casing **(ITEM NO. 44, DRAWING NO. 79151 & 79135)**).

The bearing assembly support plate is connected to the steel support frame by a grounding strap.

5.11 Support Frame



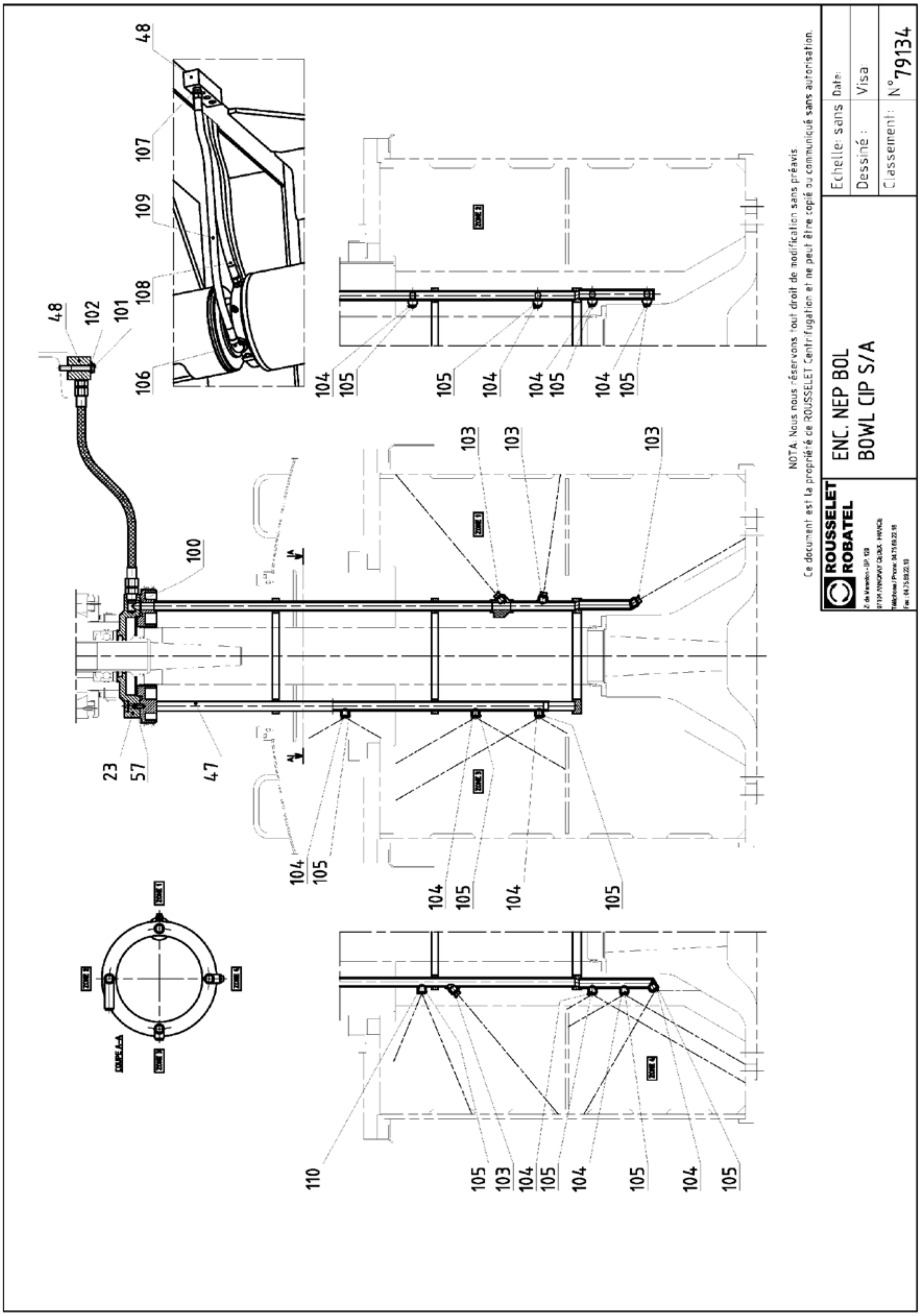
The support frame is equipped with legs and braces which are removed for shipment.

The frame is equipped with a vibration transmitter mounted on one of the upper longitudinal beams. **Refer to the vibration transmitter information in the Appendix.**

The support frame **(ITEM NO. 40, DRAWING NO. 72760)** must be fastened to the floor by four **1”** anchor bolts passing through the mounting holes in the feet of the frames. The anchor bolts must be securely cast into the concrete or welded to a structural support. The frame should be installed so that the top surface of the support frame is level by adjusting the leveling screws **(ITEM NO. 51, DRAWING NO. 72760).** Then tighten the lock nuts, install shims, tighten the anchor bolts, and grout around the base of the frame.

The support frame is equipped with 2 grounding lugs.

5.12 Clean In Place System



5.12.1 Principle

⚠**CAUTION!** Be sure that the personnel operating the centrifuge know the risks and correct procedures associated with processing the specific products to prevent fire, explosion, and exposure to hazardous materials.

⚠**WARNING!** The oxygen monitor must be checked and calibrated at regular intervals to be sure that the atmosphere within the centrifuge is safe.

⚠**WARNING!** Do not operate the centrifuge unless the oxygen content inside the centrifuge is safe for the products being processed.

⚠**WARNING!** Never feed product to the centrifuge unless the centrifuge atmosphere has been inerted to a point, this is considered safe for the solvents being processed. Failure to do so could result in fire, explosion, injury or death.

⚠**WARNING! Never obstruct the liquid discharge from the machine. The backup of liquid could result in excessive vibration or mechanical damage to rotor or bearings.**

⚠**CAUTION!** Do not use any surfactants to clean internal components. This could potentially affect the machines operation.

On this equipment, it's possible to fit a Clean In Place (CIP) system inside the bowl. The goal of this system is to allow the cleaning of the interior of the bowl removing any possible "solids" built up in the centrifugal field without dismantling the machine.

The CIP system includes 4 vertical pipes connected to a common support ring. These 4 pipes allow pressurized CIP liquid to be sprayed on the inner surfaces of the bowl while it is rotating at slow speed.

5.12.2 Description

The CIP system comprises a washing assembly with 4 pipes, each of which washes a specific portion of the bowl. The CIP system is mounted in place of the original labyrinth. The CIP system is equipped with a liquid inlet for each of the 4 pipes.

- ZONE No.1 is equipped with a set of nozzles **(ITEM NO. 103, DRAWING NO. 79134)** located in the middle and lower portion of the bowl. The upper nozzle washes the heavy phase discharge zone under the rim at the upper portion of the bowl. The middle nozzle washes the bowl walls above the perforated baffle that is located half way up the bowl. The bottom nozzle washes the openings in the bottom of the bowl to assist the discharge of the solids that are removed from the bowl walls by the other nozzles of the CIP system.

- ZONE No. 2 is equipped with set of nozzles **(ITEM NO. 104, DRAWING NO. 79134)** located and directed in the central portion of bowl. The nozzles wash the central portions of the bowl, bowl wall and perforated baffles.

- ZONE No. 3 is equipped with a set of nozzles **(ITEM NO. 104, DRAWING NO. 79134)** located in the upper part of the bowl. The upper nozzle washes the light phase weir and deflector. The lower nozzles wash the bottom of the bowl rim, the sides of the radial baffles in the bowl, and the top of the perforated baffle.

- ZONE No.4 is equipped with a set of nozzles **(ITEM NO. 104, DRAWING NO. 79134)**. The lower nozzles wash the bottom of the bowl, wall and baffles. The upper nozzle washes the heavy phase discharge zone under the rim at the upper portion of the bowl.

The nozzles **(ITEM NO. 104, DRAWING NO. 79134)** are equipped with cylindrical threads, and flat gaskets **(ITEM NO. 105, DRAWING NO. 79134)** ensure that these threaded zones are sealed.

5.12.3 Operating

3.7.3.1.Piping

⚠**CAUTION!** Do not use any surfactants to clean internal components. This could potentially affect the machines operation.

The CIP system can be connected to a circuit under pressure of industrial water, hot water or any other cleaning agent:

- Between 1 and 10 Bars for the line N°2 and N°3
- Between 1 and 20 Bars for the line N°1 and N°4.
- **Above 10 Bars, the nozzles with flat jet lose their effectiveness.**

3.7.3.2. CIP Cycle

The CIP cycle must be adapted to the different problems that may be encountered:

- Elimination of solids stored in the bowl during the extraction.
- Sanitation of wetted parts.
- Rinsing in the case of multi use products….

The pressure in each line is to be adapted according to the needs and to be optimized according to the results obtained with the tests.
A general-purpose cycle can be used to begin tests: with a bowl rotating speed ranging between **10 and 20 rpm** and under pressure from **3 to 5 Bars**, feeding during approximately **1 to 2 minutes** on each line.

Each one of its parameter can be modified to improve cleaning

WARNING! The motor should not operate below **6 Hz** for prolonged periods of time. Operating below the rated minimum speed could cause the motor to overheat. Once the motor temperature rating is reached, the motor should be shut down and allowed to cool.

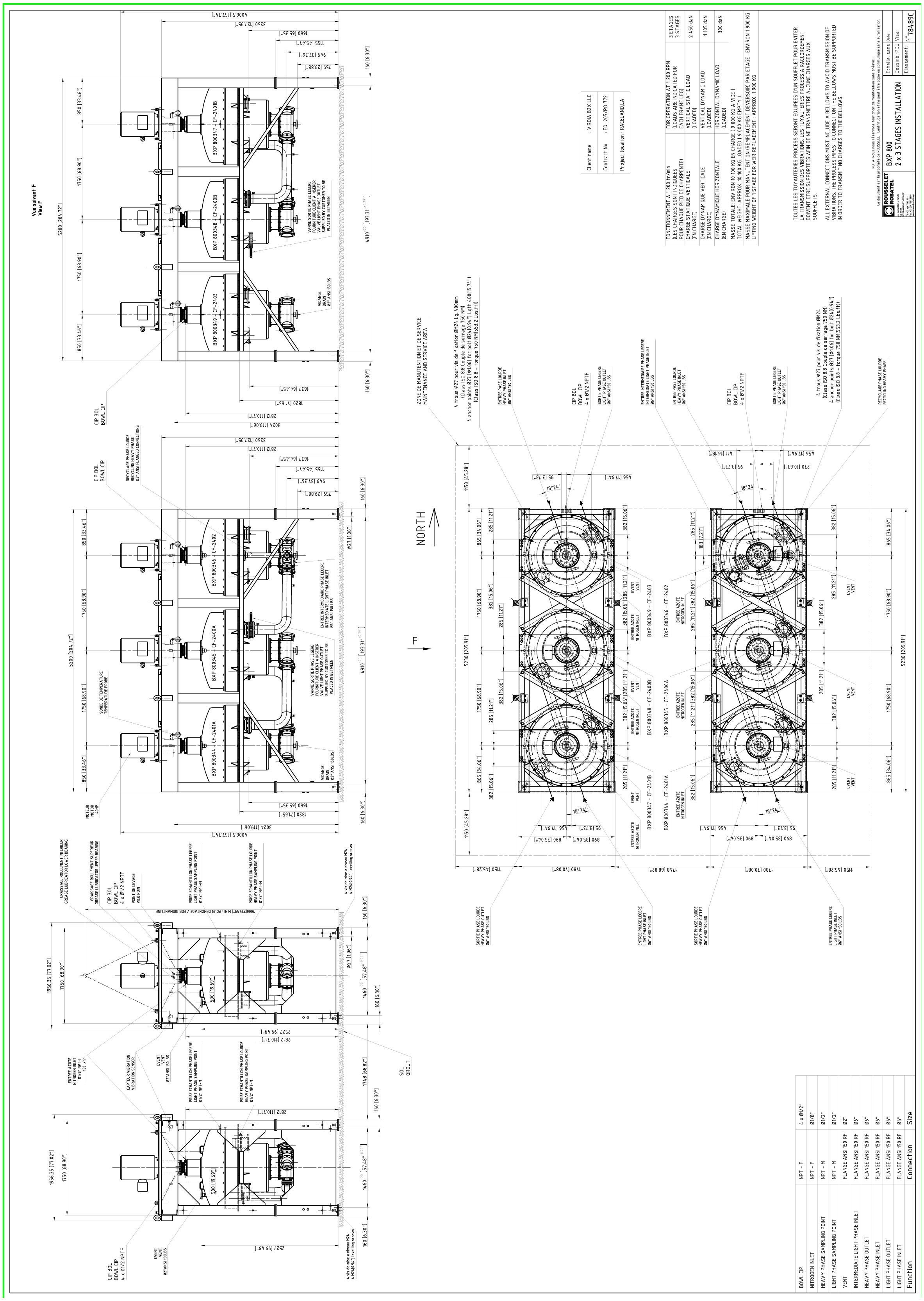
WARNING! Operation at a temperature above that which is allowed for the hazardous area is considered dangerous and could cause fire or explosion resulting in serious personal injury or death.

3.7.3.3. Nozzles characteristics

	Tag	Number of nozzles	Flow rate by nozzle @ 1 bar	Total flow rate @ 1 bar	Flow rate by nozzle @ 2 bar	Total flow rate @ 2 bar	Flow rate by nozzle @ 3 bar	Total flow rate @ 3 bar	Flow rate by nozzle @ 5 bar	Total flow rate @ 5 bar	Flow rate by nozzle @ 10 bar	Total flow rate @ 10 bar	Flow rate by nozzle @ 20 bar
CIP Bowl Z1	103	**3**	7,16	**21,48**	10,1	**30,3**	12,4	**37,2**	16,0	**48,0**	22,6	**67,8**	32,0
CIP Bowl Z2	104	**4**	7,16	**28,64**	10,1	**40,4**	12,4	**49,6**	16,0	**64,0**	22,6	**90,4**	
CIP Bowl Z3	104	**3**	7,16	**21,48**	10,1	**30,3**	12,4	**37,2**	16,0	**48,0**	22,6	**67,8**	
CIP Bowl Z4	104	**3**	7,16		10,1		12,4		16,0		22,6		
	103	**1**	7,16	**35,8**	10,1	**50,5**	12,4	**62,0**	16,0	**80,0**	22,6	**113,0**	32,0
	110	**1**	7,16		10,1		12,4		16,0		22,6		

Table 3. CIP Line Flow Rates (liters/minute).

6 HANDLING



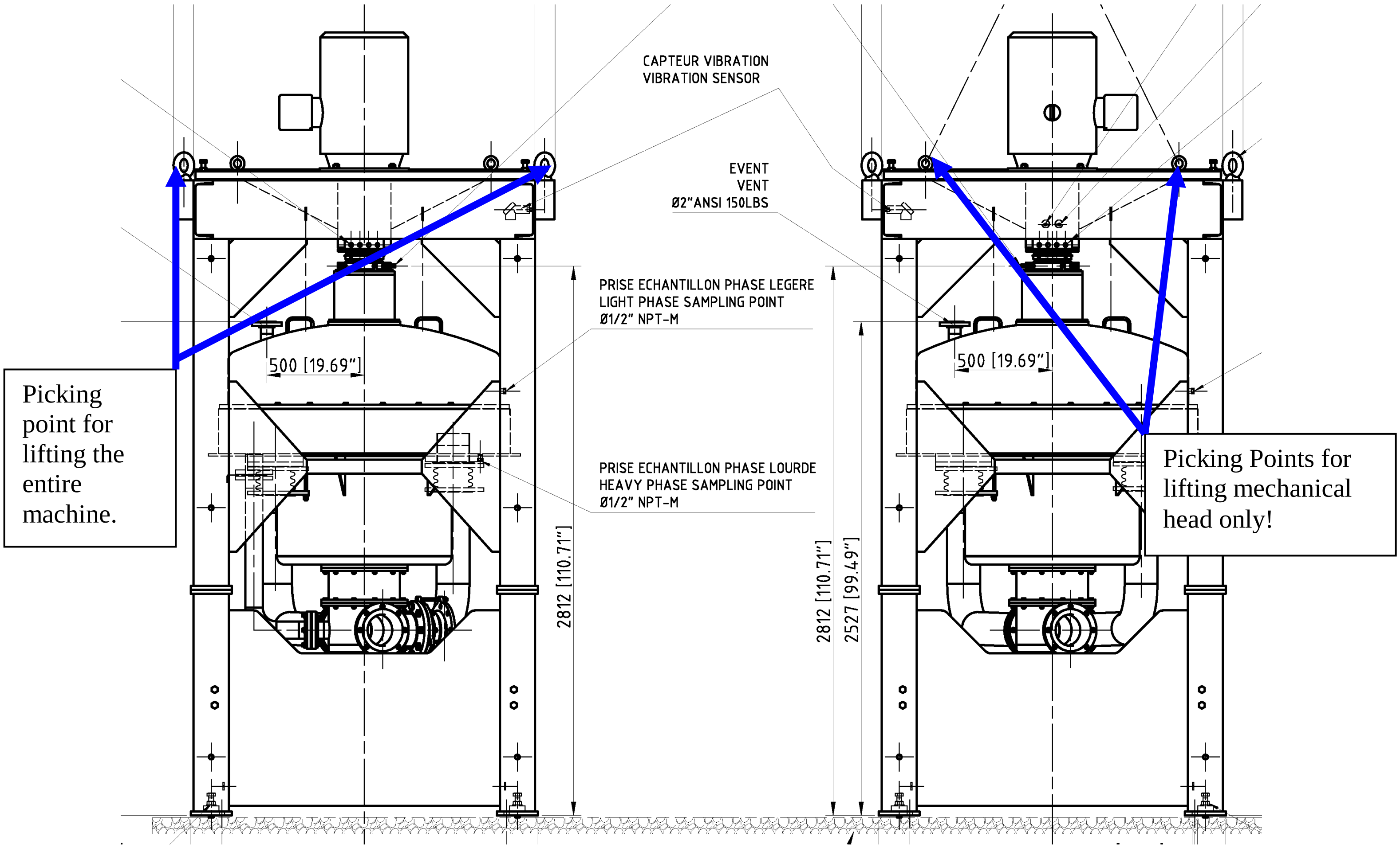


Figure 4. Extractor lifting points.

The support frame and **BXP-800** extractor weighs approximately **9000 kg**, and must be lifted by slings attached to the upper beams of the support frame **(ITEM NO. 40, DRAWING NO. 72760)** or appropriate lifting eyes **(ITEM NO. 65, DRAWING NO. 72760) as shown in Installation drawing 78489.**

⚠**CAUTION!** Do not use the rings **(ITEM NO. 57, DRAWING NO. 79133)** to lift the entire machine assembly.

The bearing assembly, the rotor, and the upper casing of each stage weigh approximately **1900 kg (1487 kg with the motor removed)** and should be handled by slings attached to the lifting rings **(ITEM NO. 57, DRAWING NO. 79133)**. It is necessary to remove the mixing chamber **(ITEM NO. 46, DRAWING NO. 79151 & 79135),** the agitator **(ITEM NO. 54, DRAWING NO. 72764),** and the screws connecting the upper and lower casings before lifting the rotor assembly from the machine.

The bowl weighs **700 kg** and can be handled by a lifting ring mounted on the end of the threaded drawbar **(ITEM NO. 15, DRAWING NO. 79133)**.

7 INSTALLATION

7.1 Packing

WARNING! Disconnect and lock out the power supply. Working on the rotor components while the power supply is not locked out could result in serious personal injury or death.

To protect the mechanical components and to use standard freight containers, the BXP 800 centrifugal extractors were disassembled into several sub units for shipment.

Each extractor is shipped and delivered with the bowl already installed into casing. To prevent the bowl from moving during transportation, it is immobilized by a disc (**Figure 5**) fitted under the lower part of the casing **(ITEM NO. 41, DRAWING NO. 79135 & 79151)** (**Figure 3**). It is compulsory that these discs and blocks must be removed before operation of the extractor.

Figure 5. Bowl immobilizing disc for transportation.

Figure 6. Bowl immobilizing disc location.

7.2 Installation Of The Support Frame

Assemble the support frame as follows:

- Install the support legs, and use 1 inch anchor bolts through the **27 mm** diameter holes to anchor the support frame to the floor. Before securing the anchor bolts, install the main support frame, and level the overall frame using the leveling bolts as described in **section 5.11.**

- Install the braces **(ITEM NO. 42 & 43, DRAWING NO. 72760)** being sure to insert the bolts so that the nuts are on the outside of the frame. All items are marked on with a letter or number and should be installed on the frame using that corresponding letter or number.

7.3 Installation of the Rotor into the Casing (Drawing No. 79133 & 72764)

⚠**WARNING!** Disconnect and lock out the power supply. Working on the rotor components while the power supply is not locked out could result in serious personal injury or death.

⚠**WARNING!** Do not operate the machine if the guards have been defeated, removed or modified. Failure to use safety guards can cause serious injury or death.

⚠**WARNING!** Loose fasteners on the rotor could cause property damage and could result in serious personal injury or death.

In the event that the rotor is removed from the casing, please observe the following procedure:

1. Verify that the casing support cables **(ITEM NO. 31, DRAWING NO. 79133)** are installed.

2. Remove the light phase discharge flange **(ITEM NO. 45, DRAWING NO. 79151 & 79135)** by removing the screws **(ITEM NO. 56, DRAWING NO. 79151 & 79135)** to release the upper casing **(ITEM NO. 40, DRAWING NO. 79151 & 79135)**.

3. Remove the O-ring.

4. Remove the screws **(ITEM NO. 51, DRAWING NO. 79151 & 79135)** that attach the upper and lower casings **(ITEM NO. 40, DRAWING NO. 79151 & 79135)** and **(ITEM NO. 41, DRAWING NO. 79151 & 79135)**.

5. Remove the grounding strap.

6. Release the mechanical head assembly from the top of the support frame by removing the screws.

7. Remove the mechanical head assembly and the upper casing as a unit (**casing support cables (ITEM NO. 31, DRAWING NO. 79133) must be installed**), being careful to lift the upper casing straight up to avoid placing any stress on the light phase discharge pipe which passes through the lower casing.

8. Be sure that the shaft protection sleeve **(ITEM NO. 56, DRAWING NO. 72764)** has its O-rings **(ITEM NO. 164-166, DRAWING NO. 72764)** and is seated into the bowl hub. Rest the upper casing **(ITEM NO. 40, DRAWING NO. 72764)** on the top of the bowl.

9. Install the mechanical head assembly on the lower shaft/bowl. Be sure that the identification number marked on the bowl and the bowl rim matches the identification number on the **ROUSSELET ROBATEL** nameplate mounted on the support frame gusset.

10. Be sure to align the upper and lower shafts which are indexed by a pin in the bottom of the tapered cone in the lower shaft.

11. Install the washer and the lock nut **(ITEM NO. 86 & 87, DRAWING NO. 79133)** on the threaded draw bar and tighten the nut to engage and secure the two halves of the shaft.

12. By removing the guard **(ITEM NO. 46, DRAWING 79133 (SCREWS ITEM NO. 96, DRAWING NO. 79133)** and the lower half of the coupling **(ITEM NO. 43, DRAWING NO. 73761),** it is possible to hold the upper shaft with the wrench **(ITEM NO. 41, DRAWING NO. 72765)** to tighten the lock nut.

13. Install the turbine **(ITEM NO. 52, DRAWING NO. 72764)** in the turbine chamber **(ITEM NO. 51, DRAWING NO. 72764)**. Hold the shaft with the wrench **(ITEM NO. 41, DRAWING NO. 72765)** and tighten the turbine using a **32 mm** open-end wrench. Do not install the agitator **(ITEM NO. 54, DRAWING NO. 72764) (if provided)** at this time.

14. Lower the rotor assembly into the lower part of the casing. Be careful when inserting the light phase discharge pipe through the heavy phase receipt compartment in the lower casing.

15. Install and tighten the screws **(ITEM NO. 51, DRAWING NO. 79151 & 79135)** that attach the upper and lower casings. Rest a level on the machined motor mounting surface and level the motor support using the screws and locking nuts. Install and tighten the screws that retain the mechanical head.

16. Adjust the mechanical stop **(ITEM NO. 27, DRAWING 79133)** to obtain **3 mm** clearance from the top of the upper casing sleeve **(ITEM NO. 22, DRAWING 79133)**. Use the screws **(ITEM NO. 102, DRAWING 79133)** to adjust this clearance.

17. If the base of the casing **(ITEM NO. 44, DRAWING 79151 & 79135)** is not installed, install it and its O-rings **(ITEM NO. 53, DRAWING 79151 & 79135)** using the nuts.

18. Install the agitator spacer **(ITEM NO. 53, DRAWING 72764)** and the agitator / dome nut **(ITEM NO. 54, DRAWING 72764)**. Hold the shaft using the wrench (**ITEM NO. 41, DRAWING NO. 72765)** and tighten the agitator / dome nut **(ITEM NO. 54, DRAWING 72764)**.

19. Center the bowl within the casing by pushing against the agitator such that the agitator becomes concentric with the casing bottom.

20. **If the agitator is not installed, verify the axial distance of 18mm +/- 2mm between the tip of the bowl nose and baffle within the "base of casing." Alternately, the tip of the bowl nose should be 65mm +/- 2mm from the lower casing. If this is not the case, adjust the position of the rotor using the leveling screws on the motor mounting plate.**

21. Install the mixing chamber **(ITEM NO. 46, DRAWING NO. 79151 & 79135)** with its O-ring **(ITEM NO. 53, DRAWING NO. 79151 & 79135)** using the screws **(ITEM NO. 62-64, DRAWING NO. 79151 & 79135)**.

22. Install the lower half of the coupling **(ITEM NO. 43, DRAWING NO. 79133)** on the top of the shaft using the screw **(ITEM NO. 88, DRAWING NO. 79133)**.

23. Install the motor with the upper half of the coupling (and elastic insert) on the motor support plate and tighten using washers and nuts **(ITEM NO. 78 & 89, DRAWING NO. 79133).**

24. **Adjust the clearance between the upper and lower coupling halves to obtain a clearance of 28 mm.**

25. Install the guards **(ITEM NO. 46, DRAWING NO. 79133)** over the couplings using the screws.

26. Install the O-ring **(ITEM NO. 55, DRAWING NO. 79151 & 79135)** on the light phase discharge piping of the upper casing **(ITEM NO. 40, DRAWING NO. 79151 & 79135)** and install the light phase discharge flange **(ITEM NO. 45, DRAWING NO. 79151 & 79135)** which is retained by the four screws **(ITEM NO. 56, DRAWING NO. 79151 & 79135)**.

27. This O-ring will be sealed when the screws on the flexible piping connections are tightened.

Be sure that the casing support cables **(ITEM NO. 31, DRAWING NO. 79133)** remain installed. During rotor disassembly, these cables prevent the sleeve **(ITEM NO. 22, DRAWING NO. 79133)** from becoming unseated, and they hold the upper casing suspended above the bowl.

7.4 Installation Of Piping

- The flange of each pipe is marked with its item number and the number of the stage to which it should be connected as described in **Section 5.4.**

- Mount the heavy phase interstage piping **(ITEM NO. 40, DRAWING NO. 72762)** on the flexible connections (using the screws **(ITEM NO. 56, DRAWING NO. 72762)**), and attach the piping to the mixing chambers **(ITEM NO. 46, DRAWING NO. 79151 & 79135)** using the envelope gaskets **(ITEM NO. 53, DRAWING NO. 72762)** and the screws **(ITEM NO. 54, 61 & 62, DRAWING NO. 72762)**.

- Mount the flexible connections on the light phase discharge flanges using the screws which pass through the flanges.

- Mount the light phase interstage piping **(ITEM NO. 41, DRAWING NO. 72762)** on the flexible connections (using the screws **(ITEM NO. 54, 61 &62, DRAWING NO. 72762)**) and attach the piping to the mixing chambers **(ITEM NO. 46, DRAWING NO. 79151 & 79135)** using the envelope gaskets and the screws.

- Mount the heavy phase recycling pipe with screws (when provided). Be sure to install the orifice plate to control the recycling rate.

7.5 External Piping

7.5.1 Feed Piping

To prevent the transmission of vibrations, the feeding pipes must be attached to the extractors using flexible connections.

7.5.2 Vent Piping

Because the labyrinth **(ITEM NO. 47, DRAWING NO. 79133)** is purged by air or inert gas, the vent outlet on the top of the casing **(ITEM NO. 40, DRAWING NO. 79151 & 79135)** must not be plugged. This vent outlet can be connected to a vent header. It may be preferable to connect a vertical section of vent piping to enable any mist to drain back into the casing.

7.5.3 Discharge Piping

To minimize perturbations caused by windage in the casings, it may be necessary to install hydraulic guards on the light and heavy phase discharge piping. All discharge piping must be connected to the extractors using flexible connections.

7.6 Electrical Devices

ROUSSELET ROBATEL did not supply any electrical controls for this machine. Proper installation and machine control is the responsibility of the customer.

⚠**WARNING!** Before working on the electrical system, the power supply should be disconnected and locked-out.

⚠**CAUTION!** If it is necessary to open the electrical enclosures while the system is powered, confirm that the atmosphere is safe to do so.

⚠**WARNING!** The conduit seals must be poured before operating this equipment in a hazardous environment. Confirm that all field wiring meets the area classification requirements.

⚠**WARNING!** Do not defeat, bypass or modify any safety interlocks provided with the machine.

⚠**WARNING!** Operation at a temperature above that which is allowed for the hazardous area is considered dangerous and could cause fire or explosion resulting in serious personal injury or death.

Normal precautions should be taken whenever servicing electrical components.

Each extractor is supplied with an electric motor; however we have not provided the AC variable frequency drive or electrical control system.

The customer must provide a control system including an Emergency Stop Push Button located near the centrifuge.

We recommend that the customer's control system be configured so that the liquids cannot be fed to the extractor(s) until it is rotating.

7.6.1 Field Panel (Option not provided)

Each steel support frame has a Field Panel that is equipped with a pressure regulator, rotometer, and flow switch to regulate and monitor the nitrogen flow to the labyrinth seals of the **BXP-800** extractors on that steel frame. The Vibration transducer and the RTDs described below are wired to the Field Panel to provide a single connection site for the instrumentation field wiring.

7.6.2 Labyrinth Seal Flow Switch (Option not provided)

Each **BXP-800** extractor is equipped with a Flow Switch to monitor the flow of nitrogen to the labyrinth seal assembly. If the nitrogen flow falls below **5 SCFH**, the flow switch will change state. This should signal an alarm in the customer's control system. Although it is not necessary to shut down the extractor if the labyrinth seal gas flow falls below **5 SCFH**, the nitrogen flow should be restored as quickly as possible since the labyrinth seal gas flow is an important part of the bearing protection system.

7.6.3 AC Variable Frequency Drive (Option not provided)

The AC variable frequency drive powers the vertically mounted **40 HP** asynchronous motor. The drive output has been programmed to yield a maximum basket speed of **1400 RPM. Please refer to the AC variable frequency drive's pre-programmed parameters in the Appendix.**

⚠**WARNING!** Under no circumstances should the maximum rotating speed be exceeded. Operation above the rated maximum speed could result in serious personal injury or death.

Robatel Inc has programmed the AC variable frequency drive for **the 40 HP** motor which is installed. **Please refer to the Parameter summary for the changes that were made from the factory default settings.**

⚠**WARNING!** Do not adjust the programming or any programmed parameters without ROBATEL Inc.'s written authorization. Improperly adjusted set points could cause equipment damage and result in personal injury or death.

5.6.1 Vibration Transducer

Each steel support frame is equipped with a vibration transmitter. This transmitter is supplied and mounted to give a vibration level corresponding to the overall vibration of the frame. As such, this transmitter is not intended to provide information pertaining to bearing performance.

The vibration transmitter has an operating range of **0 to 2 Inches/second (0 to 50 mm/second)** and spans the **VIBRATION PEAK** found between **5 and 1500 Hz**. The device is rated for **Class I, Group C&D** operation and must be field powered to generate its **4-20 mA** output.

The machine's vibration level is dependent on its foundation, the connected piping, and the operating conditions. However, based on shop tests we suggest:

- An alarm set point of **0.3 IPS.** To avoid nuisance trips, the client's controller should initiate an alarm after **10 seconds** of maintaining this vibration level.

- A shut down set point of **0.5 IPS.** To avoid nuisance trips, the client's controller should initiate an alarm after **3 seconds** of maintaining this vibration level.

It may be necessary to disable the vibration alarm during the initial acceleration of the machine.

⚠**WARNING!** Do not adjust the programming or any programmed parameters without **ROUSSELET ROBATEL's** written authorization. Improperly adjusted set points could cause equipment damage and result in personal injury or death.

⚠**WARNING!** Do not increase the shutdown setpoint of a vibration monitoring system above the value set by **ROUSSELET ROBATEL** at startup.

5.6.2 Temperature Probe

The Mechanical Head of each extractor is equipped with a temperature probe to monitor the overall temperature of the bearings. The probe is a **100 ohm platinum wire** device terminated in a **Class I, Group D** housing. Care should be taken to minimize the resistance in the field wiring. If the bearing temperature reaches **80º C**, an alarm should activate in the customer's control system. Bearing temperatures above **90º C** are considered excessive and the machine should be shutdown and the cause investigated.

⚠**WARNING!** Operation at a temperature above that which is allowed for the hazardous area is considered dangerous and could cause fire or explosion resulting in serious personal injury or death.

7.6.4 Nitrogen Blanketing (Option not provided)

If an oxygen monitoring system is not installed, prior to processing any solvents through the **BXP** extractor, nitrogen should be fed to the machine through the nitrogen inlet. This nitrogen inlet serves two purposes: it provides a sweeping seal of the bearing assembly; and it also establishes an inert gas blanket inside the extractor's casing.

The nitrogen purge flow rate should be in the range of **5-15 SCFH** to create a sweeping seal of the lip seal area. Prior to introducing solvents to the **BXP** extractor, the air originally inside the casing and bowl should be displaced three times by nitrogen.

Depending upon the flammability hazard associated with the solvent system, nitrogen may be fed at a higher flow rate prior to introducing the solvent to establish an inert gas blanket. The maximum pressure inside the **BXP** extractor should not exceed **12" W.C. (water column)**

⚠**WARNING! Pressure above 16" W.C. is considered dangerous and creates a risk of vapor out-leakage and/or mechanical damage to the equipment.**

If desired, an oxygen monitoring system can be connected to the vent line of the **BXP** extractor to sample the oxygen content inside the casing and bowl.

⚠**WARNING!** The oxygen monitor must be checked and calibrated at regular intervals to be sure that the atmosphere within the centrifuge is safe.

⚠**WARNING!** Do not operate the centrifuge unless the oxygen content inside the centrifuge is safe for the products being processed.

⚠**WARNING!** Never feed product to the centrifuge unless the centrifuge atmosphere has been inerted to a point which is considered safe for the solvents being processed. Failure to do so could result in fire, explosion, injury or death.

⚠**WARNING!** Do not operate the **BXP** extractor without an inert gas blanket while processing flammable solvents. If there is a loss of inert gas blanket during operation, all feeds to the **BXP** extractor should be stopped immediately, and the bowl should be shut down and allowed to decelerate to a stop. **Operating the BXP extractor without an inert gas blanket while processing flammable solvents is a dangerous operating condition and can result in explosion, fire, personnel injury or death.**

5.6.3 Motor

The **40 HP** motor is rated for **Class 1 Division 1, Group C&D** and should be installed in accordance to NEC and plant standards. The customer is responsible for controlling the motor through an AC Drive **(Supplied by the customer).** The customer should restrict the maximum speed of the machine **(Refer to machine plaque for maximum speed set point).** Each extractor maximum bowl speed should be verified prior to operation.

Motor current can be an accurate indication of process conditions and we suggest using an accurate amperage monitor on each electric motor. Higher flow rates or additional re-circulation will increase motor amperage.

WARNING! Do not operate the machine if the guards have been defeated, removed or modified. Failure to use safety guards can cause serious injury or death.

WARNING! Operation at a temperature above that which is allowed for the hazardous area is considered dangerous and could cause fire or explosion resulting in serious personal injury or death.

The motor will be driven by an AC Variable Frequency Drive provided by the customer to achieve optimum processing flexibility.

WARNING! Under no circumstances should the maximum rotating speed, the maximum load, or the maximum operating temperature be exceeded. Operating above the rated maximum speed or temperature could result in serious personal injury or death.

WARNING! Do not adjust the programming or any programmed parameters without **ROUSSELET ROBATEL's** written authorization. Improperly adjusted set points could cause equipment damage and result in personal injury or death.

WARNING! Disconnect and lock out the power supply before working with components mounted on the machine rotor.

7.6.5 Control System

The customer will provide the hardware and software to control the **BXP-800** extractor(s).

WARNING! Under no circumstances should the maximum rotating speed be exceeded. Operation above the rated maximum speed could result in serious personal injury or death.

WARNING! Do not defeat, bypass or modify any safety interlocks provided with the machine.

7.7 Utility Summary

FUNCTION	BXP-800 (PER MACHINE)
Main Motor	460VAC, 40 HP, 60Hz, 52 Amp, 3Ø
Machine Vent	Maximum Machine Pressure is 16” W.C.
Labyrinth Nitrogen	Nitrogen, 20”W.C. (50 mbar), 5.25 SCFH (150 LPH) minimum. Additional flow flows of nitrogen higher than 150 liters/hour may be used during the initial purge to expedite the purging process.
Organic Feed	230 GPM, Liquid having the below characteristics: 3-7 cP 0.82 SG 160-170˚F
Combined Feed	350 GPM

Table 4. Utility Summary

8. START-UP AND ADJUSTMENTS

8.1 Before Start-Up

⚠**WARNING!** Disconnect and lock out the power supply. Working on the rotor components while the power supply is not locked out could result in serious personal injury or death.

1. Before starting the motor, remove the guard **(ITEM NO. 46, DRAWING NO. 79133),** grasp the coupling **(ITEM NO. 43, DRAWING NO. 79133),** and be sure that the rotor turns freely by hand.

2. Reinstall the guard **(ITEM NO. 46, DRAWING NO. 79133),** and verify that the motor rotation is in the direction indicated by the arrow mounted on the motor support plate (clockwise viewed from the top of the extractor).

WARNING! Do not operate the machine if the guards have been defeated, removed or modified. Failure to use safety guards can cause serious injury or death.

3. All shipping blocks, plates and straps are removed.

4. The machine must be installed on a level surface. With normal processing and the associated vibration, the machine need not be fastened to the floor.

5. All fasteners are tight, particularly the fasteners on the rotating parts.

6. No foreign material is in the feed tank(s), casing, or discharge piping.

7. No rigid bonds connect the centrifuge to the external piping or receptacles.

8. Be sure that the grease fittings are accessible, and inject 1 shot of grease in each inlet. (**See Section 10.)**

9. Check the compression adjustment of the rubber dampener assembly. The distance between the lower surface of the SKF nut **(ITEM NO. 73, DRAWING NO. 79133)** and the lower surface of the rubber buffer holder **(ITEM NO. 45, DRAWING NO. 79133)** should be **11 mm**. This corresponds to an available height of **13.5 mm** for the spring washers **(ITEM NO. 83, DRAWING NO. 79133)**. **Refer to the figure 7 below for details.**

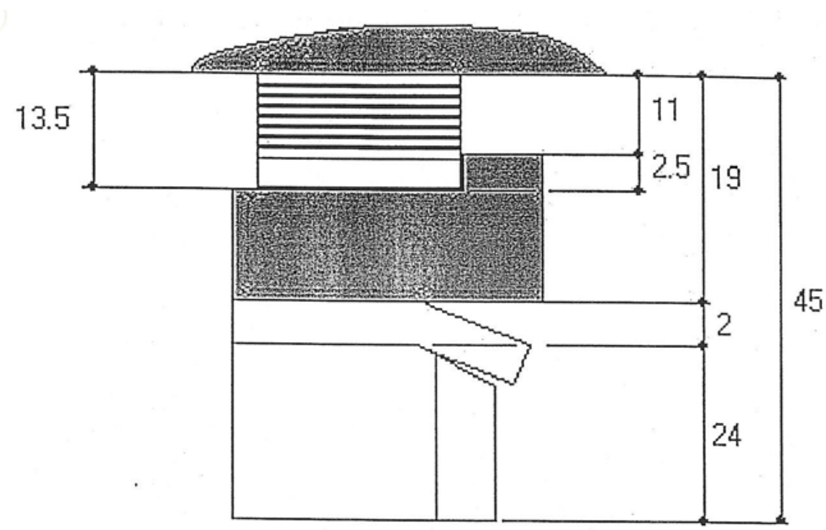


Figure 7. Spring compression height requirement.

10. Be sure the outlet piping is not blocked or restricted.

11. Test the electrical equipment and verify set points and desired flow.

12. **It is the responsibility of the customer to set the oxygen monitor (if provided) set points in accordance to the plant policy for operating with the specific process solvents.**

⚠**CAUTION!** Be sure that the personnel operating the centrifuge know the risks and correct procedures associated with processing the specific products to prevent fire, explosion, and exposure to hazardous materials.

⚠**WARNING!** The oxygen monitor must be checked and calibrated at regular intervals to be sure that the atmosphere within the centrifuge is safe.

⚠**WARNING!** Do not operate the centrifuge unless the oxygen content inside the centrifuge is safe for the products being processed.

⚠**WARNING!** Never feed product to the centrifuge unless the centrifuge atmosphere has been inerted to a point which is considered safe for the solvents being processed. Failure to do so could result in fire, explosion, injury or death.

NOTE: A STOP OR E-STOP BUTTON MUST BE PROVIDED NEAR THE MACHINE.

Before delivery, the centrifuge went through tests of long duration. Nevertheless, shipment can provoke maladjustments requiring these precautions. Several dry runs should be performed to assure the correct operation and increase operator familiarity.

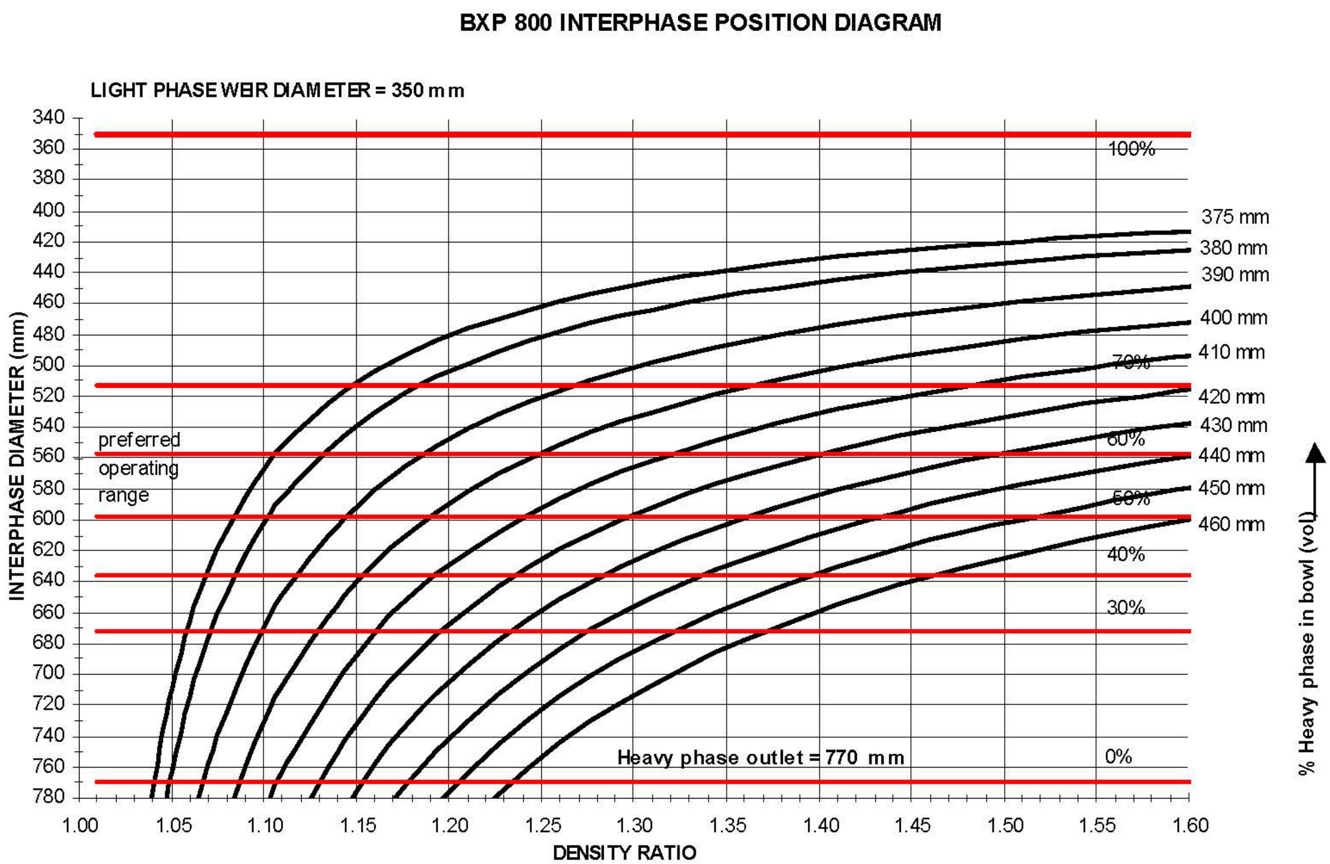
PERSONAL SAFETY EQUIPMENT SHOULD ALWAYS BE WORN WHILE THE MACHINE IS BEING WORKED ON OR WHILE THE MACHINE IS IN OPERATION.

⚠**WARNING!** Do not defeat, bypass or modify any safety interlocks provided with the machine.

⚠**CAUTION!** Care should be taken to prevent operator exposure to solvent vapors and/or nitrogen, which may accumulate within the machine casing.

8.2 Weir Adjustment:

The interphase position within the bowl is a function of the density ratio of the two phases and the diameter of the heavy phase weir. Since the light phase weir is a fixed diameter, the interphase is adjusted by changing the heavy phase weir **(Drawing No. 79133)** diameter. **The theoretical position of the interphase is shown in Graph 1.**

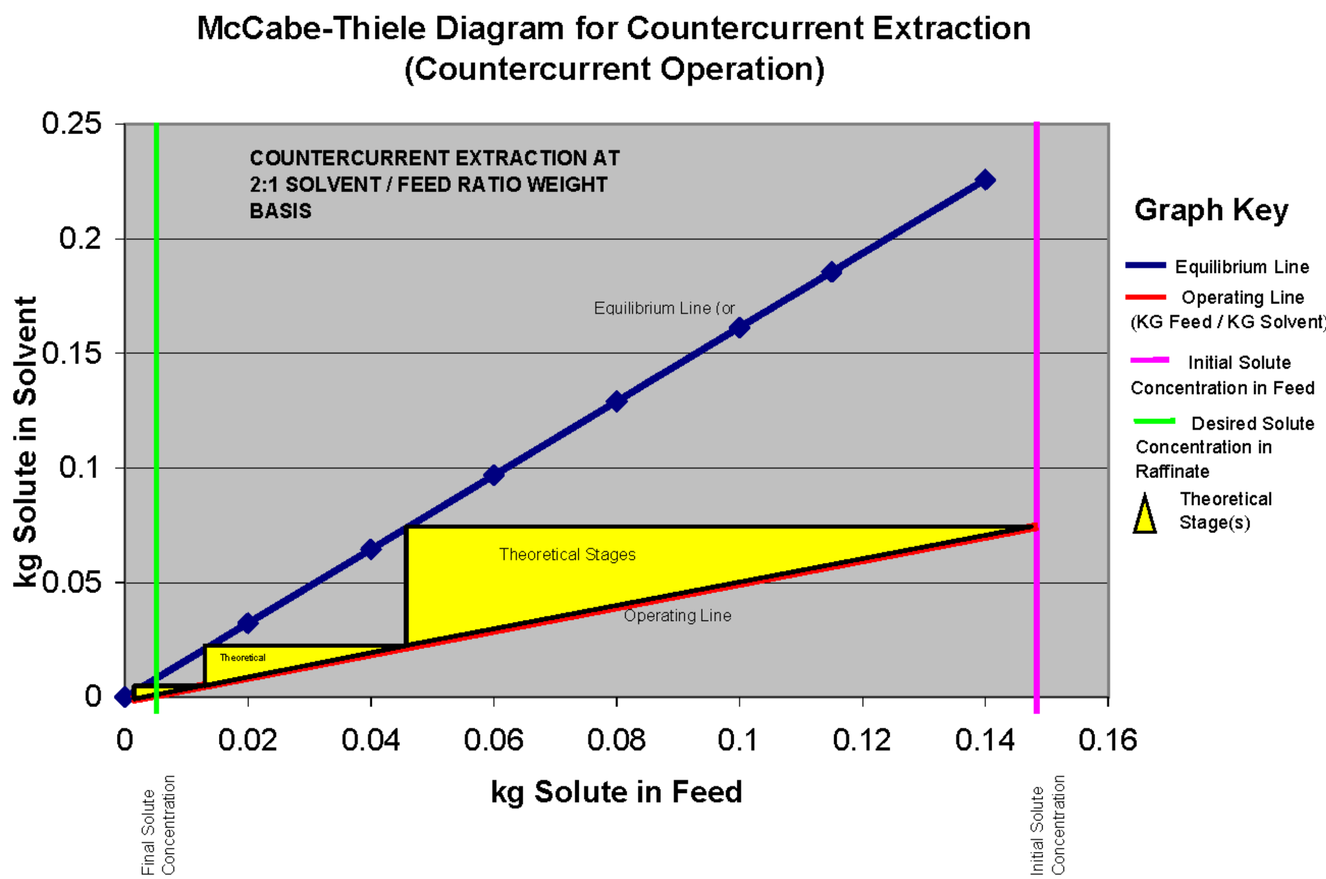


Graph 1. BXP-800 Interphase Position Diagram.

8.3 Throughput Ratio:

The efficiency of each stage is very close to that of a theoretical stage. If an equilibrium curve is available, such as a McCabe Thiele diagram **(please refer to diagram 2),** it is possible to determine the necessary solvent to feed ratio to achieve a desired chemical result with a given number of stages. If the equilibrium curve is not available, testing with several flow ratios and varying numbers of stages (2 stages and 4 stages for example) will yield practical diagrams.

With the exception of special applications, we do not recommend using flow ratios above 10 to 1.



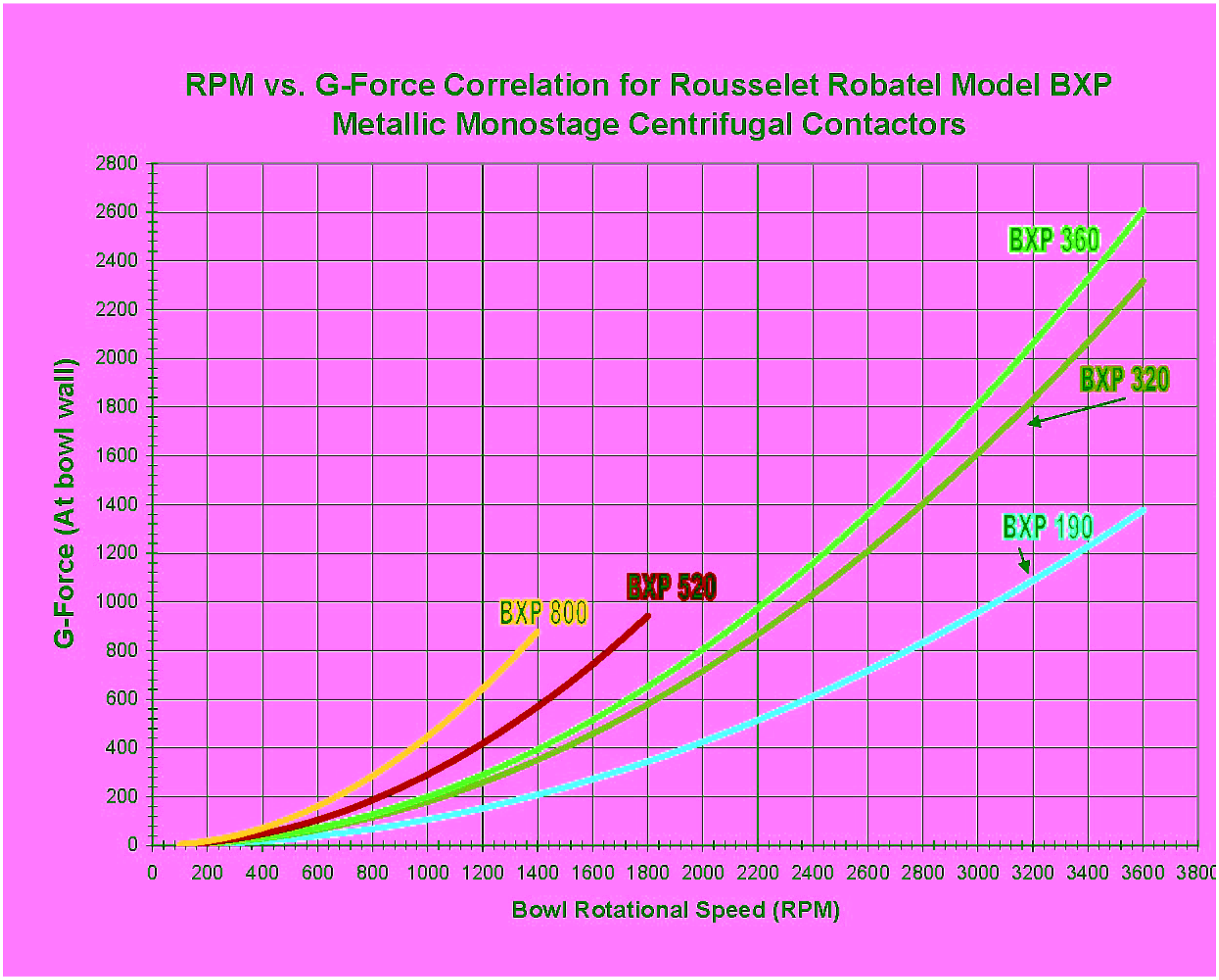
Graph 2. Example McCabe Thiele diagram.

8.4 Speed Adjustment:

The standard **BXP-800** is equipped with a motor that can operate between **120 and 1400 RPM.**

When scaling up, it is important to perform tests at various speeds **(Please refer to the Diagram 3, which illustrates G-Force at the bowl wall vs. rotational speed for Mono-stage extractors).**

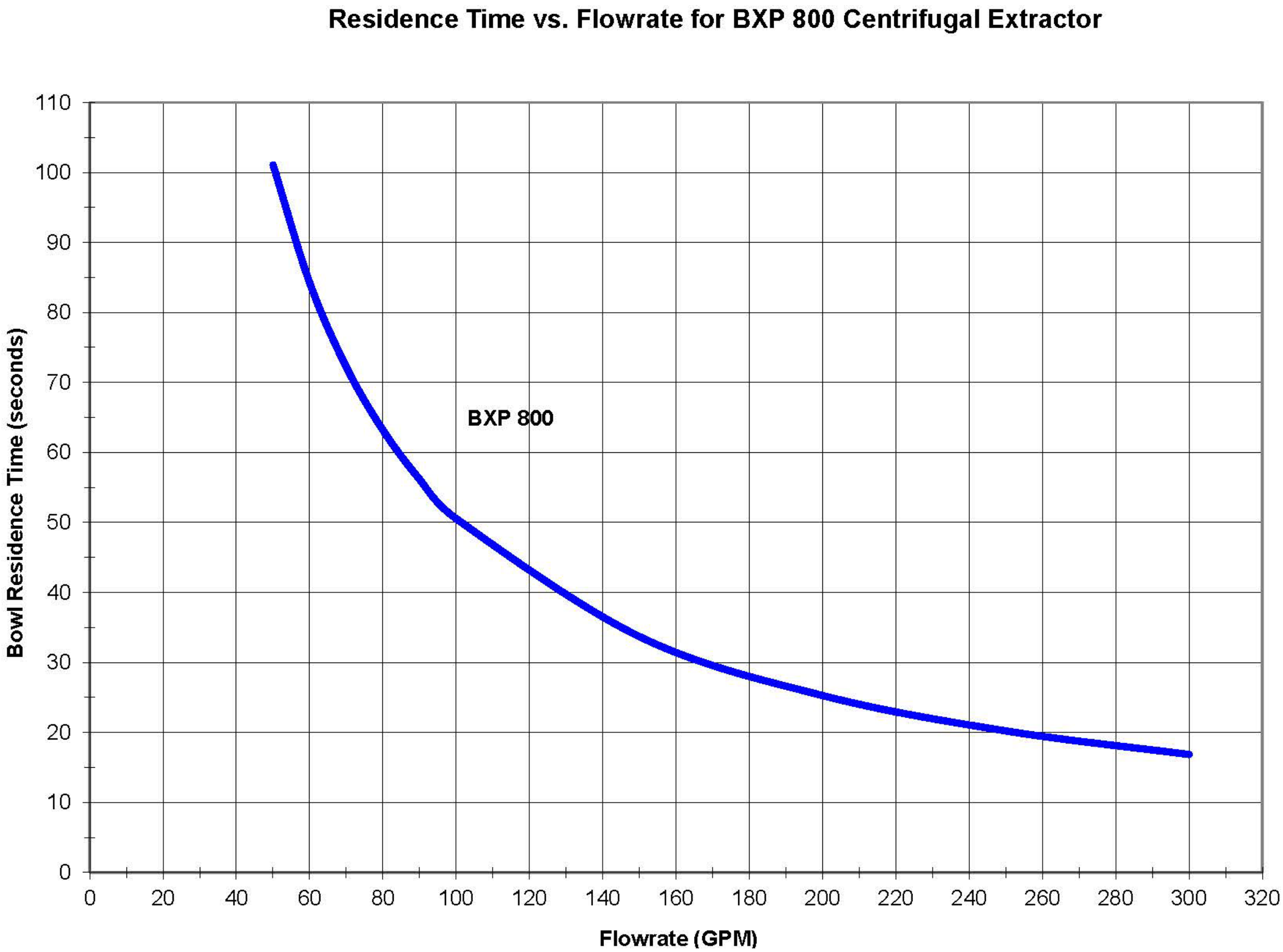
⚠**WARNING!** Under no circumstance should the maximum rotating speed or maximum operating temperature be exceeded. Operation above the rated maximum speed or temperature could result in serious personal injury or death.



Graph 3. G-force at bowl wall vs. rotational speed for Mono-stage BXP metallic extractors.

The optimum speed for a given product is determined by testing at various speeds. The optimum rotational speed depends upon the following factors:

1. Hydraulic Throughput: If the rotational speed is too slow, there may not be enough centrifugal force to properly separate the two phases, and one phase may be entrained within the other. Prior to operating the extractor a shake test can be performed in a separatory funnel or test tube to provide a starting point for flow rates and the required residence time within the bowl. Please refer to **Diagram #4** for details. For high flow rates, speeds up to **1400 RPM** may be used.



Graph 4. Flowrate vs. Residence Time for BXP-800

2. Emulsivity of the Liquids: Some liquid combinations produce emulsions which are very difficult to separate when strong mixing forces have been applied. With such products, better results (flow rate and phase purity) may be obtained at a low or medium rotational speed.

3. Solids formation: It is recommended that if solids are present in either of the phases, that they be pre-filtered before being fed to the extractor. Solids can accumulate inside the bowl and reduce performance and cause abnormal vibration.

⚠**CAUTION!** Do not operate the machine for a prolonged period while experiencing high vibration.

8.5 Start Up

After having performed the inspections of **Section 8.1**:

1. Start up the empty rotor(s).

2. After reaching the operating speed, feed the heavy phase at its nominal flow rate. If the heavy phase contains solutes that will be extracted, it may be necessary to collect the heavy phase discharged during start up and reprocess it to ensure complete solute recovery. It is also possible to use a previously extracted raffinate to fill the bowls initially. If the bowl is filled too slowly, it is possible to witness machine vibration caused by waves occurring in the bowl.

⚠**WARNING!** Never feed product to the centrifuge unless the centrifuge atmosphere has been inerted to a point that is considered safe for the solvents being processed. Failure to do so could result in fire, explosion, injury or death.

⚠**WARNING!** Under no circumstances should the maximum rotating speed or maximum operating temperature be exceeded. Operation above the rated maximum speed or temperature could result in serious personal injury or death.

3. As soon as the heavy phase is discharged from the extractor, reduce its flow rate to one half its nominal rate and begin feeding the light phase at one half of its nominal flow rate.

4. When the light phase is discharged from the extractor, the flow rates of both phases may be gradually increased to their nominal values.

The above procedure should produce continuous heavy phase dispersion. If a light phase continuous dispersion is desired, refer to the start-up procedure in **Section 8.8.6 Example 2**.

Note: It is necessary to feed heavy phase to the extractor until the heavy phase is discharged from the bowl before light phase is fed to the extractor to be sure that when the light phase is introduced into the bowl that the light phase is discharged through the light phase pathway.

If light phase were fed to the empty bowl before the heavy phase, the light phase would follow the heavy phase pathway since it would be the heaviest phase in the bowl at that time.

The flow rate reduction during start up is necessary because when the light phase is initially fed to the bowl, it displaces a portion of the heavy phase. This creates instantaneous flow rates above the maximum throughput.

When the nominal flow rates are less than 50% of the extractors' capability, these precautions are not necessary.

When starting up, chemical equilibrium is normally achieved after displacing **3 times** the hold-up volume allocated to the liquid with the lower flow rate.

For example, with the light phase weir diameter of **350 mm**, a heavy phase weir diameter of **420 mm**, and a phase density ratio of **1.25**, the heavy phase will occupy approximately **45%** of the bowl volume according to the **Interphase Position Diagram.** The bowl volume of the **BXP-800** is **320 liters**, and the heavy phase volume in the bowl is therefore approximately **144 liters** (**320 liters x 45%**).

The corresponding volume of the light phase in each bowl under these conditions is approximately **176 liters**.

If the light phase flow rate is lower than the light phase flow rate, and for the two BXP 800 extractors, chemical equilibrium will be achieved when **864 liters** of heavy phase have been discharged from the last extractor. (**144 liters/stage x 2 stage x 3 displacements**.)

The above calculations do not take into account the volume of liquids contained in the field piping provided by the customer.

⚠**CAUTION!** Do not operate the machine for a prolonged duration while experiencing high vibration.

8.6 Normal Shutdown

The extractor can be shut down with or without exhaustive extraction.

To recover all the solute present in the extractor (exhaustive extraction), replace the normal feed solution with the raffinate and continue feeding for several minutes to ensure that the solvent can extract all the solute present in the extractor. Three displacements of the hold up volume allocated to the liquid with the lower flow rate normally assure complete solute recovery.

Stop the feed and solvent pumps, and then stop the extractor's drive motor. During the deceleration of the rotor, some liquids will be discharged from the casing. When the bowl stops, the bowl's contents will drain into the lower portion of the casing.

If the casing is not drained, the liquids in the casing will be drawn into the bowl when the extractor is re-started. If solids accumulate in the liquid-liquid system, they will likely decant and eventually block or restrict the heavy phase passage within the bowl. If this occurs, heavy phase may be entrained in the light phase. . **Initiate the Clean In Place procedure described in Section 5.11 to remove the solids from the interior of the extractor.**

The mixing chamber **(ITEM NO. 46, DRAWING NO. 79151 & 79135)** are equipped with a drain flange. A drain valve may be installed on the bottom of the mixing chamber. It may be preferable to drain the process materials each time the machine is shut down in order to remove suspended solids or rag. Additionally, the extractor may be run with solvent, stopped, and drained in order to dissolve accumulated solids and remove them from the system. The optimum cleaning procedure depends upon the nature of the materials processed.

8.7 Non-Scheduled Shutdown

If the extractor suddenly loses power due to an electrical overload, immediately stop feeding the liquids, then:

1. Lock-out the power supply. Verify that the rotor turns easily by hand and that the motor and the extractor's bearings were not overheated.

2. Restart the motor after having checked performed the above checks.

   ⚠**WARNING!** Do not operate the machine if the guards have been defeated, removed, or modified. Failure to use safety guards can cause serious injury or death.

3. When the extractor reaches its normal rotational speed, begin feeding the liquids at slow rates and gradually increase to the nominal feed rates.

4. If the outlet piping becomes blocked, immediately stop feeding the liquids.

5. If there is an electrical interruption to the motor for a period shorter than **5 seconds**, the feed pumps may continue running and the motor can be re-started without waiting for the rotor to stop.

NOTE: A full bowl operating at 1200 rpm takes approximately 55 minutes to come to a complete stop after de-energizing the motor and stopping the feed material if the extractors are not equipped with AC variable frequency drives. The deceleration time with an AC variable frequency drive will depend upon the braking ability of the specific AC drive.

NOTE: If the casing was drained before the bowl is restarted, follow the initial startup procedure as described in **Section 8.5**.

8.8 Performance Optimization

8.8.1 General

Extraction is a complex process, and the results are a function of the products being extracted. Variations in viscosity, surface tension, temperature, solubility, and specific gravity have different effects on the success of an extraction process. By modifying the configuration of the extractor and adjusting the process parameters within acceptable limits, optimum results can be obtained.

The solvent to feed ratio affects the extraction performance and the phase separation. We therefore recommend feeding the extractor with pumps whose flow rates can be accurately controlled.

The weir adjustment is a function of the density ratio of the two phases. The interphase position is regulated by changing the inner diameter of the heavy phase weir. The theoretical position of the interphase is a function of the internal diameter of the light and heavy phase weirs. Provided that the unit is running below its hydraulic capacity, changes in the throughput should not affect the interphase position significantly.

8.8.2 Throughput

The throughput is a function of the products being treated and the extractor's rotational speed.

The nominal throughput is based upon products with low emulsivity, a density ratio of 1.3, and a flow ratio of 1, to produce entrainment of less than 0.5% of one phase within the other.

Products with higher emulsivity, lower density ratio, and a high flow rate ratio will require a longer settling time and therefore the throughput will likely be reduced.

There is no absolute limitation to the throughput ratio (aqueous/organic or vice versa). However, ratios higher than 10:1 may result in lower mass transfer efficiency or may cause entrainment of the minority phase within the majority phase with a resultant decrease in efficiency. If this is the case, four possibilities exist:

1. Reduce the overall flow rate to allow more time for the materials to settle.

2. Add more extraction stages (if the phase separation is acceptable).

3. Add a supplemental separation stage of decantation.(if the mass transfer efficiency is acceptable)

4. Artificially increase the minority flow rate by recycling it in the selected stages. This method often not only reduces entrainment but also increases extraction efficiency.

8.8.3 Rotational Speed

In each BXP extractor, two distinct operations are performed:

1. An intimate mixing of the two phases occurs in the mixing zone. The majority of the mass transfer between the two phases occurs in this zone. The mixing becomes more intense as the rotational speed is increased.

   In general, non-emulsive products require intense mixing to obtain high mass transfer efficiency, particularly if the phase flow ratio is high. On the other hand, emulsive liquids only require a low mixing intensity to achieve high mass transfer.

2. A thorough separation of the two phases in the extractor’s bowl (where a portion of the mass transfer also occurs).

   As the rotational speed is increased, the centrifugal force is also increased, and the phase separation should be better. The hydraulic capacity of the extractor is theoretically proportional to the rotational speed. If the rotational speed is too slow, one phase may be entrained in the other.

WARNING! Under no circumstances should the maximum rotating speed or maximum operating temperature be exceeded. Operation above the rated maximum speed or temperature could result in serious personal injury or death.

Since the mixing operation and the separation operation do not always respond to different rotational speed in the same manner, we offer the following general comments:

1. For non-emulsive products, operation at higher rotational speeds is generally beneficial. High speeds increase the amount of agitation, which may increase the extraction efficiency by increasing the interfacial area for mass transfer. Increased speed also increases the centrifugal force available for separation of the two liquids, and the separation should therefore be better than at slow rotational speed, even though the liquid-liquid dispersion created at fast rotational speeds contains smaller droplets than the dispersion that would have been formed at slower rotational speeds.

2. Nonetheless, at higher speeds, some liquids produce emulsions which are very difficult to separate if strong mixing has been applied. With this type of emulsive products, better results (throughput and entrainment) may be obtained at slow or medium rotational speeds.

Tests at different rotational speeds will determine the optimum speed to obtain excellent mass transfer efficiency and thorough phase separation.

The friction of the agitator in the mixing zone increases the temperature of the liquids by approximately 1° C per stage when operating at nominal speed and nominal flowrate with a 1/1 solvent / feed ratio. If thermally sensitive products are being processed, it may be necessary to reduce the rotational speed, particularly at low flowrates.

8.8.4 Mixing Components

The standard agitator **(ITEM NO. 54, DRAWING NO. 72764)** is appropriate for most products. For very emulsive products, it is possible to use a smaller agitator, or to remove the agitator because the mixing that occurs when the liquids enter the mixing chamber and the bowl may be adequate to assure high mass transfer efficiency.

On the other hand, special agitators may be required to thoroughly mix non-emulsive products.

8.8.5 Overflow Weirs

The overflow weir diameters are selected as a function of the density ratio of the two phases in equilibrium in the decanter, and the theoretical position of the interphase is determined using the **Interphase Position Diagram shown in Graph 1**.

The pressure drops experienced by the liquids during their circulation in the bowl modify the position of the interphase slightly. This influence is negligible at the extractor's nominal speed when operating at or below the nominal flow rate. However, when the speed is decreased or the flow is increased, it may be necessary to take this factor into account. High liquid viscosity may also modify the position of the interphase due to a cresting phenomenon as the viscous liquid overflows its weir. When the flow rate of one of the phases is increased, the volume available in the bowl for that phase is decreased.

When the flow rates of the two phases are very different, a higher percentage of the bowl volume should be allocated to the liquid having the higher flow rate to increase its residence time.

In addition, note that the emulsion produced in the mixing chamber can be either **"heavy phase continuous"** consisting of droplets of light phase dispersed within the heavy phase, or **"light phase continuous"** in which the droplets of the heavy phase are dispersed within the light phase.

Usually, the continuous phase is the one with the higher flow rate, but this is not always true.

The droplets of the dispersed phase coalesce in the centrifuge to yield a pure liquid without entrainment of the continuous phase.

On the other hand, following decantation, the continuous phase often contains some fine droplets of the dispersed phase.

It is therefore useful to allocate more bowl volume for the continuous phase to reduce the entrainment.

As a practical matter, these concerns may be contradictory because it is possible for the continuous phase to have a lower flow rate than the dispersed phase.

We therefore suggest:

1. To choose the initial heavy phase weir diameter to position the theoretical interphase between 40 and 60% of the bowl's volume, with the larger volume being allocated to the phase with the higher flow rate.

2. To subsequently change the position of the interphase by using larger or smaller diameter heavy phase weirs based upon the initial results obtained:

    i. Increase the diameter of the heavy phase weir if there is entrainment in the light phase.

    ii. Decrease the diameter of the heavy phase weir if there is entrainment in the heavy phase.

8.8.6 Continuous Phase

It can be helpful to select, and if possible, control the continuous phase when:

1. The mass transfer is easier in one continuous phase system than the other.

2. The phase separation is better in one continuous system than the other. If the entrainment in one phase must be minimized, this phase should be chosen as the dispersed phase.

In most cases, and particularly if the flow rate ratio is high, it is impossible to control which phase is continuous.

Nonetheless, when the flow rate ratio is approximately 1:1, it is possible to select either continuous phase by using the correct start-up procedure.

The phase that will be dispersed should not be fed into the mixing zone until this zone is filled with the liquid that has been selected to be the continuous phase.

The flow rate of the dispersed phase should be increased very slowly while maintaining the flow rate of the continuous phase.

Example 1: Start-up procedure favoring a continuous heavy phase system.

1. Fill the extractor with heavy phase at 50% of its nominal flow rate until heavy phase is discharged. Maintain the heavy phase flow.

2. Feed the light phase at 20% of its nominal flow rate.

3. Gradually increase the flow rate of the light phase to 50% of its nominal value.

4. Increase the flow rate of the heavy phase to its nominal value. Gradually increase the flow rate of the light phase to its nominal value.

Example 2: Start-up procedure favoring a continuous light phase system.

1. Fill the extractor with the heavy phase and, when it is discharged, stop feeding.

2. Feed the light phase at 50% of its nominal flow rate until it is discharged.

3. Continue feeding the light phase, and after 2 or 3 minutes start feeding the heavy phase at 20% of its nominal flow rate.

4. Gradually increase the flow rate of the heavy phase to 50% of its nominal value.

5. Increase the flow rate of the light phase to its nominal value. Gradually, increase the flow rate of the heavy phase to its nominal value.

8.8.7 Temperature

Increasing the process temperature:

1. May influence the solubilities of various components and therefore alter the distribution coefficient. This may change the number of stages or the phase flow ratio necessary to achieve the desired chemical result.

2. May improve phase separation if the viscosities are decreased at higher temperatures.

3. May cause the emulsivity to increase and cause entrainment.

8.8.8 Stage Efficiency

To evaluate the stage efficiency of a given extractor, collect samples of the light and heavy phases discharged from a given extractor using the sampling taps.

Take one half of each sample and analyze them for the solutes in question. Take the other half of each sample, and mix them vigorously in a separatory funnel. Separate the phases and analyze them for the same solutes. If the distribution coefficient is highly temperature dependent, be certain that the separatory funnel test is performed at the same temperature as the BXP 800's operating temperature.

Comparison of the analyses will determine the stage efficiency. If the stage efficiency is not acceptable, try the following tests:

1. If the extractors are equipped with variable speed drives, change the rotational speed. Test at faster and slower speeds to evaluate the relationship between stage efficiency and rotational speed.

2. Reduce the flow rates to increase the liquids' residence time in the mixing chamber.

3. If the extractor is equipped with a recycling system, recycle a portion of the liquid with the lower flow rate to increase the phase flow ratio in the mixing chamber.

8.8.9 Summary

Tests at various speeds, throughputs, phase flow ratios, and recirculation rates should be conducted. It may be necessary to change the heavy phase weir in order to obtain the optimum interphase position for the actual phase density ratio. By having accurate measurements of the flow rates, process temperatures and bowl speeds versus efficiency, the tests should yield adequate data for evaluation.

9 DISASSEMBLY AND REASSEMBLY

9.1 Preparation & Safety Precautions

⚠**CAUTION!** Personal safety equipment should always be worn while the machine is being worked on or while the machine is in operation.

⚠**WARNING!** Disconnect and lock out the power supply. Working on rotor components while the power supply is not locked out could result in serious personal injury or death.

⚠**CAUTION!** If it is necessary to open the electrical enclosures while the system is powered, confirm that the atmosphere is safe to do so. Normal precautions would be taken whenever servicing electrical components.

1. Drain the extractor and rinse it with water or other safe, non- hazardous product before beginning the disassembly procedures. Perform CIP procedure if provided with the extractor.

2. Be certain that the bowl has stopped rotating before any disassembly procedures are begun.

⚠**WARNING!** Never disassemble the extractor unless the rotor has come to a complete stop. This should be confirmed by looking through the coupling guard provided.

⚠**WARNING!** All required procedures should be performed by qualified personnel only!

9.2 Disassembly of the Bearing Assembly, Rotor, & Upper Casing

⚠**WARNING!** Disconnect and lock out the power supply. Working on rotor components while the power supply is not locked out could result in serious personal injury or death.

1. **Lock out power supply to the motor.** Disconnect motor leads and conduit from motor junction box.

2. Remove the motor with its half of the flexible coupling **(ITEM NO. 43, DRAWING NO. 79133).**

3. Remove the screws **(ITEM NO. 53, DRAWING NO. 79133)** that retain the motor support plate **(ITEM NO. 40, DRAWING NO. 79133)**.

4. Remove the grounding strap **(ITEM NO. 104, DRAWING NO. 79133)** between the motor support plate and the steel support frame.

5. Remove the light phase interstage piping **(ITEM NO. 41, DRAWING NO. 72762)** with its flexible connection. If the extractor in question is at the end of the group, remove the light phase discharge pipe and its flexible connection.

6. Remove the mixing chamber **(ITEM NO. 46, DRAWING NO. 79151 & 79135)**.

7. Unscrew the agitator **(ITEM NO. 54, DRAWING NO. 72764)**, being careful to remove the spacer **(ITEM NO. 53, DRAWING NO. 72764)** at the same time.

8. Loosen the light phase discharge flange **(ITEM NO. 45, DRAWING NO. 79151 & 79135)** to loosen the O-ring **(ITEM NO. 55, DRAWING NO. 79151 & 79135)** by removing the screws **(ITEM NO. 56, DRAWING NO. 79151 & 79135)**. This O-ring ensures the sealing around the light phase discharge tube as it passes from the upper portion of the casing **(ITEM NO. 40, DRAWING NO. 79151 & 79135)** to the lower portion of the casing **(ITEM NO. 41, DRAWING NO. 79151 & 79135)**.

It is essential to loosen this flange and release the O-ring before disassembly or reassembly of the upper casing.

9. Disconnect the vent pipe, the labyrinth gas inlet pipes, CIP piping and light phase sample piping.

10. Disconnect the RTD on the mechanical head (if provided).

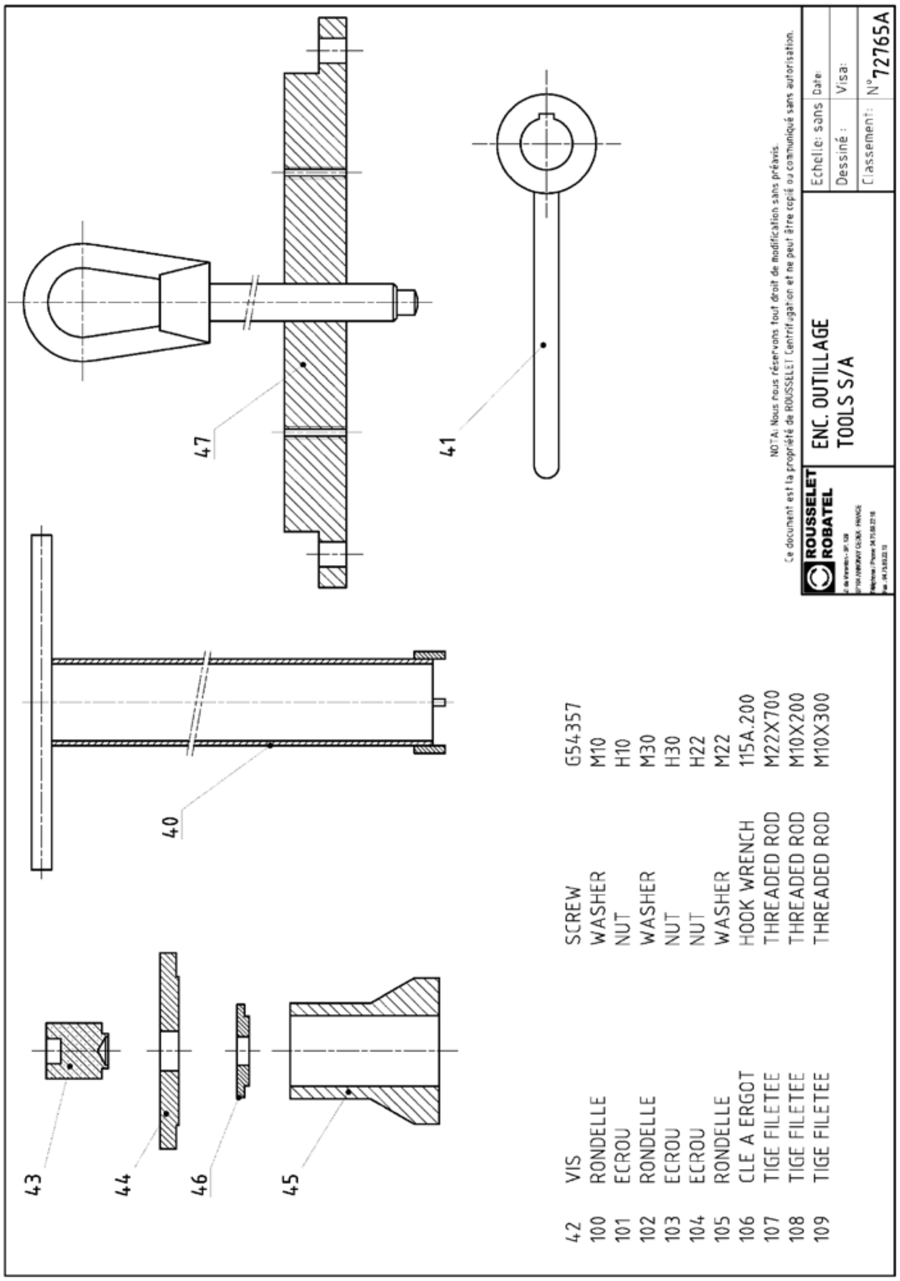
11. Remove the screws **(ITEM NO. 51, DRAWING NO. 79151 & 79135)** holding the upper and lower casings together.

12. Be certain that the casing support cables **(ITEM NO. 31, DRAWING NO. 79133)** are installed before attempting to lift the rotor and upper casing assembly.

13. Attach slings to the lifting rings **(ITEM NO. 57, DRAWING NO. 79133)** and lift the bearing assembly - rotor - upper casing as a sub unit (**1487 kg without motor**). Be careful that the light phase discharge tube releases easily from the lower casing.

9.3 Rotor Disassembly

The bearing assembly - rotor - upper casing is suspended using slings attached to the lifting rings **(ITEM NO. 57, DRAWING NO. 79133)**.



1. Rest the bottom of the bowl on spacer blocks to prevent damaging the turbine **(ITEM NO. 52, DRAWING NO. 72764)**. Maintain tension on the lifting slings.

2. Remove the support cables **(ITEM NO. 31, DRAWING NO. 79133)** which will allow the upper half of the casing **(ITEM NO. 40, DRAWING NO. 79151 & 79135)** rest on the bowl rim **(ITEM NO. 42, DRAWING NO. 72764)**.

3. Remove the lower half of the coupling **(ITEM NO. 43, DRAWING NO. 79133) (**remove screw **(ITEM NO. 88, DRAWING NO. 79133)**).

4. Remove the locknut **(ITEM NO. 86, DRAWING NO. 79133)** from the threaded drawbar by holding the end of the upper shaft with the special wrench **(ITEM NO. 41, DRAWING NO. 72765)**.

5. Install the special tool **(ITEM NO. 47, DRAWING NO. 72765)** in place of the motor (**refer to Page 1 of the disassembly / reassembly sketches below**).

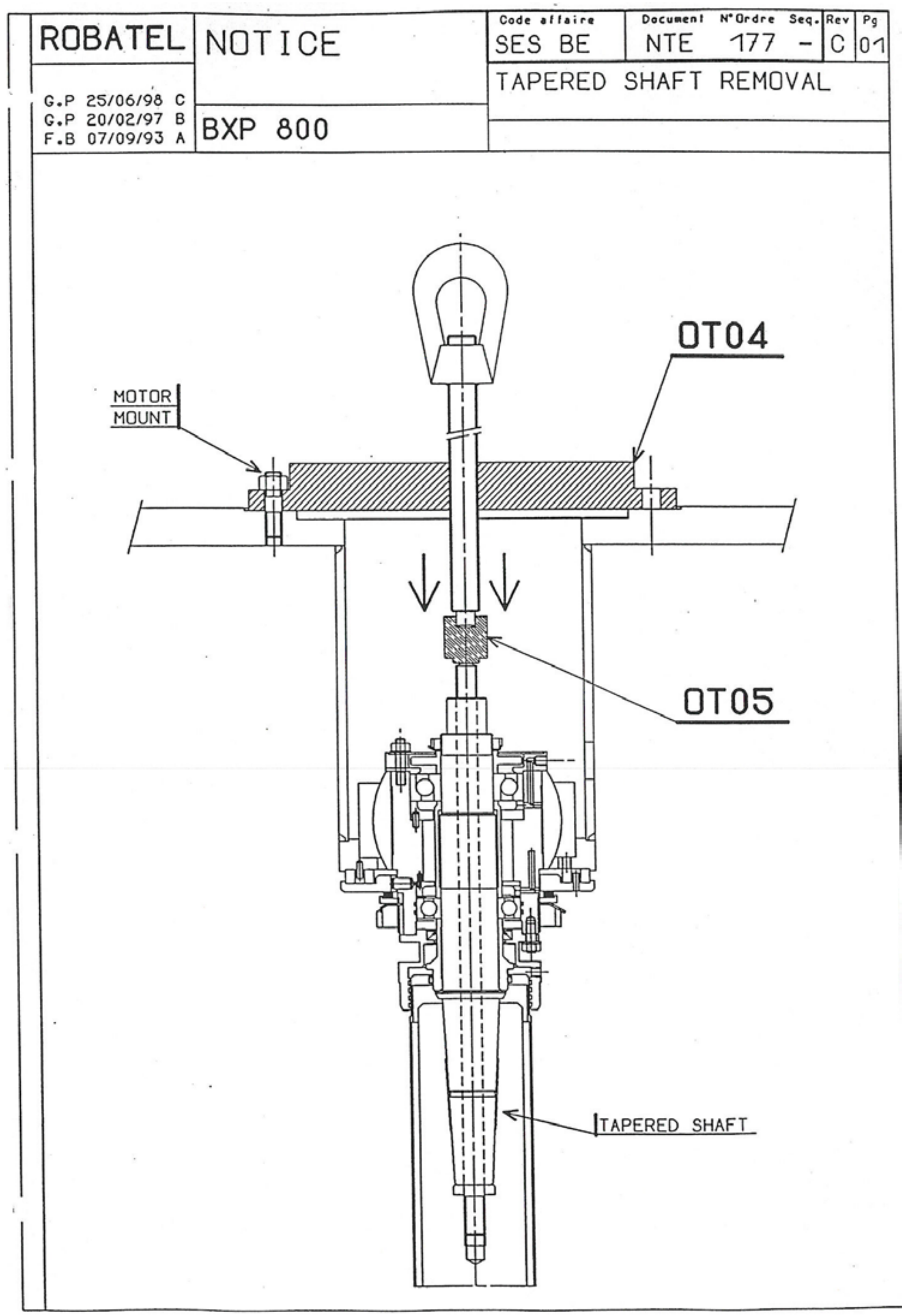


Figure 8. Page 1 of the disassembly / reassembly sketches.

6. Press on the top of the threaded draw bar **(ITEM NO. 15, DRAWING NO. 79133)** using the special spacer **(ITEM NO. 43, DRAWING NO. 72765)** to release the tapered fit between the two sections of the shaft **(ITEM NO. 41, DRAWING NO. 79133)** and **(ITEM NO. 47, DRAWING NO. 72764)**.

7. Remove the mechanical head and the upper casing **(ITEM NO. 40, DRAWING NO. 79151 & 79135)** as a unit.

9.4 Bowl Dismantling

9.4.1 Removal of Heavy Phase Weir

Remove the screws **(ITEM NO. 151, DRAWING NO. 72764)** and remove the heavy phase deflector **(ITEM NO. 44, DRAWING NO. 72764)** to access the heavy phase weir**.**

9.4.2 Removal of the Bowl Rim

Remove the screws **(ITEM NO. 153, DRAWING NO. 72764)** and then remove the bowl rim **(ITEM NO. 42, DRAING NO. 72764)**. Insert 3 **M12** screws in the two jacking holes provided to disassemble and handle the rim.

9.4.3 Removal of the Lower Shaft

1. Remove the shaft sleeve **(ITEM NO. 56, DRAWING NO. 72764)** (if this optional sleeve is supplied on the extractor).

2. Remove the screws **(ITEM NO. 159, DRAWING NO. 72764)** to remove the turbine chamber **(ITEM NO. 51, DRAWING NO. 72764)** including the turbine **(ITEM NO. 52, DRAWING NO. 72764)**. For this step, it is possible to lift the bowl onto spacer blocks using 3 lifting rings screwed into the **M12** threaded holes in the bowl flange, or rest the bowl on its side. The bowl sub assembly weighs approximately **700 kg,** the bowl rim weighs approximately **145 kg,** the turbine chamber weighs approximately **50 kg,** and the lower shaft weighs approximately **90 kg.**

3. Remove the setscrew **(ITEM NO. 162, DRAWING NO. 72764)** that locks the bowl-retaining nut **(ITEM NO. 48, DRAWING NO. 72764)** in place.

4. Loosen the bowl-retaining nut **(ITEM NO. 48, DRAWING NO. 72764) by** 1 or 2 mm using a **75 mm** wrench.

5. With the bottom surface of the bowl resting on spacer blocks, lift the bowl assembly slightly by using an **M22** lifting ring attached to the threaded drawbar **(ITEM NO. 15, DRAWING NO. 79133)**.

6. Striking the bowl retaining nut **(ITEM NO. 48, DRAWING NO. 72764)** should loosen the bowl / shaft conical fit.

7. If the bowl does not release easily from the tapered shaft:

i. Remove the bowl retaining nut and install the special tool **(ITEM NO. 42, DRAWING NO. 72765)** equipped with an M 8 x 100 grease fitting in the threaded hole in the bottom of the shaft. Use this grease fitting to fill the hole bored in the bottom of the shaft with grease.

ii. Remove the tool **(ITEM NO. 42, DRAWING NO. 72765)** and its grease fitting, and insert tool (3/8" G) with its threads covered with Teflon tape. Tightening this screw will pressurize the grease, which should release the conical fit between the bowl and the shaft.

iii. If the initial attempt does not succeed, try again after adding more grease each time to eliminate air bubbles, which might limit the pressurization of the grease.

9.5 Bearing Assembly Dismantling

1. Remove the bowl and the upper casing as described above**. Refer to the disassembly / reassembly sketches in the Appendix.**

2. Using the wrench **(ITEM NO. 40, DRAWING NO. 72765)** and a **10mm** diameter rod inserted through the hole in the upper shaft to prevent the shaft from rotating, remove the SKF nut **(ITEM NO. 84, DRAWING NO. 79133)**. **Refer to Page 2 of the disassembly / reassembly sketches below.**

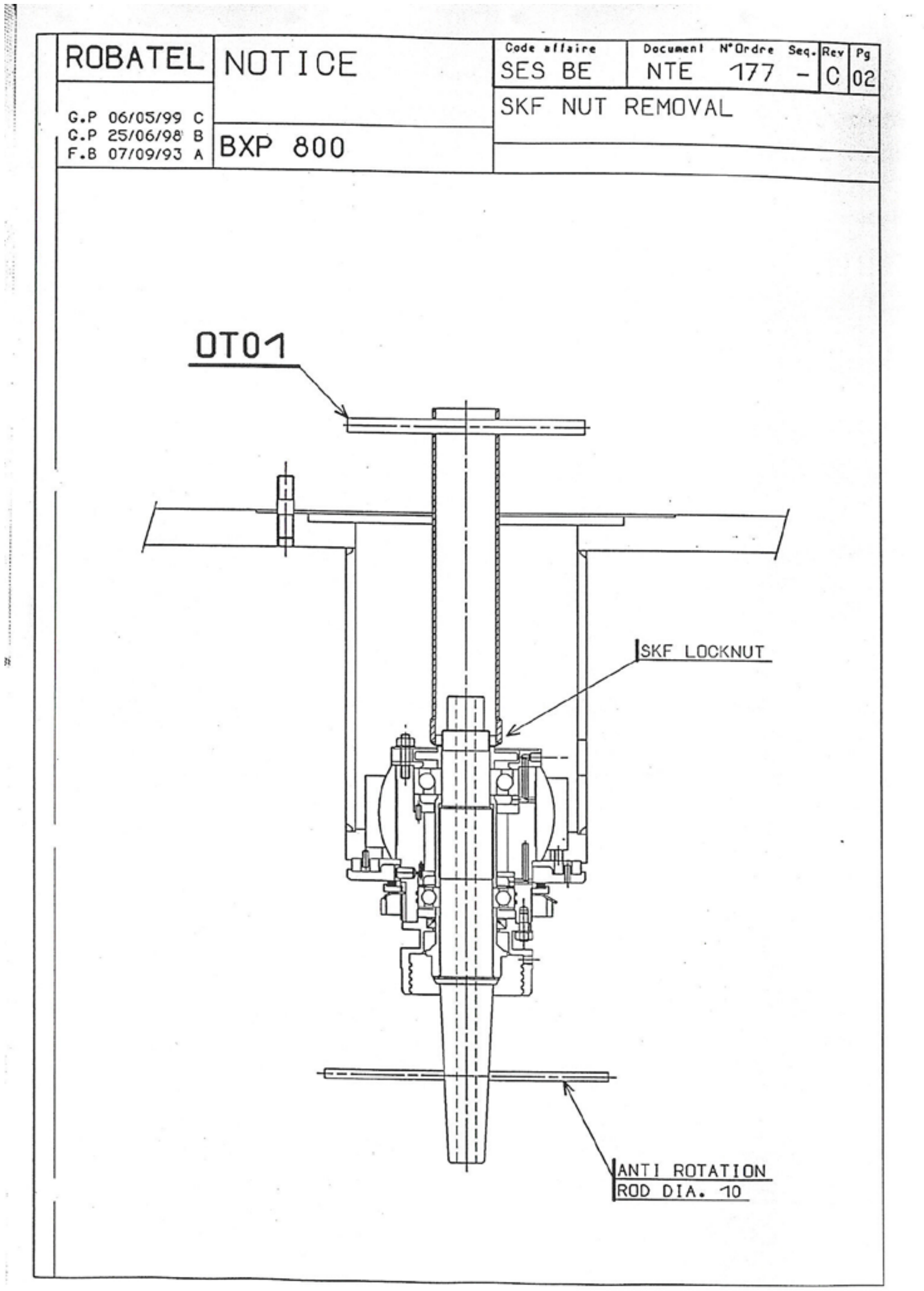


Figure 9. Page 2 of the disassembly / reassembly sketches.

3. Remove the fasteners **(ITEM NO. 97, DRAWING NO. 79133** that attach the labyrinth **(ITEM NO. 47, DRAWING NO. 79133)** to the bearing housing. Release the labyrinth from its fit in the bearing housing.

4. Press on the top of the upper shaft **(ITEM NO. 41, DRAWING NO. 79133)** with the special spacer **(ITEM NO. 43, DRAWING NO. 72765)** and the tool **(ITEM NO. 47, DRAWING NO. 72765)** (**Page 3 of the disassembly / reassembly sketches below).** This will push the shaft out of the upper bearing **(ITEM NO. 67, DRAWING NO.**

79133), but the lower bearing **(ITEM NO. 68, DRAWING NO. 79133)** will remain on the shaft.

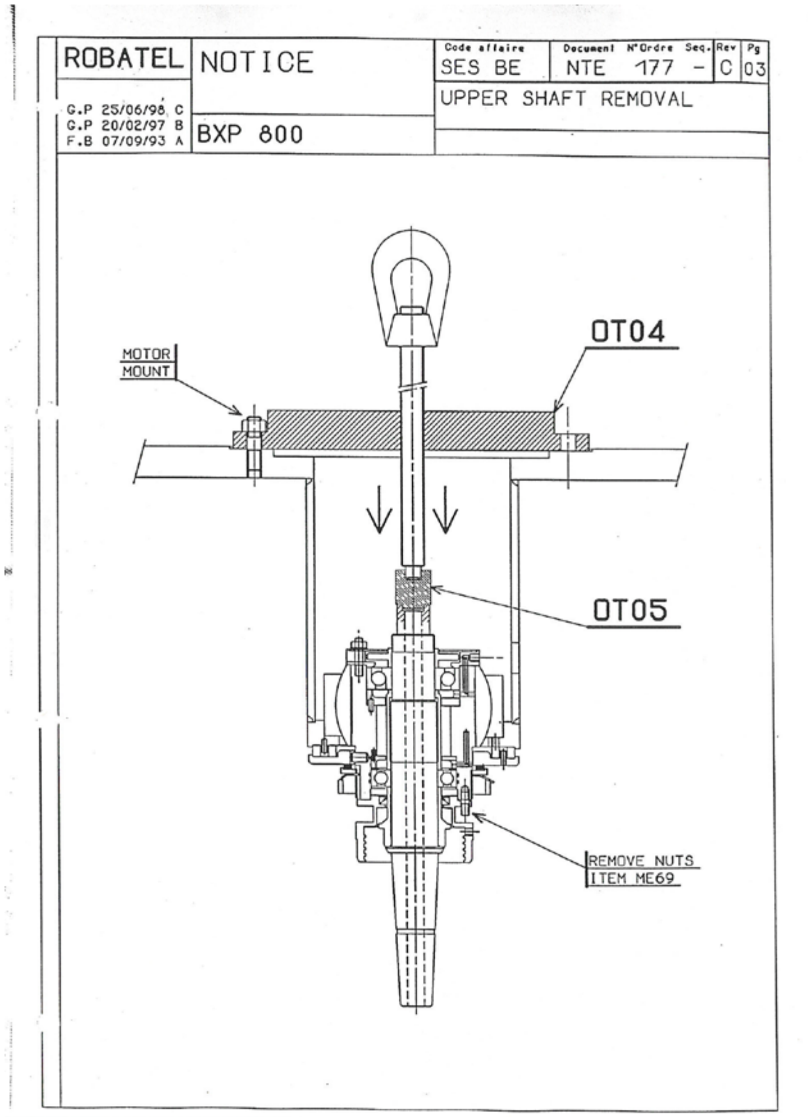


Figure 10. Page 3 of the disassembly / reassembly sketches.

5. Remove the components remaining on the shaft:
   i. Remove the bearing spacer **(ITEM NO. 49, DRAWING NO. 79133)**.
   ii. Remove the lower bearing **(ITEM NO. 68, DRAWING NO. 79133)**.
   iii. Remove the labyrinth **(ITEM NO. 47, DRAWING NO. 79133)** with the lip seal **(ITEM NO. 75, DRAWING NO. 79133)**.
   iv. Remove the shaft sleeve **(ITEM NO. 44, DRAWING NO. 79133)**.

Inspect the components for wear or damage:

Upper Shaft:

Top Bearing Fit 55 mm, tolerance k6
Bottom Bearing fit 60 mm, tolerance k6
Bearing surfaces concentric to each other and to taper within 0.02 mm

Bearing Spacer:

Overall height 103.5 mm +/- 0.05
Top and bottom surfaces parallel to 0.02 mm

6. Remove the following components from the bearing housing:

   i. Remove the RTD (if supplied) and its support by removing the compression fitting and the nuts.

   ii. Remove the grease discharge housing **(ITEM NO. 7, DRAWING NO. 79133)**, its cover **(ITEM NO. 48, DRAWING NO. 79133)**, and the slinger **(ITEM NO. 8, DRAWING NO. 79133)**.

   iii. **Refer to Page 4 of the disassembly / reassembly sketches below.** Using special tools **(ITEM NO. 43, DRAWING NO. 72765)**, **(ITEM NO. 46, DRAWING NO. 72765)**, and **(ITEM NO. 47, DRAWING NO. 72765)**, push on the bearing housing to remove it from the swivel **(ITEM NO. 63, DRAWING NO. 79133)**.

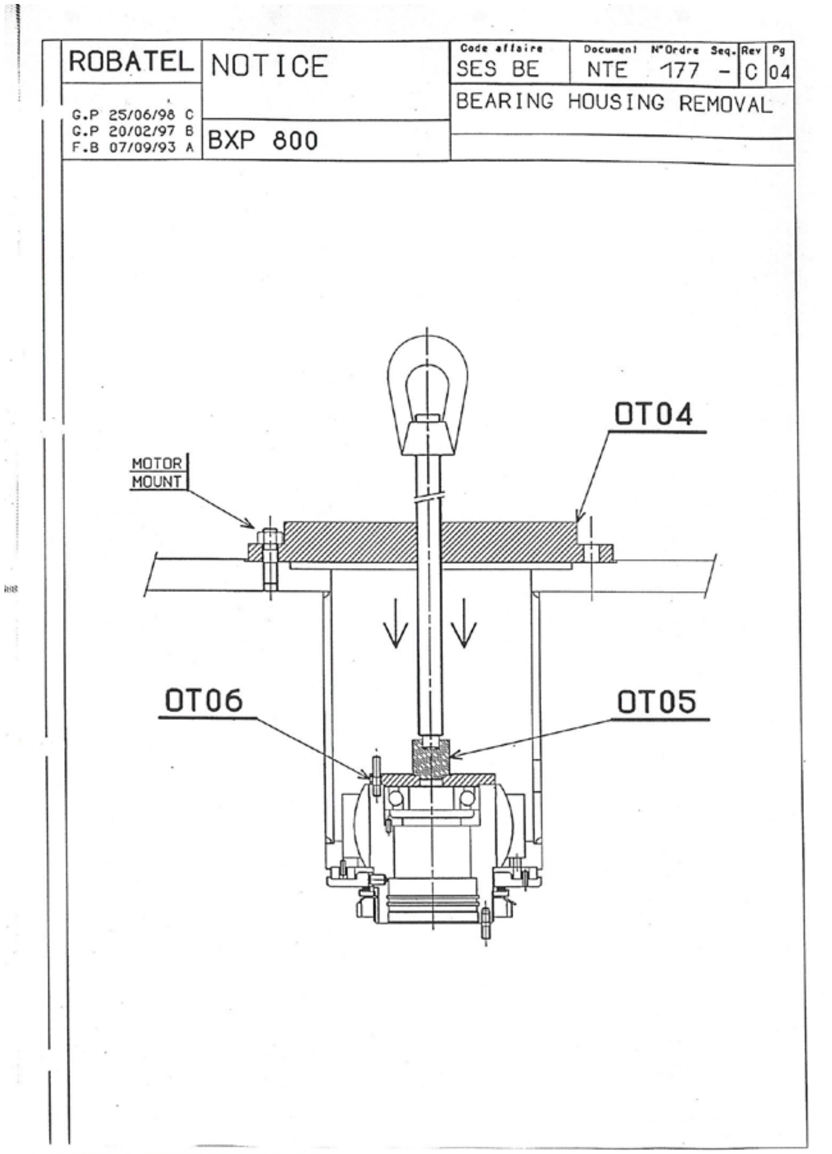


Figure 11. Page 4 of the disassembly / reassembly sketches.

iv. If it is necessary to remove the swivel, use the **3 M10** jacking holes in the lower flange of the support **(ITEM NO. 40, DRAWING NO. 79133).**

v. If the upper bearing **(ITEM NO. 67, DRAWING NO. 79133)** is damaged, remove it.

Inspect the components for wear or damage:

Bearing Housing:

Top Bearing Fit 120 mm, tolerance k6, depth of bore = 52 mm -0/-.05
Bottom Bearing fit 110mm, tolerance k6, depth of bore = 57 mm +/- 0.05
Overall height 175 mm +/- 0.1
Outside diameter, 160 mm, tolerance g6

Avoid removing the upper bearing **(ITEM NO. 67, DRAWING NO. 79133)** from the bearing housing unless it is necessary because there is a risk of dislodging the ball bearings from their races, which will damage the bearing.

For this reason, we do not recommend reusing this angular contact bearing if it has been removed from the bearing housing.

9.6 Reassembly of the Bearings

1. Install the sleeve **(ITEM NO. 44, DRAWING NO. 79133)** on the shaft.

2. Hand-pack the lipseal **(ITEM NO. 75, DRAWING NO. 79133)** with grease.

3. Install the labyrinth **(ITEM NO. 47, DRAWING NO. 79133)** on the shaft being careful not to damage the lip seal **(ITEM NO. 75, DRAWING NO. 79133)**.

4. Install the lower bearing **(ITEM NO. 68, DRAWING NO. 79133)** and the bearing spacer **(ITEM NO. 49, DRAWING NO. 79133)** on the shaft using the special tools. **Refer to Page 5 of the disassembly / reassembly sketches below.**

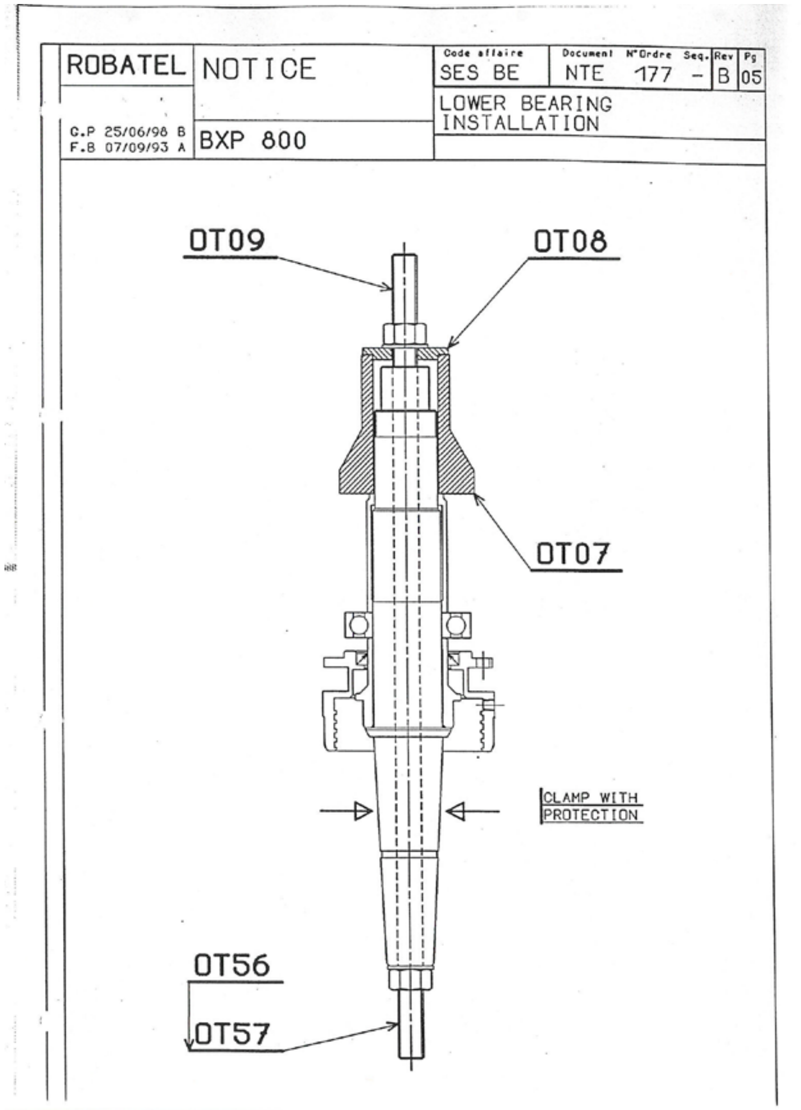


Figure 12. Page 5 of the disassembly / reassembly sketches.

5. Install the spacer **(ITEM NO. 59, DRAWING NO. 79133)** in the bearing housing **(ITEM NO. 42, DRAWING NO. 79133).**

6. Install the upper bearing **(ITEM NO. 67, DRAWING NO. 79133)** in the bearing housing **(ITEM NO. 42, DRAWING NO. 79133)** using the special tools. **Refer to Page 6 of the Disassembly / reassembly sketches below.**

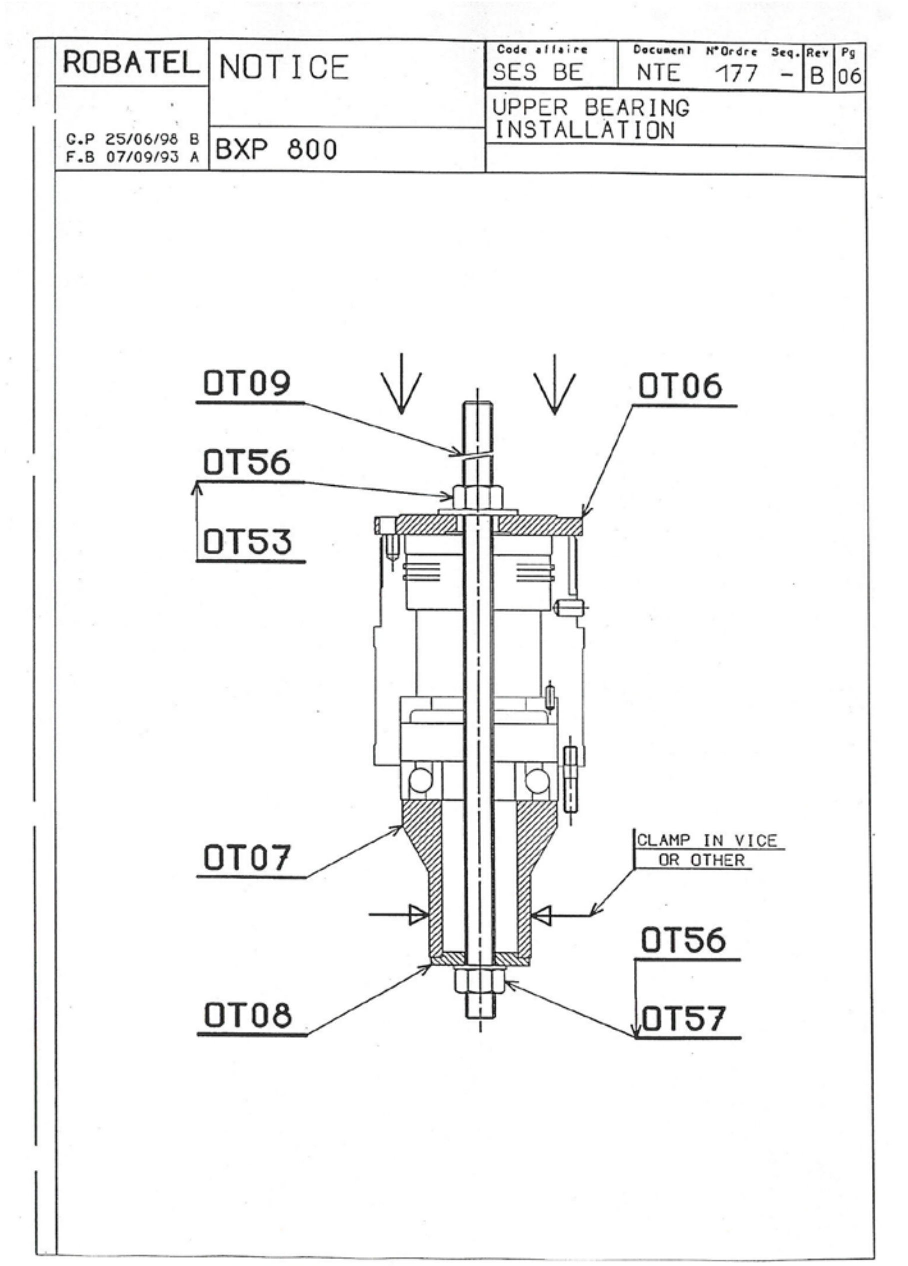


Figure 13. Page 6 of the disassembly / reassembly sketches.

7. Install the lower bearing spacer, spring washers and the O-rings in the bearing housing. Install the lock-nut with washer.

8. Press the shaft sub-assembly into the bearing housing using the special tools and an M22x700 mm long threaded rod with two nuts and washers. **Refer to Page 7 of the disassembly / reassembly below.**

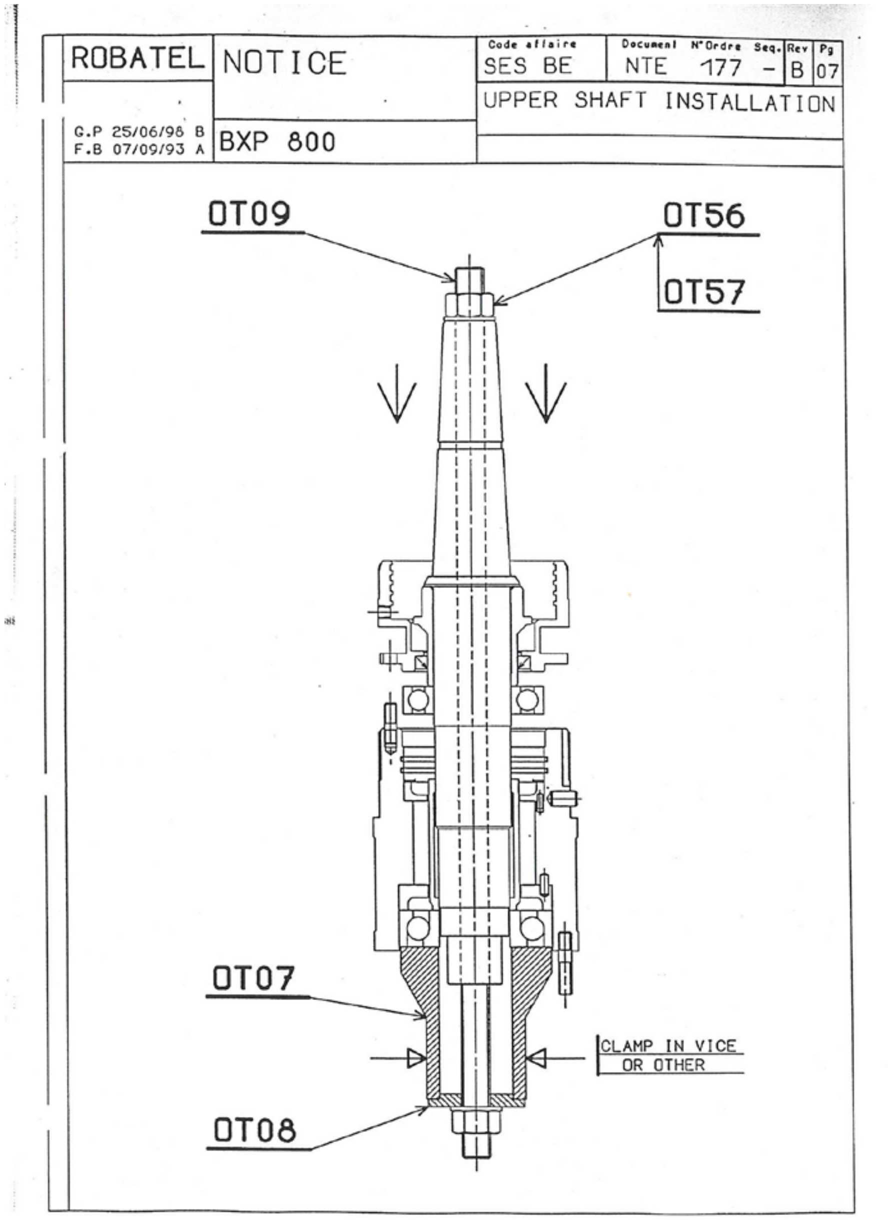


Figure 14. Page 7 of the disassembly / reassembly sketches.

9. Mount the spring washer holder **(ITEM NO. 61, DRAWING NO. 79133)**, the spring washers **(ITEM NO. 83, DRAWING NO. 79133)**, the pin **(ITEM NO. 5, DRAWING NO. 79133)**, the rubber buffer holder **(ITEM NO. 45, DRAWING NO. 79133)**, and the rubber buffers **(ITEM NO. 55, DRAWING NO. 79133)**.

10. If the swivel **(ITEM NO. 63, DRAWING NO. 79133)** has been removed from the support **(ITEM NO. 40, DRAWING NO. 79133)**, reinstall it.

11. Draw the bearing assembly into the swivel using the special tools. Be certain that the O-rings are installed. Hold the swivel in place using the **2 M10 x 380** threaded rods and **4 M10** nuts. **Refer to Page 8 of the assembly / disassembly sketches below.**

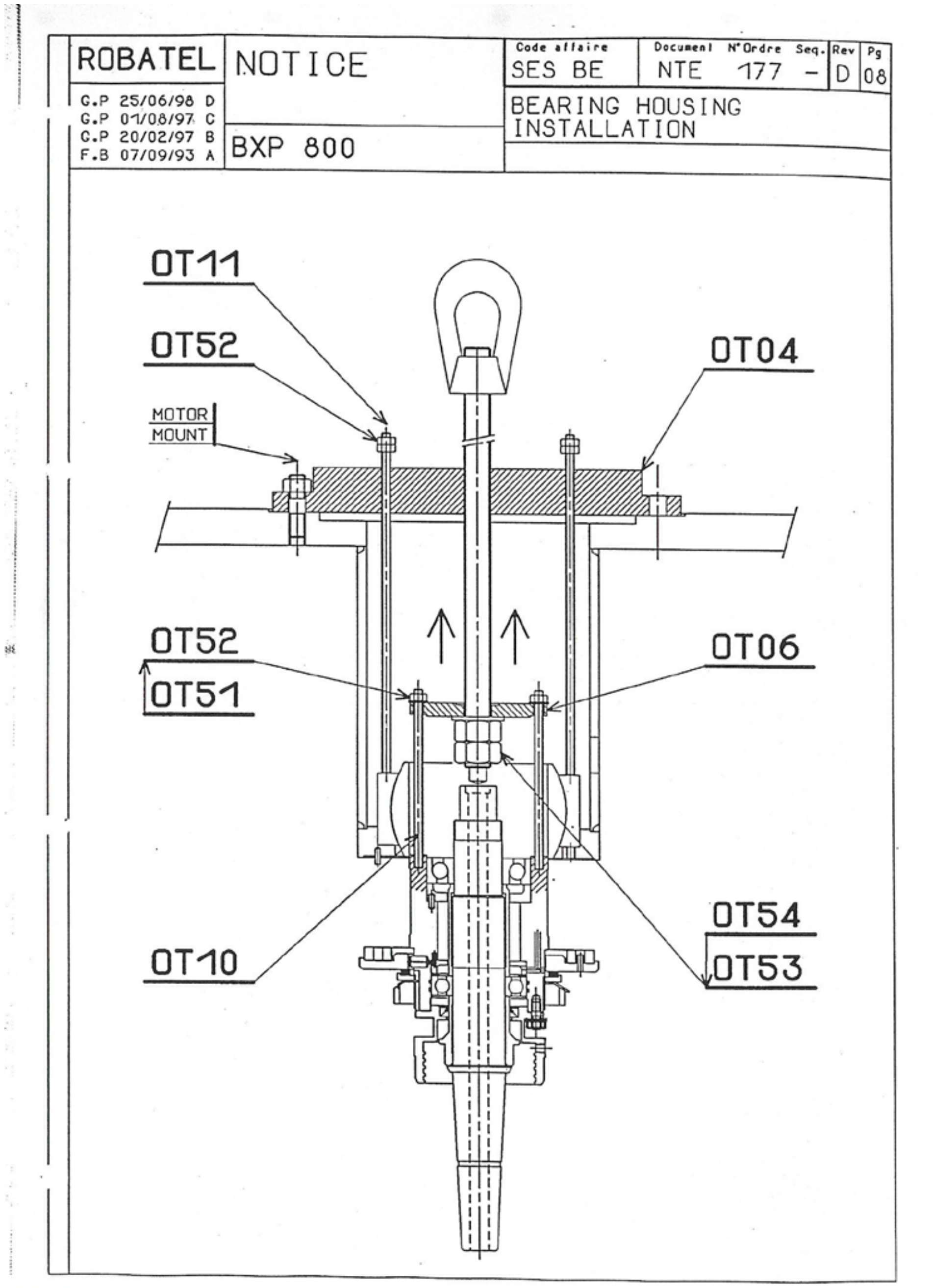


Figure 15. Page 8 of the disassembly / reassembly sketches.

12. Install the grease discharge housing **(ITEM NO. 7, DRAWING NO. 79133)**, the grease slinger **(ITEM NO. 8, DRAWING NO. 79133)**, the grease discharge cover **(ITEM NO. 48, DRAWING NO. 79133)**, and tighten the hex nuts **(ITEM NO. 64, DRAWING NO. 79133)**.

13. Install the RTD (if supplied) and its support using the compression fitting and the nuts.

14. Install the lock ring and tighten the SKF nut **(ITEM NO. 84, DRAWING NO. 79133)**. Secure the lock ring by bending a tab into a notch in the SKF nut. The compression on the bearings is fixed by the height of the spacer and the wave washers.

15. Adjust the lock-nut **(ITEM NO. 73, DRAWING NO. 79133)** to compress the spring washers to a total thickness of **13.5 mm** as described in **Section 8.1.**

9.7 Reassembly of the Bowl

1. Reassemble the bowl components in the inverse order of the disassembly procedure. Be sure that the identification numbers of the components are aligned as match marks. Be certain that all the necessary O-rings are installed.

2. Re-install the lower shaft in the bowl hub being careful that the pin **(ITEM NO. 57, DRAWING NO. 72764)** engages in the groove in the lower shaft to avoid damaging the pin and the groove.

3. Tighten the bowl nut **(ITEM NO. 48, DRAWING NO. 72764)** with a **75 mm** wrench, striking the wrench with a hammer to assure tightness of the bowl nut. Lock the nut with the set-screw **(ITEM NO. 162, DRAWING NO. 72764)**.

4. Install the shaft protection sleeve **(ITEM NO. 56, DRAWING NO. 72764)**. Be sure that the sleeve seats correctly on the bowl hub and all o-rings are installed.

9.8 Reassembly of the Rotor / Bearing Assembly / Upper Casing

Reverse the order of the disassembly sequence.

1. When assembling the two shafts **(ITEM NO. 41, DRAWING NO. 79133)** and **(ITEM NO. 47, DRAWING NO. 72764)**, be sure that:

    i. The pin welded in the lower shaft enters the groove in the upper shaft to ensure correct angular position.

    ii. The mechanical head is lowered slowly over the lower shaft so that the top end of the shaft protection sleeve **(ITEM NO. 56, DRAWING NO. 72764)** engages smoothly on the lip seal sleeve **(ITEM NO. 44, DRAWING NO. 79133)**.

2. When lowering the bearing assembly - rotor - upper casing into the lower casing:

i. Guide the turbine **(ITEM NO. 52, DRAWING NO. 72764)** so that it is not damaged by hitting the bottom of the casing.

ii. Guide the light phase discharge pipe attached to the upper casing so that it enters its corresponding opening in the lower casing. To simplify this step, the light phase discharge flange **(ITEM NO. 45, DRAWING NO. 79151 & 79135)** and the O-ring **(ITEM NO. 55, DRAWING NO. 79151 & 79135)** should be removed.

iii. Do not tighten the light phase discharge flange **(ITEM NO. 45, DRAWING NO. 72764)** until after the upper and lower casings **(ITEM NO. 40, DRAWING NO. 79151 & 79135)** and **(ITEM NO. 41, DRAWING NO. 79151 & 79135)** have been bolted together

10. Install all the grounding straps and all process piping.

11. Reconnect motor leads and conduit to the motor junction box. **Please verify all wiring is per NEC code.**

10 LUBRICATION

10.1 Bearing Lubrication

The bearing assembly is equipped with two lubrication inlets equipped with grease fittings **(ITEM NO. 66, DRAWING NO. 79133)** and extensions.

The grease inlet on the left is for the lower bearing and the one on the right is for the upper bearing.

We recommend injecting approximately **5 grams** of grease into each fitting following every **1000 hours** of operation.

The upper bearing is equipped with a grease relief system to evacuate excess grease. The lower bearing does not have grease relief, and overgreasing can cause abnormal bearing overheating.

Following **8000 hours** of operation, or at least every **3 years**, we recommend dismantling the bearing assembly and repacking with grease (40 to 50% of the bearings' volume).

The recommended grease is KLUBER PETAMO GHY 133N or equivalent.

The swivel is self-lubricated and does not require grease injection.

10.2 Lubrication of the Motor

Refer to the motor manufacturer's greasing recommendations.

11 MAINTENANCE

Robatel Inc. provides preventative maintenance inspections (PMI). Please contact Robatel Inc. for details.

The only necessary routine maintenance procedures are the periodic lubrication described above and a disassembly inspection every **8000 hours** of operation.

During the disassembly, inspect, and if necessary, replace.

- The bearings **(ITEM NO. 67, DRAWING NO. 79133)** and **(ITEM NO. 68, DRAWING NO. 79133)**
- The lip seal **(ITEM NO. 75, DRAWING NO. 79133)**
- The shaft sleeve **(ITEM NO. 44, DRAWING NO. 79133)**
- The O-rings

12 SPARE PARTS

When ordering replacement parts, always refer to the model and serial number of the machine as designated on the centrifuge nameplate.

MODEL: BXP-800
SERIAL: 800344-800349

Parts should be ordered by part name, drawing number, and number as designated by the **spare parts list.**

⚠ **CAUTION!** Do not replace components with parts, which are unequal in quality or type.

For long periods of operation, we recommend purchasing the following spare parts for each extractor:

- One set of bearings
- One set of lip seals
- One set of inserts for the couplings
- One set of spring washers
- One set of rubber buffers
- One turbine
- One agitator
- One set of O-rings
- One upper shaft
- One shaft sleeve
- One threaded drawbar
- One lower shaft
- One bowl retaining nut
- One swivel
- One set of flexible piping connections

It may also be desirable to purchase a complete mechanical head subassembly.

Please contact Robatel Inc for all your spare parts, maintenance and preventative maintenance needs. Please refer to the contact information in **Section 13.**

13 TECHNICAL SERVICE CONTACT INFORAMTION:

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Phone:	33 (0) 4 75 69 22 11
Fax:	33 (0) 4 75 67 69 80
Email:	rousselet.sa@rousselet.fr
Website:	www.rousselet.fr

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Request Specific Information:	Request Form
Directions From Albany:	Directions
Directions From Boston:	Directions
Directions From Hartford:	Directions

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Fax:	+420 224 833 093
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Web site:	http://www.rousselet.cz/kontakty.html

14 EXTRACTION GLOSSARY:

1) **Continuous Phase:** The liquid phase, in a liquid / liquid emulsion/dispersion/liquid mixture, which surrounds and contains droplets of the dispersed phase.
2) **Counter-current Extraction:** An extraction process in which the liquid feed from each stage is continuously contacted with solvent from the preceding extraction stage.
3) **Cross-current Extraction:** An extraction process in which the liquid feed is contacted with fresh solvent for each extraction stage.
4) **Dispersed Phase:** The liquid phase, in an emulsion/dispersion/liquid mixture, which is in droplet form and is surrounded by the continuous phase.
5) **Distribution Coefficient (**also known as **Partition Coefficient):** The ratio of solute concentration in the extract versus the concentration of solute in the raffinate.
6) **Emulsion:** A mixture of two immiscible liquids formed during the mixing step of an extraction stage.
7) **Entrainment:** The quantity of one immiscible liquid remaining in the other discharged liquid exiting a single extraction stage or extraction unit operation.
8) **Extract:** The enriched solvent phase exiting the extraction unit operation containing the solutes.
9) **Extraction Efficiency:** The total quantity of solute extracted from the raffinate phase divided by the total quantity of solute in the feed, over the entire extraction unit operation.
10) **Extraction Factor:** Product of distribution coefficient and flow rate ratio. Used for determining extraction efficiency and number of stages in the Kremser equation.
11) **Extraction stage (**or **"stage"):** A single extraction step in which the solvent and feed are mechanically mixed and decanted by gravity or centrifugal force in which a given quantity of solute is transferred from the feed to the solvent.
12) **Equilibrium:** The condition, after an extraction of solute from the feed into the solvent, when there is theoretically no further mass transfer between the extract and raffinate.
13) **Feed:** The liquid phase entering the extraction unit operation containing the solutes to be extracted.
14) **Flowrate Ratio:** Ratio (by volume or by weight) of feed flow rate versus the solvent flow rate.
15) **Fractional Extraction:** An extraction process in which the feed is introduced at an intermediate stage, and two immiscible solvents are introduced at each end of the extraction unit operation to perform selective extraction of multiple solutes.
16) **Heavy phase:** The liquid phase having the higher density or specific gravity.
17) **Interphase:** The area where the two immiscible liquid phases are in contact after separation.
18) **Light phase:** The liquid phase having the lower density or specific gravity.
19) **Mass transfer:** The process in which the solute leaves the feed phase and is dissolved into the solvent phase during the mixing step of an extraction stage.
20) **Mechanical stage:** A single extraction step in which solute recovery is determined through the practical use of selected equipment.
21) **Operating line:** The line on a McCabe-Thiele diagram that corresponds to the solvent to feed ratio. On the diagram, the slope of this line is equal to the inverse of the solvent / feed ratio. This line is used to determine the number of theoretical stages required to achieve the desired final concentration of solute in the raffinate.

22) **Raffinate:** The liquid phase exiting the extraction unit operation that is depleted of solute(s).
23) **Scrubbing:** An extraction process in which an extract phase is washed with a solvent to remove impurities
24) **Selectivity:** In extractions where several solutes are present, it is the ability of the solvent to effectively extract the desired solute(s) and not extract the undesired solute(s).
25) **Solute:** Dissolved material in an extraction process to be removed from the feed phase by the solvent phase.
26) **Solvent:** The liquid phase entering an extraction unit operation that is used to remove the solute(s) from the feed phase.
27) **Stage Efficiency:** The quantity of solute recovered in a mechanical stage divided by the quantity of solute recovered in a theoretical stage.
28) **Theoretical stage:** A single extraction stage in which the quantity of solute recovered is determined through mathematical or graphical means.
29) **Weir:** A dam or barrier that aids in the separating of the two immiscible liquid phases during the liquid / liquid separation step of an extraction stage. The weir regulates the liquid / liquid interphase position.

15 APPENDICES

15.1 Interphase Position Diagram

15.2 Mechanical Head Assembly/Disassembly

15.3 Parts Lists

15.3.1 Mechanical Part List

15.3.2 Instrumentation Part List

15.4 Drawings

15.5 Grease Information, KLUBER, PETAMO GHY 133N

15.6 Motor Information:

15.6.1 Manual

12.3 Vibration Transmitter, METRIX, ST5484E-123-020-00