US CENTRIFUGE SYSTEMS
A Division of Filtertech

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Model M512 Operations Manual

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Table of Contents

- PLEASE READ THIS ENTIRE INTRUCTION MANUAL PRIOR TO INSTALLING OPERATING OR SERVICING THE CENTRIFUGE.
- FAILURE TO COMPLY WITH THESE INSTRUCTIONS MAY RESULT IN PERSONAL INJURY, PROPERTY DAMAGE, EQUIPMENT DAMAGE, AND MAY VOID THE WARRANTY.
- RETAIN MANUAL WITH UNIT FOR FUTURE REFERENCE. SERVICING OR REPAIRING THIS EQUIPMENT WHILE STILL UNDER WARRANTY WITHOUT PERMISSION FROM US CENTRIFUGE MAY VOID WARRANTY.
- FOR ASSISTANCE CALL **U.S. CENTRIFUGE** AT **1-800-899-2040**.

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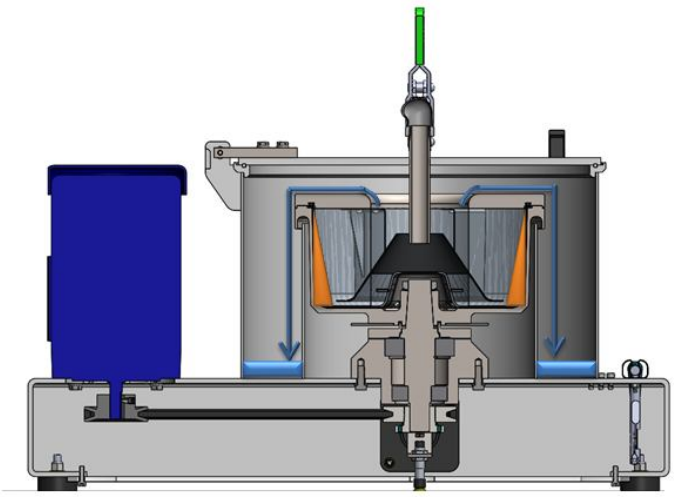
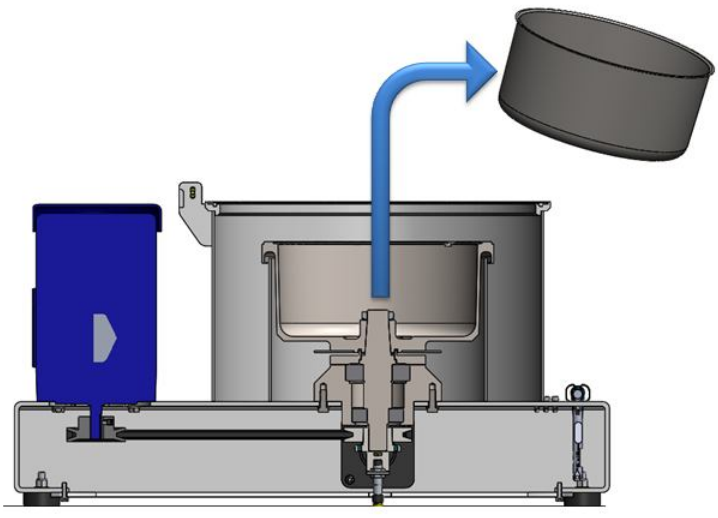
SECTION 1.0 PRINCIPLE OF OPERATION

The model M512 basket centrifuge is designed for the separation, removal, and centrifugal compaction of solid particles entrained in a liquid media. The liquid to be clarified is pumped through the inlet connection and into the spinning bowl through the feed tube. The feed cone accelerates the liquid up to the speed of the bowl and feeds under it and into the bowl chamber at a greater diameter than the pool surface. The centrifuge bowl spins at 3,000 rpm applying up to 1500 times "G" on the liquid continuously passing through the bowl. Under multiplied gravitational force solids are separated from the liquid and retained in the bowl's solids holding space. The solids are continuously collected in the solids holding space until it becomes full and requires cleaning. The liquid fills the bowl to the depth of the center aperture in the bowl top and overflows into the bowl enclosure. The clarified liquid decelerates and drains out the 3" discharge fitting.



The machine requires cleaning once the solids holding space becomes filled. The total bowl volume is 1.6 gallons/6.0 liters with a maximum solids holding capacity of up to approximately 1.0 gallons/3.785 liters. The volume you can fill the machine to will depend on the nature of the application. The cleaning interval can be calculated by using the following formula:

CLEANING INTERVAL (Minutes) =
BOWL SOLIDS HOLDING CAPACITY
Divide by the
FEED RATE X's the % SOLIDS IN THE LIQUID



- **Note:** Experience is the best means for determining when it is necessary to stop the unit and clean the bowl.

- **Note:** If the machine is vibrating excessively during operation it typically means the machine has reached its solids holding capacity and should be stopped and cleaned out.

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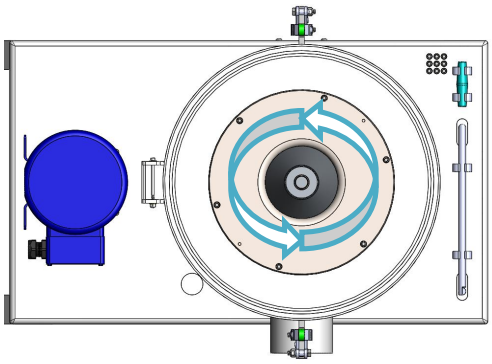
SECTION 2.0 TECHNICAL SPECIFICATIONS

General:

The M512 spins in a counter clockwise rotation. See figure below.



Frame:

- Length 40” / 101.6cm
- Width 19.5” / 49.5cm
- Height with portable stand 55” / 139.7cm
- Weight with portable stand 315-lbs. / 693-kg
- Mounting fixtures Four (2) locking swivel castors (2) non lock swivel castors

Bowl:

- Bowl material 316L stainless steel (Aluminum optional)
- Bowl diameter 12”
- Bowl liner material 304 stainless steel up to 200°F (ABS optional)
- Bowl-top o’ring NBR up to 120°F or Viton up to 200°F (Teflon optional)
- Bowl speed 3,000-RPM
- Bowl volume 1.62 US gallons / 6.1 liters
- Solids holding capacity 1.00 gallons / 3.785 liters
- “G” force Up to 1,500 x “G” @bowl perimeter

Piping connections:

- Inlet ¾” NPT Hose
- Inlet pressure 5-psi
- Discharge 3” NPT Female pipe connection
- C.L discharge outlet height 28” / 61.6 cm
- Discharge Pressure 0-psi or gravity

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Efficient Working Capacity

Flow rate Up to 10-gpm Maximum

Note: *The working capacity is not determined by the volume of liquid the machine can process per minute, but rather a flow rate for which the machine will perform efficiently on a given product.*

The efficient working capacity of the unit is dependent upon many variables such as:

- **Flow rate**
- **Retention time**
- **Liquid density**
- **Viscosity**
- **Particle size**
- **Particle shape**
- **Particle density**

Standard motor:

3-HP (2.2-kw) 230/460-volt 3-phase 60-Hz. 1750-rpm TEFC drive motor with a 1.15 service factor.
Other motor horsepower and model types and voltages available.

Standard motor starter:

Manual push stop/start station housed in NEMA 1 or NEMA 12 enclosure and pre-mounted and wired to motor.

AVAILABLE OPTIONS:

Timer control box:

Includes magnetic IEC starter with panel mount push stop/start station housed in a NEMA 12 enclosure with an adjustable timer that shuts off the unit at the predetermined time illuminates a red panel mounted light to indicate cleaning is required.

Progressive cavity pump:

Progressive-cavity positive-displacement self-priming feed pump with cast iron, and/or stainless housing with stainless steel rotor and NBR stator (Viton optional).

- Pump inlet connection ¾” NPT
- Pump suction lift 10’ of head
- Maximum particle size 3/16”
- Maximum temperature 140°F (NBR)
- Maximum viscosity 1,000-ssu
- Standard flow rate 5 to 7-gpm

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AODD feed pump:

Air powered double diaphragm pump with aluminum body and NBR diaphragms and seals. Pump includes air-regulating solenoid mounted onto and controlled by the motor starter controls. Stainless steel pump body and other diaphragms and seals optional.

- Pump inlet connection 1" suction female NPT and ¾" female NPT discharge.
- Pump suction lift 10' of head
- Maximum particle size 3/16"
- Maximum temperature 140°F (NBR diaphragms) / 200°F (Teflon diaphragms)
- Maximum viscosity 1,000-ssu
- Standard flow rate 1 to 10-gpm depending on adjustment of air regulator

SECTION 3.0 PHYSICAL INSTALLATION REQUIREMENTS

- **Proper installation is mandatory for efficient and trouble free operation.**

1. **Location:** The unit should be located in such a way that it permits easy access for opening the bowl-enclosure lid and removing the bowl-top and bowl-liner. The machine's location relative to the liquid source is unimportant provided the specific piping and flow requirements are maintained.

2. **Mounting:** The unit can be made portable with the optional balloon cushion locking castors or left completely stationary with standard adjustable footpads. The centrifuge should have a solid, level, secure foundation but does not require base or anchor bolt type fasteners to fix the machine to the floor. The unit should be leveled corner to corner + or – 1/8".

3. **Feed connection and piping:** DO NOT hard pipe to the centrifuge inlet. The connections to the inlet connection should be made with a flexible coupling, which prevents damaging the machine during abnormal periods of imbalance that can occur from full and/or uneven solids distribution in the bowl. The feed line should be constructed of no greater than 1" with flexible hose. A manually operated ball valve should be installed at the liquid source ahead of the pump for the maintenance purposes. Installation of a strainer on the inlet side of the line is also recommended to prevent particles larger than 3/16" from plugging the feed line and/or damaging the feed pump.

4. **Discharge connection and piping:** DO NOT hard pipe the centrifuge outlet discharge connection to the liquid source tank. The discharge connection should be free or made with a flexible coupling or hose, which prevents damaging the machine during abnormal periods of imbalance that can occur from full and/or uneven solids distribution in the bowl. Because the centrifuge is a gravity discharge design, DO NOT reduce the diameter of the outlet connection, coupling, or drain piping.

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- THE DISCHARGE LINE MUST HAVE A MINIMUM SLOPE OF A ½" PER EVERY 4' OF PIPE LENGTH AND BE FREE OF ANY RESTRICTIONS THAT COULD IMPAIR GRAVITY LIQUID FLOW.

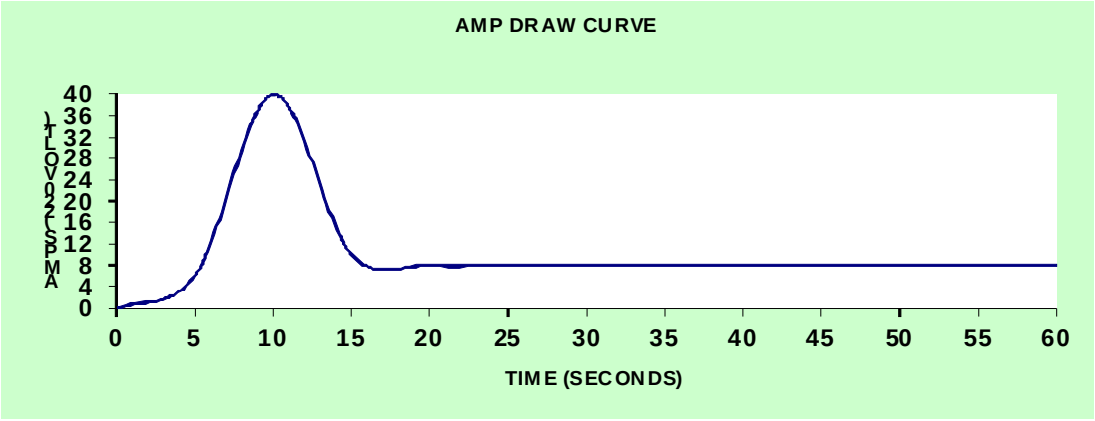
5. **Frame drain fitting:** A 1" NPT fitting is located in the bottom of the frame's bowl enclosure under the centrifuge bowl. This fitting will discharge liquid onto the floor if the liquid flow from the discharge pipe is impaired. DO NOT plug this drain fitting. The drain fitting should be fitted with a hose and drained to a bucket or piped back to the liquid source. If liquid cannot flow freely from the drain fitting due to a plugged or restricted discharge pipe, it will flood the bowl enclosure and cause premature bearing failure.

- IF LIQUID IS FLOWING ONTO THE FLOOR FROM UNDER THE UNIT, CHECK THE DISCHARGE PIPING.

SECTION 3.1 ELECTRICAL INSTALLATION REQUIREMENTS

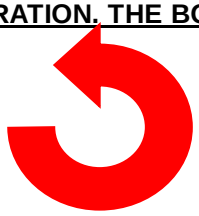
6. **Electrical connections**: The power source should be wired directly to the motor starter located on machine base frame. All components should comply with NEC, NFPA and local codes governing installation. Connect incoming power supply to the motor starter enclosure per the included manufacture's instructions.

- **Minimum fuse or breaker size should be 30 amp @ 220 volt, three phase and minimum wire size should be 14-awg. Fuses should be duel element only.**



7. **ROTATION OF THE BOWL MUST BE CHECKED PRIOR TO OPERATION. THE BOWL MUST ROTATE COUNTER-CLOCKWISE WHEN VIEWED FROM ABOVE.**

See the decal located on the machine bowl enclosure for the correct direction of rotation.



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- **Note:** If the bowl rotates clockwise, reverse two legs of the incoming three-phase power supply and recheck rotation.
- **Note:** If the unit is equipped with a progressive cavity pump driven by the centrifuge drive motor and the bowl rotated clockwise during the first check for proper direction, check the pump to make sure the stator did not unscrew itself damaging the internal components of the pump and/or rotor.
- **Note:** If the machine is equipped with an optional Timer Control Box, please refer to the included electrical diagram on the following page in order to make the proper electrical connections. The standard timer is an 8-hour timer and is adjustable for the percentage of time delay required.

SECTION 4.0 OPERATING PROCEDURES

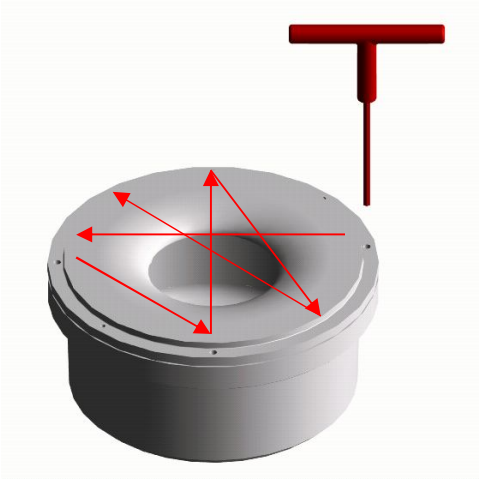
Proper disassembly, cleaning, and re-assembly of the centrifuge bowl parts are critical for maintaining the functional operation of your machine. Failure to follow the instructions can result in decreased performance, reduced bearing and seal life, and potentially bowl-top and/or bowl-bottom damage. For these reasons it is imperative that you carefully follow the cleaning procedures below:

a) Before pushing the "Start" button and starting the unit make sure the following items have been checked:

- A clean bowl-liner has been placed in the bowl-bottom.
- The six (6) socket head cap screws (SHCS) fastening the bowl-top onto the bowl-bottom are fully tightened.
- The bowl-enclosure lid has been properly closed and clamped down.
- The electrical disconnect that supplies power to the motor starter is switched on.
- The feed and discharge lines are properly installed.

b) Push the "Stop" button on the unit once the bowl has reached its maximum solids holding capacity.

- **Note:** The unit should not be allowed to run more than a few minutes after reaching its maximum solids holding capacity, which can cause excessive vibration damaging the bearings and other centrifuge components. Monitor the process times to make sure the cleaning frequency matches the filling rate.
- If you have a Timer Control Box, the unit will automatically turn off and wait.



c) After the centrifuge stopped undo the bowl-enclosure lid clamps and open the lid. USE the supplied T-handle hex key to remove the six (6) socket head cap screws (SHCS) from the bowl-top per the illustration below.

The six (6) socket head cap screws (SHCS) should always be loosened and tightened in a star pattern to ensure pressure is evenly applied or removed from the lid and prevent damage.

d) Next, lift the bowl-top off the bowl-bottom and carefully lay it aside.

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SECTION 4.0 OPERATING PROCEDURES (continued)

e) Now remove the bowl-liner using the provided liner-lifting tool. This should be done:

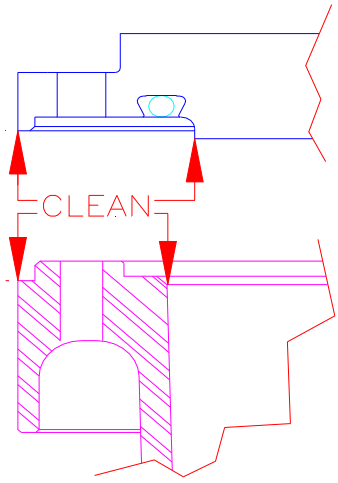
- Open the clasps on either end of the tool.
- Drop these ends into the semicircular slots in the top face of the bowl-bottom.
- Close the clasps.
- Lift the bowl-liner out vertically.

f) Once the bowl liner has been removed it can be cleaned immediately and put back into service, or used in an alternating liner approach. This means a clean liner is placed into the centrifuge and starts processing while the filled liner is cleaned and prepared for the subsequent cycle. US Centrifuge Systems recommends this for less down time and allows more time for the liner to be thoroughly cleaned before reuse.

NOTE: After the bowl-liner has been removed, inspect the bowl for moisture. If excessive moisture is present, the liner may be cracked or the o-ring may not be sealing properly. Inspect these parts to determine if replacement is necessary.

g) Before placing a bowl-liner back into the bowl-bottom, remove any moisture and/or grime in the bowl with a rag. Use cleaning solution or solvents as required.

h) Clean the O-ring groove and mating sealing surfaces on the bowl top and bowl bottom. These include all surfaces from the outer diameter to inner diameter on each piece as shown in the figure to the right.



i) These surfaces should be completely clear of foreign matter. Additionally, the o-ring should be periodically removed and cleaned making sure solids are not packing behind the o-ring and preventing it from properly sealing. After cleaning make sure the o-ring is clean and seated in the groove all the way around.

NOTE: Cleaning the O-ring groove and mating sealing surfaces on the bowl-top and bowl-bottom is the most critical step in the entire cleaning process.

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SECTION 4.0 OPERATING PROCEDURES (continued)

j) When cleaning the bowl-top, check the feed-cone and impeller-blades for residue. Sludge will often stick on the cone and blades, which can cause the machine to run rough due to an imbalance load.

k) Check the taped holes into which the six (6) SHCS tighten. Make sure no dirt or foreign matter is present which could prevent the bolts and/or bowl-top from fastening properly.

l) After all the mating surfaces and taped holes are cleaned and ready for re-assembly, place the bowl-liner in the bowl-bottom. Make sure the outer lip of the bowl-liner is clean because it provides the sealing surface for the bowl-top o-ring. Also, make sure the outer lip of the bowl liner is evenly seated on the matching shoulder in the bowl-bottom. If not, remove the bowl-liner and check for residue on the bowl bottom shoulder or on the lip of the bowl-liner.

m) With the bowl liner now in place, align **the bowl-top by aligning the (o) on the bowl lid and bowl top face** and tighten the six (6) SHCS's that were previously removed. Close the bowl-enclosure lid and fasten the clamps again. The unit is now ready to begin processing.

SAFETY NOTE: Serious damage and or injury could occur if the bowl-top is not properly aligned or securely fastened with all six (6) SHCS's to the bowl-bottom, which could allow the bowl-top to fail and come off the bowl-bottom during operation.

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SECTION 5.0 TROUBLESHOOTING

WARNING: If the machine is vibrating excessively, press the "stop" button immediately and check the following conditions for the probable cause and respective solution:

a) Incorrect assembly of the bowl components. Check bowl for the correct alignment and assembly and that all mating surfaces are clean.

- **Note:** Incorrect alignment and assembly of the bowl components may damage the bowl and void the warranty.

b) Operating the machine with a damaged o-ring or cracked bowl-liner. This may allow liquid to flow out under the OD of the bowl-top and/or through the cracked bowl-liner and into the bowl-bottom and out the bowl-bottom drain holes causing unbalance and excessive drag on the drive motor, which may result in motor failure. Replace the bowl-top o'ring and / or bowl-liner.

c) The bowl-bottom is loose and/or not properly seated on the tapered spindle. Rotate the bowl-bottom by hand and check for abnormal run-out. Check the spindle nut and lock washer to verify they are properly tightened. Check bowl for the correct assembly.

d) Worn and/or failed bearings. Replace bearings and check for wear on the bearing races and seats of the spindle and bearing housing.

e) Improper cleaning or uneven distribution of solids in the bowl. Clean out the bowl and re-assemble. Check that the liquid feed to the centrifuge has a homogenous mix of suspended solids verse big slugs of solids.

f) The bowl enclosure is filling with liquid under the bowl bottom and running out of frame drainpipe. Check the liquid discharge line per the previous liquid discharge piping instructions.

g) Liquid is leaking out from under the bowl-enclosure lid. Check the o'ring and/or seal for wear and or damage. Check that the mating surfaces are clean. Check the lid clamps for proper tension. The rubber-handled clamps may need to be replaced.

h) If you cannot determine what is wrong. Call US Centrifuge Systems LLC and ask for help.

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SECTION 5.1 TROUBLESHOOTING (For machines fitted with a progressive cavity feed pump):

WARNING: If liquid is not flowing from the machine after approximately 30 seconds from starting, press the "stop" button and check the following conditions to prevent potentially damaging the pump:

1. The feed line to the machine is plugged. **Clean out the feed line.**
2. The pump has been rotated in the reverse direction and unscrewed the pump rotor. Remove and disassemble pump. **Check rotor and shaft threads. Replace part if damaged, if not screw rotor back into position.**
3. Excessive suction lift or vacuum. **Check feed line installation.**
4. Torn stator. **Replace part.**
5. Pump will not prime. **Check for air leak on suction side.**

Progressive cavity feed pump maintenance (if applicable)

The selected feed pumps are designed for a minimum amount of maintenance. The pump is one of the easiest to work on because the main elements are very accessible and require few tools to disassemble.

Pump disassembly (per figure #4)

Disconnect suction and discharge plumbing. Remove screws holding suction housing to pump body. Remove suction housing and stator. Remove rotor from flexible joint by turning counterclockwise (RH thread). Flexible joint can be removed from shaft by using a 3/16" Allen-wrench in end of joint. Carefully slide mechanical seal off shaft. Carefully pry seal out of pump body. If any parts of mechanical seal are worn or broken the complete seal assembly should be replaced. **Seal components are matched parts and are not interchangeable.** The bearings and shaft assembly can be removed from pump body after snap ring has been removed. To remove the assembly, lightly tap the shaft at threaded end using block of wood to protect the threads. The bearings may be pressed off the shaft.

Pump assembly

Press bearings on shaft, and locate slinger ring near bearing on threaded end of shaft. Press the shaft assembly into the pump body securing snap ring. Install mechanical seal using the following procedure: Clean and oil sealing faces using clean light oil (not grease).

Lubricate the seals before assembly using glycerin or soapy water. Lubricate the outer surface of the seal seat, and push the assembly into the bore in the pump body, seating it firmly and squarely. After cleaning and oiling the shaft, slide the seal body along the shaft until it meets the seal seat. Install seal spring and spring retainer on shaft. Thread flexible joint into shaft in a clockwise direction. Thread rotor onto flexible joint in a clockwise direction. Insert rounded end of stator ring into end of stator prior to installing stator on rotor. Slide stator on rotor. Secure stator and suction housing with suction pot vertically up to pump body using screws.

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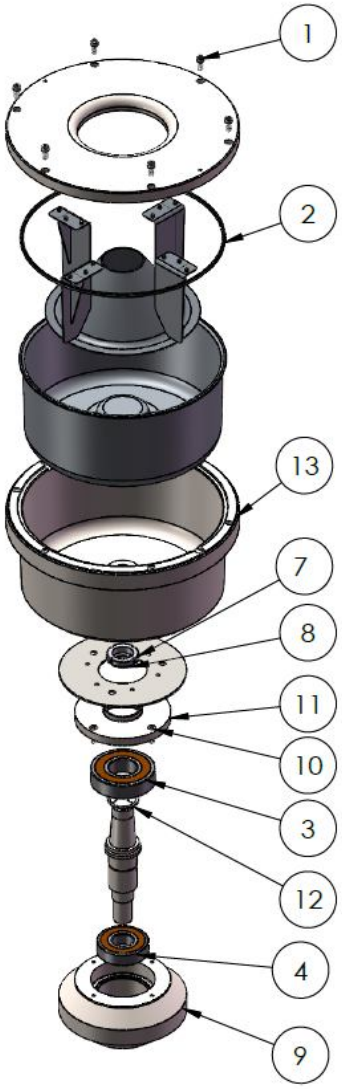
SECTION 6.0 MAINTENANCE REQUIREMENTS

Centrifuge maintenance: The model M512 centrifuge has been designed and constructed for minimal maintenance requirements given the unit is properly used as described in the previous sections. The following items will need occasional replacement depending on use. For such maintenance please see the following diagrams and respective instructions:



M512 bowl and spindle assembly exploded view

Figure 1

1. **Bowl-top fasteners item #1:** Depending on use, the six (6) SHCS's will become worn and should be replaced. Do-not substitute other types, lengths, or grades of fasteners.

2. **Bowl-top o'ring item #2:** The o'ring pushes into a retaining groove in the bowl-top. Use a small screwdriver and be careful not to gouge or burr the mating surface of the bowl-top when removing the o'ring.

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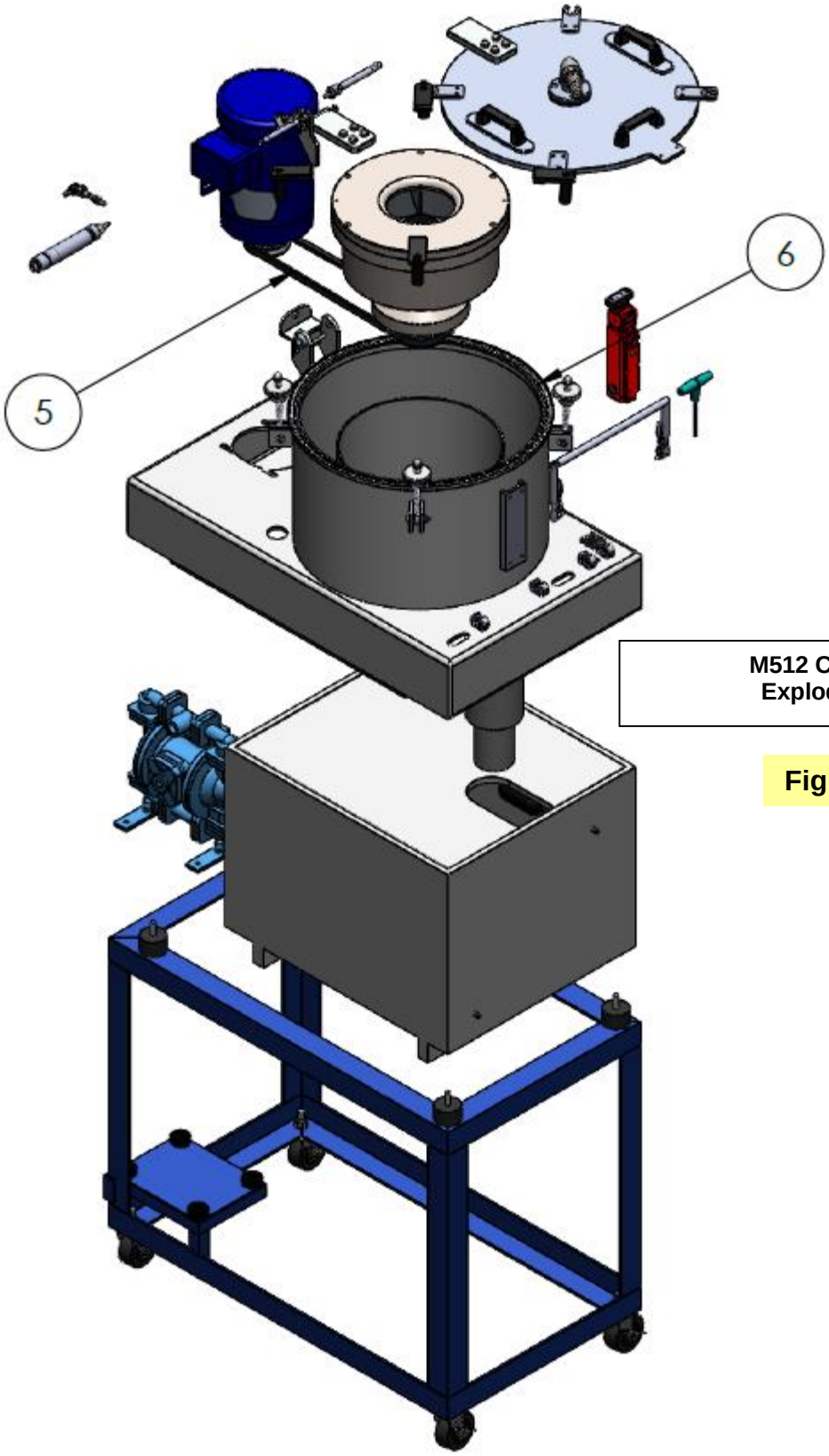

M512 Centrifuge
Exploded View

Figure 2

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SECTION 6.0 MAINTENANCE REQUIREMENTS (continued)

3. **Spindle bearings item #3 & #4:** To replace the bearings it is first necessary to remove the bowl-bottom #13 by removing the spindle lock nut #7 and lock washer #8. Then use the threaded jacking holes located in the bowl-bottom near the bowl-naive (shown in red) to push the bowl off the tapered-spindle, or a pulling tool clamped onto the OD groove of the bowl-naive and pushing off the center of the spindle. Do not use excessive force to free the bowl-bottom or pry on the OD of the bowl-bottom as such action could damage and/or distort the bowl-bottom. Once the bowl-bottom has been removed, unscrew the four (4) fasteners that hold the bearing housing #9 onto the machine frame. Once the bearing housing has been removed, unscrew the four (4) fasteners #10 that hold the bearing housing cap #11 onto the bearing housing. Then press the spindle out the top of the bearing housing. Next press the lower bearing #4 off the spindle. Then remove the snap ring #12 and press the upper bearing #3 off the spindle. To re-assemble complete the process in reverse order with special attention to re-seating the bowl-bottom onto the tapered spindle. Make sure the inside of the bowl-naïve and the mating surfaces of the spindle are clean and free of any gouges or burrs. Then carefully place the bowl-bottom over the spindle and gently push it down onto the spindle. Then properly place the lock washer over the threaded end of the spindle by fitting the lock washer tab into the milled slot on the spindle. Then lubricate the threads and snuggly screw the lock nut down into position. Then use a spanner wrench to fully tighten the lock nut. Then bend up the respective lock washer tab to secure the lock nut. To check for properly reassembly, turn the bowl-bottom by hand to insure it rotates freely and concentrically.

   - **Note:** The bearings are sealed and do not require periodic lubrication. The bearings (item #3 & #4) should be replaced once per year, or approximately every 3,000 hours depending on use.

4. **Drive belt item #5**: The drive belt should be checked for wear every six to twelve months under normal operation. Check the belt less often if cleaning intervals are once per day or less and more often if cleaning intervals are three to five times per day or more. Replace belts as required. Adjust belt tension to the point of non-slip, but do not over tighten.

5. **Bowl-enclosure lid o'ring item #6:** Replace as required. Use a small screwdriver and be careful not to gouge or burr the mating surface of the bowl-enclosure when removing the o'ring.

6. **Most other items do not require periodic maintenance and / or replacement.** Should you have any questions regarding other parts and components of this unit please call US Centrifuge.

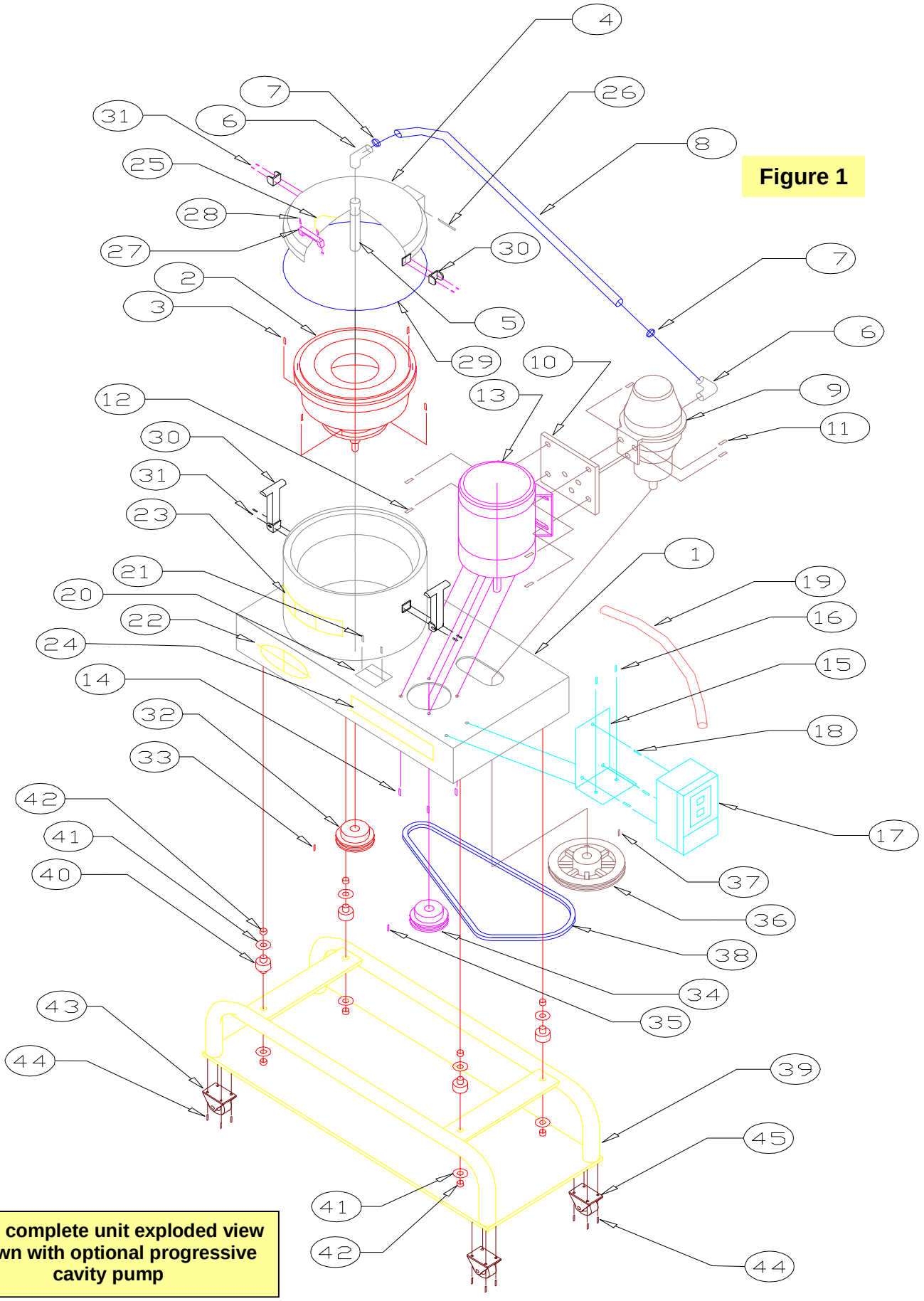

Figure 1

M512 complete unit exploded view Shown with optional progressive cavity pump

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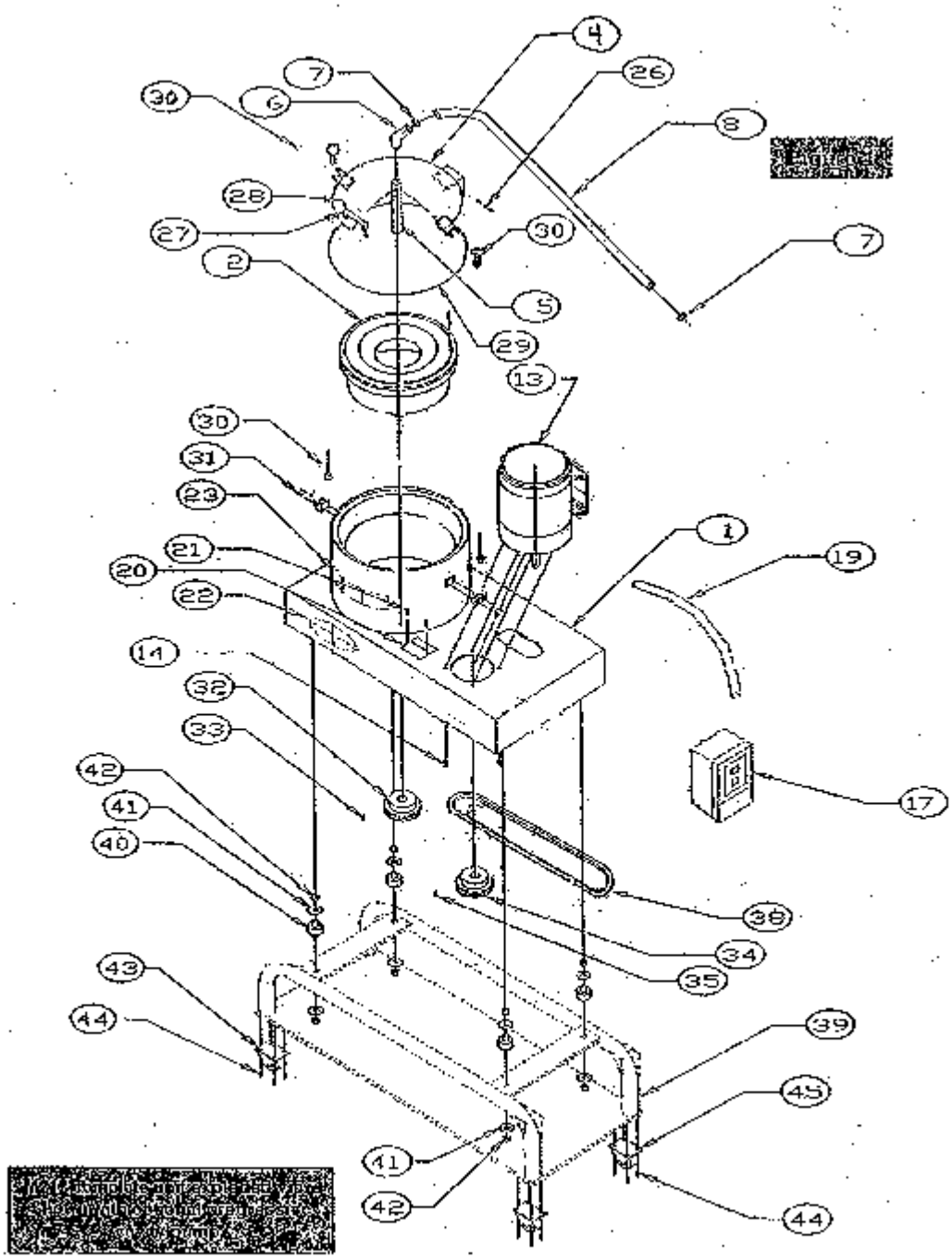

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SECTION 7.0 REPLACEMENT PARTS

To order replacement parts: Please call US Centrifuge @ 317-299-2020 / 800-899-2040, or fax US Centrifuge @ 317-299-2284, or call your authorized US Centrifuge representative. When ordering, please provide the Unit's serial number and requested replacement parts' description, part number, quantity and shipping instructions.

REPLACEMENT PARTS FIGURE 1

Item No.	USC Part No.	Description	Quantity
1	P2084A	Frame Assembly (M512)	1
2	P5001A	Rotating Assembly (M512)	1
3	92620A624	Bolt, SHCS, 3/8" x 16 X 1 lg. (M512)	4
4	P2085A	Enclosure Lid Assembly (M512)	1
5		Feed Tube (part of enclosure lid assy)	1
6	V0487A	90 degree Hose Barb, .75 Dia.	2
7	V0484A	Hose Clamp	2
8	V0485A	Hose	24"
9	Various	Pump (please specify)	1
10	P1052A	Pump Mount Base (frame mounted progressive cavity only) (M212/412 only)	1
11	92865A621	Bolt, Hex 4D, 3/8"-16 x 5/8" LG (M212/412 only)	3
12	91309A580	Bolt, Hex 4D, 5/16"-18 x 5/8" LG	4
13	Specify Brand	Motor, 3HP	1
14	92865A621	Bolt, Hex 4D, 3/8"-16 x 5/8" LG	4
15	P2098A-M512	Control Panel Mounting Plate (optional)	1
	P2097A-M512	Starter Box Mounting Plate	1
16	91309A585	Bolt, Hex, 3/8"-16 x 1 ¼" LG	4
	98125A031	Washer, Flat 3/8"	8
17		M512 OCS OLC Gold Panel	1
18	90128A624	Bolt, SHCS 3/8"-16 x 1" LG	4
	97135A230	Nut, Hex Nylock 3/8"	8
19	P0146A	Motor Cable	1
20	P0011A	Identification Plate	1
21	N0002F	Drive Screw	2
22	P0102A	USC Decal – 8" (M212/412 only)	1
23	K0049A	M512 Decal Package	1
24	P0101A	Caution Decal	1
25	P0103A	USC Decal – 4" (M212/412 only)	1

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26	V0436A	Expansion Pin	1

REPLACEMENT PARTS FIGURE 1 (continued)

27	V0468A	Handle	1
28	N18035	Bolt, SS, 10-32 UNF, .625 LG	2
29	V1065A	Frame Lid O-Ring Seal Buna N	1
	V1065A	Frame Lid O-Ring Seal Viton (optional)	1

Item No.	USC Part no.	Description	Quantity
30	P1055A	Knob, Lid Hold Down (M212/412 only)	2
	P1056A	Bracket, Lid Hold Down M212/412 only	2
	P1057A	Bracket, Eyebolt (M212/412 only)	2
	V0462A	Eyebolt, 3/*-16 x 3” (M212/412 only)	2
	CL-851-VTC	Clamp (M512 only)	2
31	N30494	Bolt, BHSC 10-32 UNF, .25 LG (M212/412 only)	8
32	V0429A	Pulley, AK39H	1
33	V0428A	Sheave, H1.0	1
34	V0429C	Pulley, .AK34H	1
35	V0433A	Key, .1875 X .1875 X .75 LG	1
36	V0493F-H	Pulley, .625 Dia. (M212/412 only)	1
37	V0433A	Key, .1875 X .1875 X .75 LG (M212/412 only)	1
38	V0492D	Belt, A40	1
39	P2096A	Machine Stand (M512)	1
40	9376K65	Mounting Pad 3/8”-16 male	4
41	98125A031	Washer, Flat 3/8”	8
42	97135A230	Nut, Hex Nylock 3/8”-16	8
43	2834T44	Swivel Caster (locking) (M512)	2
44	95615A210	Nut, Hex 1/2”-13	4
45	2834T38	Swivel Caster (M512)	2
	95229A550	Washer, Flat ½”	4
	91202A770	Washer, Lock ½”	4

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REPLACEMENT PARTS FIGURE 2

Item No.	USC Part No.	Description	Quantity
1	P2093A	Bearing Housing	1
2	P2094C-316S/S	Spindle	1
3	V0498A	Upper Bearing, 308 PP	1
4	V0437A	Snap Ring #40 (40mm)	1
5	V0497A	Lower Bearing, 306 PP	1
6	P2092A	Bearing Cap	1
7	92949A537	Bolt, BHSCS, ¼"-20 x ½" SS	4
9	P2089B	Bowl Bottom	1
11	V0500B	Lock Washer, WS-06	1
12	V0501B	Lock Nut, NS-06	1
13	P1021B or C	Bowl Liner (B-SS C-ABS)	1
14	P2088B	Bowl Top	1
15	P1020A	Feed Cone	1
16	N30384	Bolt, BHSC, SS, 10-32 UNC, .725 LG	4
17	V0480A	O-Ring Seal	1
18	N05354	Bolt, SHCS, SS, .25-20 UNC, .750 LG	4
19	V0474A	T-Handle Wrench	1
20	P1013A	Liner Lifting Tool	1

Recommended Annual Maintenance Parts List P/N: P2238A or P2238B

V0498A	Upper Bearing	1
V0497A	Lower Bearing	1
V0437A	Snap Ring	1
V0500B	Lock Washer (WS-06)	1
V0501B	Lock Nut (NS-06)	1
91290A138	Bowl Top bolts SHCS S/S	6
V0480A	Bowl O-Ring	1
V0434A	Frame O-Ring (M212/412 only)	1
V0492S	Belt	1
V1065A	Frame O-Ring	1

For machines supplied with optional progressive cavity feed pump:

Specify Material	Pump Seal Kit	1

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- **Note:** The **Recommended Annual Replacement Part List** includes parts that are to be replaced regardless of condition. Depending on the application and usage, parts typically replaced on an annual basis may require replacement more frequently. Parts not found on the **Recommended Annual Replacement Part List** should be replaced on an as needed basis.
- **Note:** Prices subject to change without prior notice. Please call to verify pricing when ordering.

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SECTION 8.0 LIMITED WARRANTY

US Centrifuge Standard Warranty and Terms and Conditions

1. **Deposit**. Purchaser agrees to make any deposit required by USCS on the date(s) set forth in this Agreement and in immediately available funds (each, a "**Deposit**").

2. **Change Orders**. The parties acknowledge and agree that from time to time the parties may desire to amend the Agreement. Any such change shall be effective only if Exhibit A to this Agreement is amended in writing attached to this Agreement and signed by both USCS and Purchaser; provided, however, any verbal change to the order shall be binding on Purchaser and USCS if USCS manufactures the Equipment with such change.

3. **Delivery**. Delivery of the Equipment shall be F.O.B. USCS's facility in Indianapolis, Indiana. Damage and risk of loss to the Equipment shall pass to Purchaser upon making the Equipment available for shipment.

4. **Payment for Equipment**. All payments shall be in an U.S. Dollars, without offset, back charge, retention or withholding of any kind. Purchaser agrees to pay the entire Purchase Price for the Equipment in immediately available funds pursuant to the terms of this Agreement. Title to the Equipment shall not pass to Purchaser until full payment is made by Purchaser. If Purchaser fails to pay any amount of the Purchase Price when due, without limiting and in addition to USCS's rights or remedies hereunder or in law or equity, (a) USCS shall not be obligated to deliver the Equipment; (b) USCS may retain the Deposit as liquidated damages (which shall not be USCS's exclusive remedy); and/or (c) USCS may declare the entire Purchase Price to be immediately due and payable with interest thereon beginning on the date the Equipment is ready for delivery at a rate of 18% per annum. Delivery of the Equipment shall not be made unless and until all payment terms are met. Purchaser agrees to pay all costs and expenses incurred by USCS (including reasonable attorneys' fees) in enforcing this Agreement including the collection or attempted collection of any amounts owed pursuant to this Agreement.

5. **Inspection; Rejection and Acceptance**. Purchaser acknowledges and agrees that Purchaser is hereby given the opportunity to examine and inspect the Equipment at the time of delivery and at the time the Equipment is installed and commences operation ("**Final Commissioning**"). Purchaser agrees that if Purchaser does not inspect the Equipment at the time of delivery and at the time of Final Commissioning, such right to examine and inspect shall be deemed waived by Purchaser and the Equipment shall be deemed accepted by Purchaser. Purchaser shall be deemed to have accepted the Equipment unless Purchaser, at the time of delivery or at the time of Final Commissioning, notifies USCS in writing (1) that it rejects the Equipment and (2) describes in this same writing the specific defect(s) which Purchaser contends justifies its rejection of the Equipment. Upon receipt of such a writing USCS will inspect the Equipment and notify Purchaser of its agreement or disagreement with Purchaser's rejection.

6. **Export**. USCS is subject to laws in various jurisdictions relating to restrictions on trade with certain countries. Shipment of the Equipment to such countries without prior written approval from USCS and the relevant governmental agency is made at Purchaser's sole risk. Purchaser is responsible for all costs, fees and expenses related to import and export including, without limitation, any customs duties, import duties, excise taxes or like charges levied by any governmental agency. Purchaser shall indemnify and hold harmless USCS from any claim, loss, liability or damage (including, without limitation, reasonable attorneys' fees) related to the import or export of the Equipment.

7. **Warranty**. USCS hereby provides to Purchaser the following warranty (the "**Warranty**"): Subject to the other terms and conditions contained herein, USCS warrants to Purchaser that the Equipment, for a period of the earlier of (a) twelve (12) months (if new Equipment) or six (6) months (if refurbished Equipment) after Final Commissioning, or (b) thirteen (13) months (if new Equipment) or seven (7) months (if refurbished Equipment) after the date of delivery of the Equipment to Purchaser (the "**Warranty Period**"), will conform in all material respects to the design/build specifications for the Equipment set forth in Exhibit A (the "**Specifications**"). **The Warranty is the sole and exclusive warranty provided by USCS relating to the Equipment and any and all parts thereof and contains the sole and exclusive remedy against USCS and obligation and liability of USCS relating in any way to the Equipment and/or any part thereof including, without limitation, for any alleged defects, any alleged negligence against USCS, or any claim for inadequate warnings, breach of contract or strict liability in tort or breach of contract. Except as provided in the Warranty, USCS makes no other warranties, express or implied, and USCS specifically disclaims all other express and implied warranties, including, without limitation, the implied warranty of merchantability and the implied warranty of fitness for particular purpose and any warranty relating to infringement or the like. Purchaser expressly and voluntarily waives and disclaims any and all other remedies available to Purchaser at law or in equity. This Warranty is subject to a Dispute Resolution procedure, described in detail below, which Purchaser has read and agrees to.** To be valid, any Warranty claim must (1) be made in writing to USCS at 1428 West Henry Street, Indianapolis, Indiana 46221, Attention: President, (2) set forth the Warranty claim in detail, sufficient to allow USCS to understand Purchaser's contention; and (3) be received by USCS at the above address no later than the earlier of 48 hours after Purchaser believes it has a related Warranty claim or the end of the Warranty Period. Any Warranty claim that fails to meet all the above requirements shall be null and void and of no force or effect. No person or entity, other than Purchaser, shall have the benefit of the Warranty and the Warranty may not be assigned to any other person or entity (whether by operation of law or otherwise) without the written consent of USCS. Any attempted assignment without USCS's express written consent shall be null and void and of no force or effect. USCS reserves the right to test and inspect the Equipment and parts thereof to determine the validity of the Warranty claim. If USCS, in its sole discretion, determines the Warranty claim to be valid, USCS will, at its option, repair or replace the Equipment or parts thereof subject to the valid Warranty claim and if it is not reasonable for Purchaser to replace a part, USCS will provide labor associated therewith (only if the Equipment is located in North America). **USCS's obligation under this Warranty shall be limited solely and exclusively to repair or replace the Equipment or parts thereof (at USCS's option). USCS shall have no other liability or obligation of any kind.** USCS shall repair or replace the Equipment only at any location directed by USCS. Cost of travel, housing, and freight charges are not covered under the warranty and are the responsibility of the purchaser. Any repair or replacement of the Equipment not subject to the Warranty shall be subject to USCS's then current charges for off-site claims which may include, without limitation, all cost of travel and housing of individuals performing the repair or replacement. If Purchaser requests repair or replacement work to be performed outside of the hours of 8:00 a.m. to 5:00 p.m., Indianapolis time, Monday through Friday (excluding USCS holidays), then Purchaser shall pay USCS's then current charges for overtime work. Any repair or replacement of the

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Equipment or any part thereof will continue to be warranted under this Warranty only for the remainder of the Warranty Period. Notwithstanding the foregoing, the following are not covered by and are excluded from the Warranty: (1) the Equipment if it was not installed by an approved USCS installer; (2) defects in the Equipment or its parts alleged to exist because of any design requested by Purchaser or any design included in the specifications provided and/or approved by Purchaser; (3) Equipment and/or any part thereof which is subject to wear and tear or consumed by the normal operation or use thereof; (4) Equipment and/or any part thereof which is subject to normal maintenance service and adjustments as process conditions dictate; (5) Equipment and/or any part thereof which has not, in USCS's sole discretion, been properly maintained or serviced by competent personnel; (6) Equipment and/or any part thereof which has been subject to improper use or operation (including, without limitation not operated in accordance with USCS's instructions and generally applicable industrial practices and/or misuse, neglect, abuse, negligent repair or failure to provide reasonable and necessary maintenance, or accident); and (7) Equipment and/or any part thereof which has been in contact with corrosive chemicals or corrosive materials. Several components which are used in the manufacture of the Equipment but not manufactured by USCS have warranties provided by the original equipment manufacturer (written copies available upon request). USCS does not separately warrant such items. Components or equipment manufactured by third parties are not covered by this Warranty. USCS, however, will provide reasonable assistance to Purchaser to make claims against any warranties applicable to such component parts as provided by such original equipment manufacturers. In order for the Warranty to be maintained: (1) A US Centrifuge Field Service Technician and / or an authorized US Centrifuge Systems representative properly inspect installation, commission, and train operators how to operate the centrifuge; (2) The machinery is being used for the purpose stated in the contract and within specified limit; (3) The equipment is maintained and operated according to the instructions in the O&M manual; (4) Damages if any are repaired immediately in order to avoid consequential damages; (5) Any repairs or changes on the machines should be done by skilled personnel and only after written acceptance from US Centrifuge Systems; (6) Source material to process must be homogenous with particle size less than 1/4 inch. Purchaser agrees that no other warranty has been or will be created, whether by any other document or agreement between USCS and Purchaser, any document provided by USCS or any of its employees, agents or representatives to Purchaser (including, without limitation, copies of warranties provided by third party manufacturers of components of the Equipment and/or any parts thereof), demonstration or description, or words or conduct of USCS or any of its employees, agents or representatives. Purchaser has not relied upon any statements, demonstrations, promises, representations or agreements, other than those in the Warranty.

8. **Release**. Purchaser agrees that USCS is not liable or responsible for any liabilities, losses, claims and/or damages of any kind (including, without limitation, property damage, death or personal injury) arising out of or in any way related to, directly or indirectly, the Equipment, except for claims to enforce the rights under the Warranty, including, without limitation, claims arising out of or in negligence, breach of contract, implied warranty and/or strict liability in tort and/or statutory claims regardless of the sole, joint and/or concurrent negligence or strict liability, breach of contract, or other legal fault or responsibility of either USCS or Purchaser or its employees or agents.

9. **Indemnity**. Purchaser hereby agrees and acknowledges that Purchaser's sole and exclusive remedy against USCS for any claim, demand, loss, damage, action, or cause of action shall be either replacement or repair of the defective Equipment or parts thereof as provided in the Warranty and therefore Purchaser voluntarily and knowingly waives and agrees to hold harmless USCS, its employees, agents, successors and assigns of and from all actions, causes of actions, claims, losses, damages and demands of every nature or kind, relating to the Equipment, including those arising in negligence (whether sole, joint and/or concurrent), breach of contract, implied warranty, and/or strict liability in tort and/or statutory claims. **Purchaser hereby agrees to indemnify, defend and hold harmless USCS and its employees and agents against any and all actions, causes of actions, and/or claims asserted by and/or damages or losses sought by any third parties regardless of the nature of the claim, whether in contract, implied warranty, negligence or strict liability in tort or statutory claims, including, without limitation, claims alleging liability due to USCS's own negligence (whether sole, joint and/or concurrent) in the design and/or manufacture of the Equipment or alleging that USCS provided any inadequate warnings and/or instructions or failed to provide adequate warnings and/or instructions. Purchaser expressly waives any rights it may have under Indiana's Product Liability Act and any other state product liability or strict liability law and agrees to reimburse, indemnify and hold USCS harmless from any claims by third parties brought under any State's product liability or strict liability law, including Indiana's Product Liability Act.**

10. **Damages Limitation**. **In no event shall USCS be liable to Purchaser or any other person or entity for lost profits or for any indirect, special, incidental, consequential, exemplary, special or punitive damages or losses whatsoever (regardless of how characterized), even if Purchaser or any other person or entity has been advised or knew of the possibility of such damages, and regardless of the form or action (whether in contract, tort, strict liability or otherwise), including, but not limited to damages of lost production, lost revenue, lost product, lost profits, lost business, loss of use, loss of goodwill, or business interruption, from USCS for any reason whatsoever including, without limitation, warranty or defect in the Equipment regardless of the sole, joint and/or concurrent negligence, breach of contract, breach of warranty, strict liability in tort or statutory claims or other legal fault or responsibility of either USCS or Purchaser or its employees, representatives, or agents..**

11. **Limitation on Remedy. Any claim or action by Purchaser, other than a Warranty claim which must be brought within the Warranty Period, shall be commenced within 1 year from the date the Equipment is delivered to Purchaser, regardless of when Purchaser learns of any such cause of action.**

12. **Lien**. Acceptance and/or installation of Equipment by Purchaser shall entitle USCS to a mechanic's or material provider's lien to the extent of any unpaid balance owned on the Equipment. In the event that USCS agrees to any leasing or financing terms (or payment is not made in full at the time of delivery) with respect to Equipment, USCS shall maintain an automatic purchase money security interest to the extent of any unpaid amount until such time as the purchase price and any financing costs are paid in full. In the event that Purchaser fails to adhere to the terms of payment as set forth herein, USCS may foreclose on its security interest and remove the Equipment, the costs of which removal shall be borne by Purchaser.

Other Terms. Any notice or other communication required or permitted to be delivered by one party to another under or in connection with this Agreement shall be deemed sufficiently given after three business days if sent by certified U.S. Mail, return receipt requested, or after one business day if sent by nationally recognized overnight carrier to the attention of the President and, for USCS, at 1428 West Henry Street, Indianapolis, Indiana 46221 and, for Purchaser, at the address first set forth above. This Agreement shall be binding upon and inure to the benefit of and be enforceable by the parties hereto and their respective successors and permitted assigns. This Agreement shall not be assigned by Purchaser without the prior written consent of USCS. This Agreement shall be governed by and construed and enforced in accordance with the laws of the State of Indiana, notwithstanding choice of law

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principles. If any provision of this Agreement is held to be illegal, invalid or unenforceable, such provision shall be fully severable and this Agreement shall be construed and enforced as if such illegal, invalid or unenforceable provision had never comprised a part hereof. Any waiver, modification or amendment of any provision of this Agreement shall be effective only if in writing and signed by the parties hereto. Waiver by any party hereto of any breach of or exercise of any rights under this Agreement shall not be deemed to be a waiver of similar or other breaches or rights or a future breach of the same duty. USCS shall not be liable for any failure to perform its obligations hereunder if (and during such time as) such failure is due to causes beyond its control which shall include, without limitation, strike, threat of strike, lockout, fire, flood, interruption or delay in manufacture or transportation, act of nature, war, insurrection, mob violence, requirement of governmental authorities, embargo, shortage of labor, equipment or materials, and/or plant breakdown. This Agreement may be executed in one or more counterparts, each of which will be deemed to be an original copy of this Agreement and all of which, when taken together, are one and the same Agreement. To the extent the Equipment is used in an environment that creates a risk of fire and/or explosion, Purchaser acknowledges and agrees that (a) Purchaser is well aware of the risks and has been adequately warned of the risks, including the risk of loss of life and property damage, (b) it will take all safety precautions (including, without limitation, those required by law and recommended by third parties) to ensure that no individual suffers personal injury or death in the event of a fire or explosion, (c) it will be solely responsible for, and releases USCS from, any liability for property damage, death or personal injury arising out of or in any way related to, directly or indirectly, any fire or explosion resulting from the Equipment or any part thereof, and (d) it will indemnify, defend and hold harmless USCS and its employees and agents from any and all actions, causes of actions, and/or claims asserted by and/or damages or losses sought by any third party (including, without limitation, any employee, representative, guest or agent of Purchaser or its affiliates) as a result of a fire or explosion resulting from the Equipment, regardless of the nature of the claim, whether in contract, implied warranty, negligence or strict liability in tort or statutory claims, including, without limitation, claims alleging liability due to USCS's own negligence (whether sole, joint and/or concurrent) in the design and/or manufacture of the Equipment or alleging that USCS provided any inadequate warnings and/or instructions or failed to provide adequate warnings and/or instructions.

The design/build terms and conditions above specifications are hereby approved by Purchaser, and USCS shall have no liability related hereto, including, without limitation, for their accuracy and that they will fulfill any intended purpose.