

# APD II Automatic Piston Discharge Centrifuge

The most advanced centrifuge for bioprocess industry

## Introduction

The patented APD (Automatic Piston Discharge) (first generation) centrifuge is used for separating liquid phases and solids from each other. APD centrifuge is suitable for a broad range of two-phase solid-liquid separation applications common to the bioprocess and pharmaceutical R&D and industries. The patent pending APD II (second generation) leverages the first generation of APD technology, is the most advanced centrifuge technology today. APD II is a breakthrough that allows the most powerful separation yet is gentle to the product in a complete automatic fashion. APD II provides solutions for high-throughput continuous flow and batch processing applications for consistent results in areas of vaccine manufacturing, antibody manufacturing, mammalian and microbial processing and blood plasma fractionation.

## Description



Unlike the original/first generation APD centrifuges, the embedded gentle feed path, assisted feed acceleration and the “no air” (zero air space in the centrifugation process) design make APD II a true breakthrough. The APD II completely solves foaming and shear issues that have been confronting many common bioprocessing applications.

Like the first generation, APD II continues to offer the driest solids and clearest centrate of any centrifuges used for bioprocessing (see sample pictures of the discharge and centrate from different applications, on the left). APD II continues to provide up-to 20,000 x G forces to ensure powerful separations. Cell paste yield is up to 5-10 times drier than disc stack centrifuges. The APD II achieves fully automatic operation in a hermetically sealed environment. Solids can be discharged by a piston to achieve TOTAL solids recovery. With bowl volumes ranging from 1.0-40.0 L, APD II centrifuges can process 1-10,000 L of bioprocess material continuously without any manual intervention.



## Benefits

### *Simplified and Smart Performance*

- ◇ Designed to reduce overall processing steps and time
- ◇ Greatly reduces the amount and cost of downstream filtration
- ◇ Complete automation without manual intervention to reduce manual labor costs associated with tube bowl and batch centrifuges
- ◇ No exposure of the bioprocess to the ambient air and no exposure of the operators to the bioprocess
- ◇ Equipped with PLC control offering built-in recipes for common applications as well as programmable cycle-by-cycle, step-by-step or complete manual operations
- ◇ Suitable for processing volume (1-10,000 L) from development to large-scale production using the same centrifuge
- ◇ Simple overall construction for easy maintenance
- ◇ Simple interior design allows thorough and repeatable CIP and SIP
- ◇ Automatic solids discharge, no scrapers, no baffles or discs to impede discharge of retained solids

### *Advanced Cell Handling*

- ◇ Incorporates a gentle processing environment for shear sensitive mammalian cells and bio molecules (e.g. vaccine, DNA and polysaccharides)
- ◇ Designed to maintain cells intact and viable during separation and discharge. Maintaining cell intact reduces the impurities and contaminants from cell debris
- ◇ Zero air/liquid interface in the system to avoid product oxidation
- ◇ No air design excludes any possibility of foaming. Foaming can cause

operation disturbance and is also a major shear force to some common bioprocess applications.

- ◇ Handles various types of cultures, low-high cell density cultures and even the most challenging viscous biomass (e.g. filamentous fungi).

### *Powerful Separation and Automatic Discharge*

APD II centrifuge provides rotational forces up to 20,000 x G. The powerful separation efficiency results in very low liquid entrainment in sediments, which is important in the isolation of solids such as protein precipitates and inclusion bodies. Automatic piston discharge allows users to collect 99.9+% of bio paste with no manual intervention. Superb clarifying power maximizes clarification efficiency to remove any impurities and improves recovery and quality of the high-value liquid phase.

### *Thermal Control*

Jacketed thermal control allows operations from -10°C to 40°C for temperature sensitive applications with control accuracy of 1°C

### *Ensures cGMP Manufacturing*

- ◇ Built to cGMP and ASME code standards
- ◇ Built-in CIP and optional SIP
- ◇ Complete hermetic containment to reduce contact risk
- ◇ Hazardous (flammable or explosive) area designs available

## Principles of Operation

The centrifuge typically operates cycle by cycle continuously until all the biomaterial is processed. Each cycle normally consists 3 steps: separation-drain-discharge, or programmed otherwise according to the user's preference.

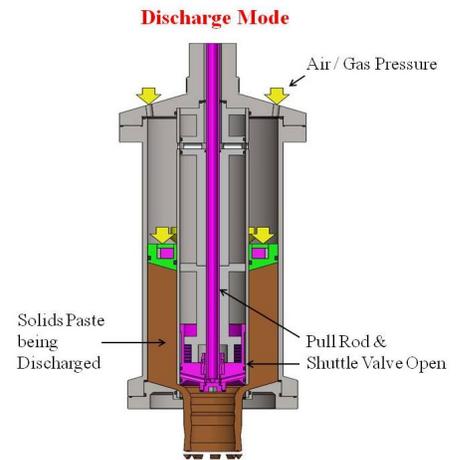
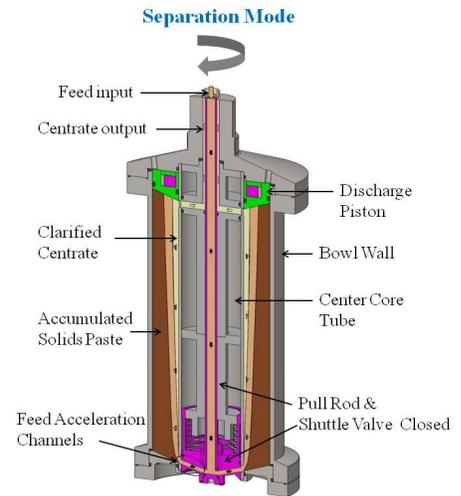
The feed liquid enters from the top to the pre-filled centrifuge bowl which has accelerated to the desired rotational speed. Pre-filling the centrifuge is an important step to form "no air" environment to exclude foaming. The feed travels down the center core through the pull rod to the shuttle valve. At the shuttle valve, the feed then enters the bowl through accelerator channels. In the fast spinning bowl, the feed tracks up along the outer wall of the center core tube where it is clarified. The entrained solid particles are deposited on the bowl wall as the clarified centrate exits out of the bowl through the centrate outlet piping to the user's centrate tank/receiver. Once the system determines the solids are full to the user's pre-programmed occupancy, the centrifuge stops. After draining the remaining liquid back to the feed tank, the discharge piston is actuated to assist depositing solids to the solids vessel (The piston can be optionally used to discharge shear sensitive materials, i.e., mammalian cells.). The discharge piston completely discharges the solids as it strokes the full length of the bowl.

### Central Core Tube and Shuttle Valve

The central core tube is the center of the pull rod which is integral to the shuttle valve. The narrow center core tube bears very low G force due to its small radius. This minimizes the shear stress to the feed before it enters the fast spinning centrifuge. Through the accelerator channels the feed gets fully angular - accelerated and then tracks along the outer wall of the center core tube all the way to the top. The solids get separated during the travel. The centrifuge also incorporates a zero dead space design for the feed path. This allows the feed to get fully accelerated in a gentle and "embedded" manner without contacting any air, crucial in eliminating foaming thus the shear stress to the process.

### Discharge Piston

This sedimentation process continues until the bowl is considered "full" as programmed by the user. This could be 25% to 98% of the bowl volume occupied by separated solids. For most applications, the discharge piston is used to discharge the solids to be collected or discarded. The pneumatic pressure driven discharge piston can achieve TOTAL sedimented solids recovery automatically. For some applications, e.g., to collect shear sensitive whole cells, the piston is not used and the discharge is assisted by air/gas to avoid piston crushing the cells.



## Applications

Celeros APD centrifuges have been successfully tested and approved for pilot and production scale operations in a variety of vaccine manufacturing, antibody, protein, blood plasma precipitate recovery, and food additive applications. We continue to work with clients to develop additional applications. APD centrifuges are ideal for:

### ◇ Microbial

E coli (whole cell or lysate): vaccine, inclusion body recovery, protein precipitates  
Lactobacillus  
Streptomyces (filamentous bacteria)  
Streptococcus pneumoniae  
Pseudomonas fluorescens

### ◇ Mammalian

CHO  
MAb recovery

### ◇ Fungal

Yeast  
Aspergillus (filamentous fungi)  
Pichia Pastoris  
Saccharomyces cerevisiae

### ◇ Insect Cell

Baculovirus infected insect cell

### ◇ Algae

Harvesting and washing

### ◇ Blood Work

Plasma fractionation

### ◇ Other

Specialty Polymers  
Electronic Materials

## APD II Models Available

Model	Bowl Volume	Maximum Throughput	Rotational Force
APD 1.0	1 liter	1.4 liters per minute	0-20,000 x G
APD 5.0	5 liters	7 liters per minute	0-20,000 x G
APD 10.0	10 liters	15 liters per minute	0-20,000 x G
APD 50.0	50 liters	70 liters per minute	0-20,000 x G

## Sales and Service Contact

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