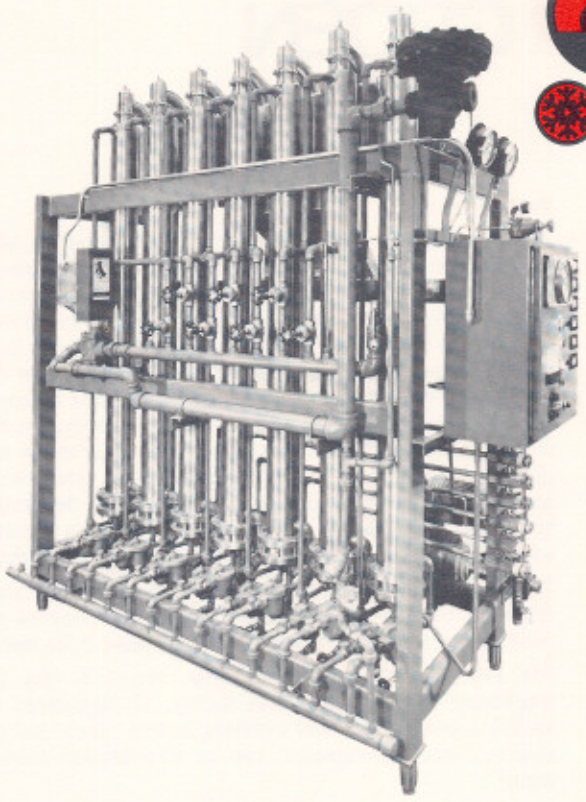
GROEN

SERIES 372 and 696
Thin Film Heat Exchanger/Evaporator



Description

The Groen 372/696 Thin Film Evaporator is designed to concentrate many types of products from as low as 4% solids up to 98% solids without the necessity of preheating the product or using a vacuum. The Series 372/696 units consist of one or more parallel tube concentrator elements. Each concentrator element is dual jacketed to provide a heat transfer surface on both the inner and outer walls of the narrow product annulus. By spreading product feeds in a turbulent, thin film between two heat transfer surfaces, extremely high heat transfer rates can be achieved.

Tubes may be banked to accommodate any required production capacity, or units can be designed to accept additional concentrators at a later date to expand production. The Series 372/696 can also be designed for vacuum and vacuum steam operation, where low temperature evaporation is required.

Construction

Standard material of construction for the Series 372/696 Thin Film Evaporators is type 304 stainless steel. Type 316 stainless steel is available by special order. Thin film evaporator units are constructed with outer steam jacket and steam core ASME approved for a maximum working pressure of 120 psi for Series 372, and 110 or 135 psi for Series 696.

- Heat Transfer Area

  Groen manufactures two sizes of thin film evaporators. The E-372 contains a product annulus with a mean diameter of 3" and an overall concentrator length of 72". The E-696 contains a product annulus with a mean diameter of 6" and an overall concentrator tube length of 96". The E-372 has a total heat transfer area of 9.4 square feet per concentrator tube, while the E-696 has 25 square feet of heat transfer area per concentrator tube.

- Annular Gap

  Series 372/696 systems are available with annular gaps of four different widths. The standard E-372-R3 has a 3/32" wide product annulus and is used for normal evaporative heating. The E-372-R2 contains a 1/16" wide product annulus is used for sensible heating of liquids (no evaporation occurring). The E-372-R4 with a 1/8" wide product annulus is used for starch cooking and the E-372-R2X6 is used for evaporative heating under vacuum conditions. This unit has a 1/16" wide product annulus in the bottom 12" of unit and 3/16" wide annulus in the upper 60" of the unit. The 696 concentrator tubes are available in the same four annular widths. The core of the Series 372/696 systems contain symmetrically positioned spacers on the outside surface to center the core inside the outer tube.

- Base Assembly

  Systems come complete with positive displacement feed pump with variable speed drive and tachometer, all mounted on a sturdy enamelled frame. Multiple tube assemblies come with product inlet manifold, metering valves for balancing the flow through the concentrator tubes, and a product discharge manifold. Floor space required for a one tube 372 system is 3' x 4' with 102" ceiling clearance. A six tube 372 system would require a 42" x 106" floor space with 102" ceiling clearance. The 696 systems require a 126" ceiling clearance.

- Vacuum Operation

  For heat sensitive products, the 372/696 systems are capable of operation under vacuum. These vacuum systems are useful in concentrating at low temperatures, products up to 99.8% total solids, and in increasing evaporative rates. Series 372/696 vacuum systems have successfully concentrated in commercial applications 70% sorbitol to 99.7% total solids under a process vacuum of 28" Hg., using 120 Psig steam. Vacuum systems are equipped with a vacuum receiver, vacuum pump, condenser, condensate receiver, product feed pump and condensate take-away pump. Groen also manufactures a 372/696 system for heat sensitive products that has vacuum steam to jacket and core.

Finish

All product contact surfaces of the units shall have a No. 4 sanitary finish conforming to all known sanitary standards.

Approvals

Series 372/696 systems are sanitary approved by the U.S Department of Agriculture and pressure ratings conform to the latest ASME codes.

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Performance

The evaporative process in the Series 372/696 begins when the product is pumped at a high velocity through the narrow annular gap in the form of a thin film between the two heat transfer surfaces. Heat is transferred radially to the product through the inner core and the outer jacket from the steam or other heating fluid. The turbulent flow, combined with an extremely high heat transfer coefficient and high temperatures, produces rapid boiling within the first 6" to 10" of travel up the annulus, depending on the properties and temperature of the product feed. Superheated steam is generated which, along with the pumping action, drive the product upwards and provide a powerful scrubbing action that further enhances the turbulent flow and heat transfer rate. This results in unusually short product residence times, generally 2-45 seconds.

The unique scrubbing action produced by the turbulent product flow eliminates burn-on and minimizes clean-up. Maintenance is minimized because the only moving part on the system is the feed pump.

The extremely short residence times result in less product breakdown and consistent high quality. The automated control system accurately monitors moisture content, flavor and product quality. Product changeovers can be accomplished quickly and easily.

Steam consumption has been found to be 1.25-1.35 times the evaporative rate, depending on the steam pressure, feed temperature and specific heat of the product.

A cabinetized, one tube E-372 unit requires 115V/1/60 power to the control panel (10 AMP maximum), and utilizes a 1/2 HP feed pump and 1/4 HP exhaust blower with 208/230/460/3/60 electrical requirements.

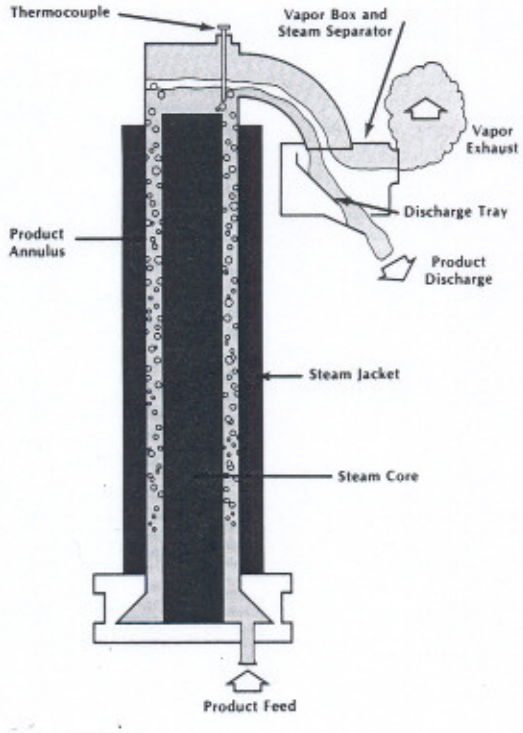
Applications

For heating applications, the Series 372/696 can be used successfully for a wide variety of products including pure sugar candy, pulled candy, mints, caramel corn coating, various syrups, cereal coatings, salad dressings, caramels, gravies and sauces.

When low temperature evaporation is required, the Series 372/696 vacuum system is applicable for several products including protein based products such as cheese whey and heat-sensitive products like fruit juices, jams and jellies.

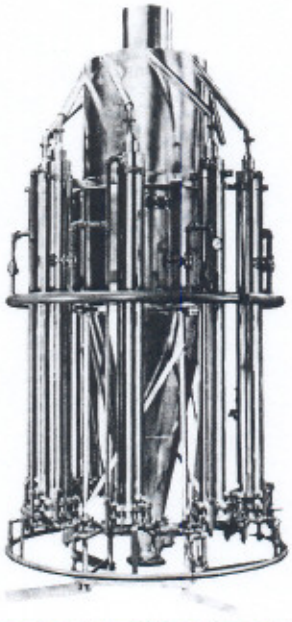
Origin of Manufacture

All components of the 372/696 system shall be manufactured in the United States.



Dual Jacketed Design

Each 372/696 concentrator tube is dual jacketed to provide a heat transfer surface on both the inner and outer walls of the product annulus. Extremely high heat transfer rates can be achieved by spreading product feeds in a thin film between these two heat transfer surfaces. The only moving parts in the system are the product feed pump components.



VACUUM SYSTEM

Series 372/696 Systems can be designed for vacuum and vacuum steam operation where low temperature evaporation is required. Vacuum applications include protein based products such as cheese whey and heat-sensitive products like fruit juices, jams and jellies.

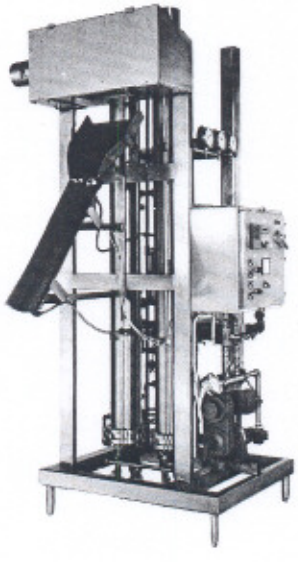
TYPICAL APPLICATIONS FOR 372 HEAT EXCHANGER/CONCENTRATOR

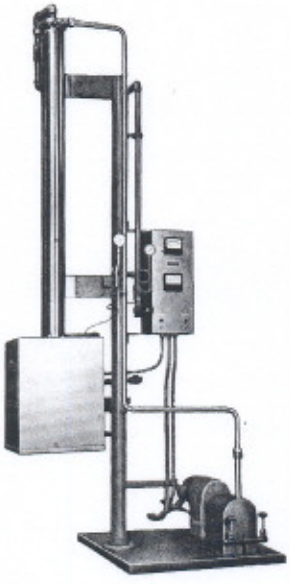
END PRODUCT	FEED CONSTITUENTS	% SOLIDS		RATE, LB./HOUR EACH TUBE		TEMPERATURE OF		STEAM PRESSURE
		FEED	FINISH	FEED	FINISH	FEED	FINISH	PSIG
Simple Candies & Syrups, Pulled Candy	Liquid Sugar, Invert Sugar	67 67 67	82 90 96-7	500 415 360	400 310 250	Room Room Room	230 254 290-305	80-100 100 100
Hard Candy—Bob Fondant	Sugar/Corn Syrup 80/20	67-74 67-74 67-74	87 94 98	450 375 300	360 270 210	Room Room Room	240 280 320-325	90-115 90-115 90-115
Caramel Corn Coating	Sugar, Brown Sugar, Corn Syrup, Molasses, Butter	73-79	94-8	500	430	160-180	280-320	90-115
Sorbitol	Sorbitol Gums Sorbitol	70-72 70	85 99.5*	730 710	600 500	150 150	280 320	90-115 100-115
Starch Base, Salads, Gravy	Starch, Water Condiment	Varying % (Non-evaporative application)			1500 2000	Room	196-200	30-40
High Fructose Syrups		75 75	80 94	2670 830	2500 660	105 105	250 280	100-110 100-110
Fruit Juices (Prune, Grape, Etc.)		8 18	32 70	340 480	85 125	Room Room	213 221	90 80
Soybean Protein		4-5	15-16	417	135	Room	213	100-105
Vegetable Puree		7	15	500	216	150	213	40
Fruit Slurry	Juice, Some Fiber	71	95	590	450	150	283	80**

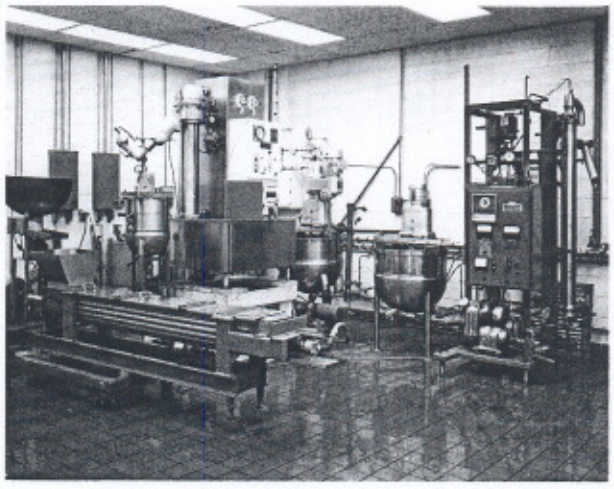
Notes:

1) The data are for a single E-372 tube. For multiple tubes the throughput rates are multiplied by the number of tubes.
2) E-696 tube has approximately 250% of the capacity of the E-372 tube.
3) For simple syrups the addition of a small tube-and-shell preheater may boost the throughput by 10-15%.

* Discharged into 26" vacuum
** Discharged into 17" vacuum







GROEN MODEL 2E-696-R3

This two-tube 696 unit can produce 2,000 lbs. per hour of pure sugar candy evaporated to more than 98% total solids. Total floor area required by the system is less than 25 sq. ft.

PILOT PLANT SYSTEMS

Pilot units are available which permit in-field testing to determine performance and capacity needs. Units are available for both atmospheric and vacuum processing.

GROEN TEST PROGRAMS

Performance of the 372/696 System can be demonstrated in Groen's fully-equipped test laboratory in Elk Grove Village, Illinois. In addition to feasibility studies on various products, test runs may be used to help size production equipment.

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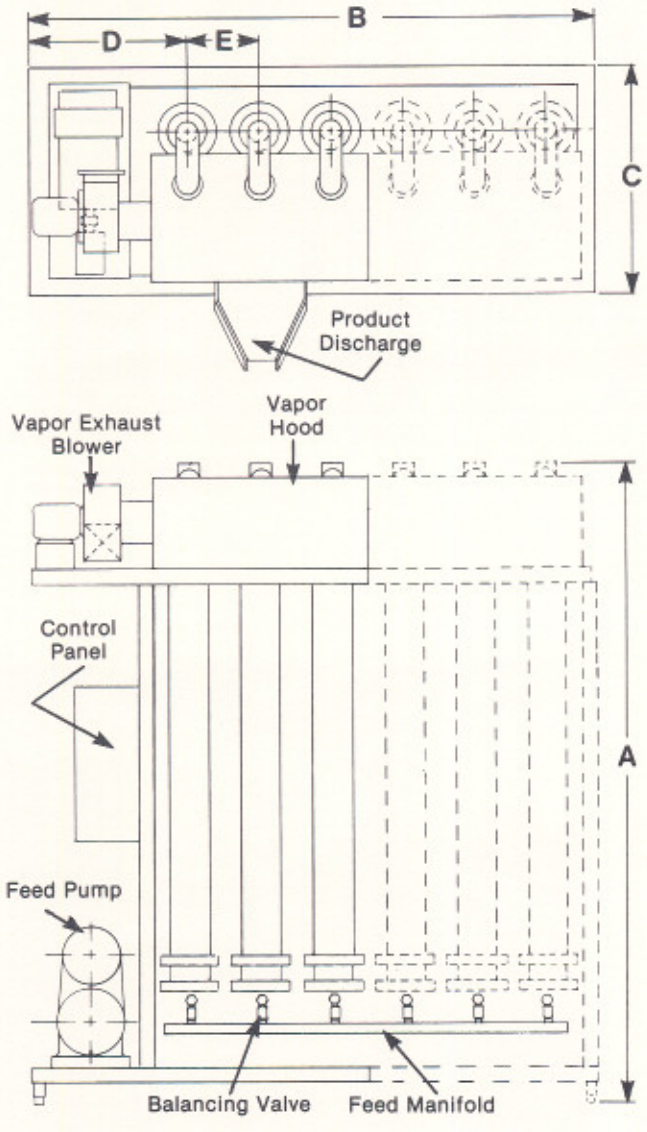
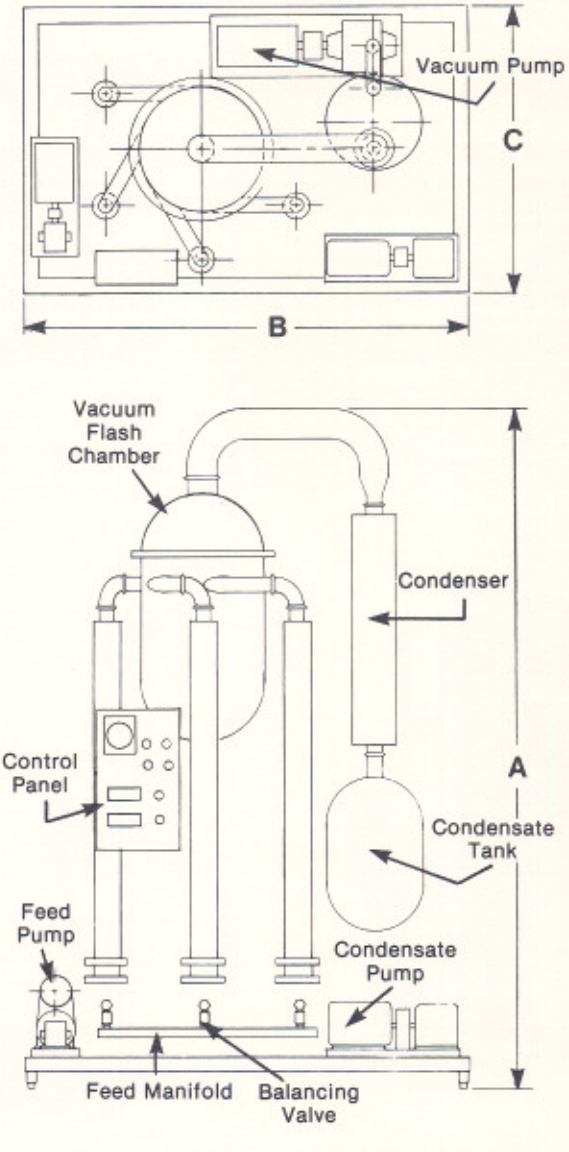
MADE IN USA

ATMOSPHERIC CONFIGURATION



VACUUM CONFIGURATION



	A	B	C	D	E
E-372	102″	106″	42″	36″	12″
E-696	126″	129″	42″	36″	16″

	A	B	C
E-372	127″	72″	48″
E-696	144″	80″	56″

*Patent Pending

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DUE TO PRODUCT IMPROVEMENTS AND MODIFICATIONS, EXACT SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

GPE

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