Crop*King* Greenhouse Package:

Dutch Bucket System

The Greenhouse Structure needs the strength to handle heavy snow loads and high winds. The roof structure members must be strong yet slender to allow the maximum amount of light and minimize the shading. CropKing uses high strength (50/55kpsi) galvanized "Gatorshield™" steel and custom aluminum extrusions to create a strong, cost effective, and long lasting frame that will survive in the high humidity of the greenhouse environment.

Freestanding Unit- Gothic shape, has a peak in the center for added strength and snow load (12 lb snow load) and is rated for an 90 MPH wind load. The arches come in two pieces (with a center coupler) and are spaced on 4' centers. They feature ground stakes and five purlins that run the full length of the greenhouse. Diagonal wind braces are used for bracing the end walls. All necessary connectors, hardware and brackets for attaching the end wall framing are included. Our entrance door is embossed steel clad with aluminum casing.

Pros:

- **Lower initial investment**
- **Easier to get started**
- **More simple to build**

Cons:

- **There are more outside walls, per square foot, resulting in more heat loss**
- **Is not expandable**

Gutter Connect Unit (can be expanded by adding additional 22 foot wide bays) - Our frames are made of galvanized structural steel and the connecting gutter is made of extruded aluminum. We use QuickLock, a poly lock system for attaching the covers to the extruded aluminum gutters. The gutter support posts are on 8 inch centers and the roof arches are on 4 foot centers. Included are three purlins per bay, wind braces, connecting hardware, and an embossed steel clad entrance door with aluminum casing (one door for up to 4 bays). This structure is rated for a 20 pound snow load and 90 MPH wind load. With a gutter connected greenhouse, we suggest that you start with at least a two bay unit for structural integrity.

Pros:

- **Can be expanded as needed by adding on additional bays**
- **More energy efficient, with less outside walls per square foot**
- **Can share equipment such as computerized controls, fertroller, or injection systems with the other bays as it is all one structure**
- **Straight side walls make more efficient use of inside space**

Cons:

- **More involved construction process**
- **First 2 Bays are more costly per square foot than a Freestanding Unit**

Plant Support System A plant support system is needed to support the weight of vine crops. Galvanized steel posts are spaced every 8 ft the length of the structure. The posts are supporting a stranded wire cabling along with the necessary clamps and turnbuckles.

Greenhouse Covering CropKing greenhouses are covered with greenhouse grade polyethylene plastic. Air is pumped between the two layers of plastic with inflation fans. The covers are fastened to the greenhouse using an aluminum extrusion. The pillow of air between the two layers of greenhouse plastic, provides insulation, rigidity (helps keep the plastic from flapping during windy weather) and also has an anti-condensation feature. The greenhouse plastic film has a coating for light diffraction which spreads the incoming light to eliminate shadows, and the inner layer has an IR blocking ability which helps to keep heating costs lower. While glass has higher light transmission than greenhouse plastic, once you consider the additional shading due to glazing bars and the additional structure to support the weight of the glass, the two systems provide similar net light transmission levels to the plants. There is a considerable cost differences between a glass house and a poly house and you can easily see why most commercial greenhouse structures are covered with poly. The South wall covering included in the greenhouse package is 8mm twin wall, UV resistant polycarbonate panels, the needed "H" and "U" channel to join the panels together, and Tek screw for fastening to the framework. Polycarbonate is strong, clear and impact resistant. It is also very easy to cut and install, and comes with a 10 year warranty. The greenhouse package does not include the North end wall covering and we recommend that this wall be insulated and sided with the customer's choice of material.

Cooling System Keeping the plants at their ideal temperature and humidity is crucial to optimizing growth and controlling plant diseases. If the greenhouse were not equipped with a cooling system, during sunny days it would easily reach temperature in access of 100°. Such high temperatures severely reduce crop quality and worker productivity. Because CropKing greenhouses are designed to grow year around, equipment is required to keep the greenhouse cool. Exhaust Fans in the north end of the greenhouse pull air from the back of the greenhouse across Evaporative Pads or a "wet wall". This wall lowers the temperature of the incoming air. Evaporative cooling is a common and one of the most cost effective methods for reducing the temperature inside a greenhouse. While air conditioning or refrigeration systems can be used, their installation and operating costs are usually prohibitive**.** The greenhouse system includes exhaust fans and an evaporative pad system. A Glacier-Cor PVC open top evaporative wet wall pad with a self-contained water distribution system (so no sump tank is needed) is positioned on the *inside* of the south end of the house. The heavy duty greenhouse grade American Coolair fans include slant wall housings, fan guards, aluminum shutters, motors and all necessary hardware.

Power Vent Door When the exhaust fans come on in the North wall of the greenhouse, an automatic vent door opens to allow air to enter the greenhouse. The rack and pinion driven vent door on the South end of the greenhouse, the opposite end from the fans, will open when the fans are running and close securely when the fans are not running. It has a gear driven motor with limit switches and is covered with 8mm twin wall polycarbonate. The frame of the vent door is made of aluminum extrusions. The proportional opening and closing of Power Vent door is controlled by the iGrow 1400 environmental control system.

Air Circulation System Air Circulation is important for a healthy greenhouse environment. Air circulating through the foliage of a plant brings a much needed supply of fresh carbon dioxide to the plant. Good air circulation helps to prevent diseases that would start more easily in areas of stagnant air. The air Circulation System in the greenhouse consists of a motorized intake shutter with Jet Fan in the peak of the greenhouse. The unit heaters blow warm air into the heater diverter, providing uniform heat down the length of the greenhouse. A punched poly air tube is attached to the jet fan and runs the full length of the greenhouse to disperse the air evenly. The support wires and tube hangers for this air tube are included.

Overhead Unit Heater Each bay or unit includes two Modine PDP 80% efficient standard unit heaters (10 year limited warranty) with 180 degree rotating power exhauster and aluminized steel heat exchanger and burners. Galvanized steel heater hangers are included. ***For an additional charge****, we suggest that in cold climates, one of the heaters can be replaced with a 93% efficient unit heater. While this Modine Effinity93 heater is more expensive, studies have shown that it can have a payback in less than two years in typical northern climates. Since only one of the heaters runs during the majority of the heating season, we recommend only upgrading one heater per bay.*

Computerized Environmental Controls The iGrow 1400 Control System is the brain of the greenhouse. This dedicated unit controls all the environmental equipment in the greenhouse such as fans, heaters, vent door, wet wall, lights and CO2. Due to the quickly changing environment of the greenhouse, specialized greenhouse controllers are critical to maintaining the correct plant environment. The computer controller measures both temperature and humidity of the greenhouse and adjusts the equipment to maintain the correct set points. By maintaining tight tolerances on the environment both night and day, significant energy savings can be achieved over simpler thermostat control. The iGrow Control System has onscreen programming for easy tracking and adjustment of the environment. There are 12 outputs with LED status display indicators and manual over-ride switches. With the addition of "slave units" the iGrow system can be expanded.

Electrical Panel For ease of installation, CropKing provides a pre-wired electrical panel that has been tailored to your greenhouse needs. Mounted on a white painted board is the breaker panel, a relay box, and the iGrow controller(s). All of these are pre-wired together and terminal strips are provided to connect the greenhouse equipment. This pre-wired panel makes installation much easier, with only a need to provide incoming power to the panel and then run wires from the terminal strips out to all the equipment. Since the computer controller only provides low power outputs, high amperage equipment such as motors and pumps need to be controlled with line voltage relays. The wiring for this system can be complicated and often misunderstood by the local electrician. CropKing simplifies all this with their prewired electrical panel. Our panels and boxes are interior grade NEMA enclosures as we find this appropriate for a hydroponic greenhouse operation. The power requirements of a greenhouse depend on the size of the greenhouse and whether grow lights are being installed. *Note: Please check with the local electric codes. While we use UL listed components in our electrical panels, some codes require the constructed panel be UL listed.*

Technical Support Technical support is a very important part of any CropKing Greenhouse System. Included is attendance to one of our Grower Training Workshop and a copy of the workshop on DVD for future referral. One of the most valuable features of our technical support package is the access to our techs with your specific questions. We suggest that you email weekly pictures of your crop or call into our office to discuss your growing concerns. We also include several books and DVDs based on your growing system. (i.e. *Lettuce Production Training DVD, Hydroponic Lettuce Production by Morgan)*

Dutch Bucket Growing Systems CropKing offers two distinct produce growing systems for greenhouse production. The tomato or "vine" crop Dutch Bucket system is suitable for longer growing fruiting crops such as tomatoes, cucumbers, peppers, eggplant, melon and a few other crops. CropKing's Dutch Bucket system uses horticulture grade perlite as a growing media because it is clean and has an excellent capability for absorbing water. The Dutch Buckets are made of tan plastic, rather than black so they do not absorb as much heat around the roots of the plant on a hot, sunny day. The containers have a special integrated drainage system as well as a small nutrient reservoir in the bottom of each bucket. In these systems, water is mixed with two tanks of concentrated hydroponic fertilizers and acid is added to control pH with a three head Nutrient Injector System. The Nutrient Injector dilutes the fertilizer in the correct ratios, and pumps the nutrient solution to the plants via drip irrigation emitters. Any excess nutrient solution or leachate is drained to waste and not recirculated for disease prevention. A mature tomato plant with fruit, on a warm sunny day, can require up to 1 gallon of water per plant, per day during peak usage periods, with an average usage of ½ gallon of water per plant per day over the growing season. Two tomato plants are positioned in each bucket and the buckets are placed on 16 inch centers. Slightly different spacing is recommended for cucumber production.

Vine Crop Dutch Bucket and Nutrient Feed System

- **Three Head Nutrient Injector System**: (pre-assembled, mounted and tested), three concentrate tanks, mixing tank, pressure gauge, solenoid valve, plumbing kit and pump.
- **Nutrient Delivery System**: Pre-cut and drilled Dutch Bucket drain line, PVC Nutrient feed header and solenoid valve(s), drip irrigation plumbing with pressure compensated emitters (1 per plant), 1/2 inch poly feed tube, emitter tubing and barbed stake guides.

Testing Equipment Myron AG-5 Conductivity DS Meter, TDS Conductivity Standard (1/2 pint) Fisher pH Test Kit, Sensaphone Model 1104, Sensaphone Remote Temperature Sensor, Nutrient Mixing Pump, Mini-Max Thermometer (2), Tomato Pollinator with 6V battery and charger, pocket sling psychrometer.

Growing Supplies Growing Supplies include: Estimated one year supply of Hydroponic fertilizer, Perlite Growing Media, AO36/40 1.5 inch Rockwool Seedling Cubes, Beef Stake Type Tomato Seeds, Bato Bobbins Plant Layering System, Seedling Trays, Propagation Mats and Thermostats, Vine Clips, Truss Hooks, Pre-Tom, Greenshield, and Insect Monitoring sticky strips.

Additional Options

Floor Heating System BioTherm Floor Heat Package includes low mass gas fired hot water boiler, heat distribution system, IGrow auxiliary temperature sensor and a conversion box from IGrow to BioTherm.

CO2 Enrichment and Control System Johnson CO2 generator, one per unit, electronic remote CO2 monitor with control package pre-wired and programmed into the iGrow 1400 environmental controller.

Shade Cloth 40% white exterior shade cloth including cable tie down kit and shade cloth quick clips.
Note: 50% white shade cloth is available at additional cost for deep south applications.

Insect Exclusion System A "screen room" which extends the south end of the greenhouse by 8 ft. This additional 8' of greenhouse is covered with NO-Thrip Insect Screening and covers the power vent door to stop insects from being pulled through the wet wall into the greenhouse. One of the best answers to insect control in the greenhouse is to stop them from ever getting in. This price includes an access door into this 8'extension for maintenance of the wet wall. Also included is an additional entrance door and air curtain to turn a customer supplied head house into an air-locked greenhouse entry reducing the chance of insects entering through the main entrance of greenhouse.

Steel Endwalls and Sidewalls CropKing's galvanized structural Steel endwall package includes 3 steel framed endwalls and 2 steel sidewall baseboards made of structural 1 1/2 x 3 inch galvanized C channel, aluminum brackets, hardware and additional end wall bracing and connecting hardware. Pricing on a per project.

H**igh Efficiency Unit Heater Upgrade** This option replaces one 80% efficient unit heater per bay with a 93% efficient separated combustion, high efficiency Modine PTC-180 Effinity93 Unit heater. Pricing based on location.

Remote Access Software Also available is a remote monitoring and programming software package which allows the iGrow to be attached to a host computer and allows for ease of programming.

Complete Package Pricing

	Freestanding 30’ x 128’ 870 grow out	Gutter Connect 44’ x 128’ 2 Bay 1,440 grow out	Gutter Connect 88’ x 128’ 4 Bay 2,880 grow out	Gutter Connect 176’ x 128’ 8 Bay 5,760 grow out
Structure, Plant Support and Covering	$ 12, 213	$ 29,645	$ 52,220	$ 97,370
Cooling System, Vent Door, Air Circulation, Heaters, Environmental Controls, Electrical Panel and Technical Support	$ 16,781	$ 26,474	$ 41,728	$73,215
Growing System	$ 7,940	$ 9,995	$ 15,618	$ 28,099
Testing Equipment and Growing Supplies	$ 8,592	$ 11,295	$ 20,037	$ 36,439
Standard Package Total	$ 45,526	$ 77,409	$ 129,603	$ 235,123
Additional Options				
Flooring Heating System	$ 12,585	$ 13,583	$ 21,735	$45,899
CO2 Enrichment and Control System	$ 1,136	$ 1,830	$ 3,290	$ 6,209
Shade Cloth	$ 755	$ 1,995	$ 3,345	$ 6,052
Insect Exclusion System	$ 3,153	$ 5,122	$ 7,693	$ 12,865

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