



## Introducing the Power Pallet

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## ***I. Overview and Specifications***

ALL Power Labs offers downdraft gasifier systems in various sizes: 10kW, 20kW, and 100kW. These kW ratings reference the potential of electrical power capable in a gasifier/ICE/generator system at the gasifier's maximum gas flow capacity. The GEK Power Pallet integrates an internal combustion engine and a generator with automated controls with the ability to utilize the gas for other purposes, while the GEK Gasifier comes as an assemble-yourself kit that provides stand-alone wood gas for a variety of end uses. Below are the specifications of the systems provided by ALL Power Labs.

**GEK Gasifier System Sizes provided by ALL Power Labs**

	<i>10kW GEK</i>	<i>20kW GEK</i>	<i>100kW GEK</i>
electrical capacity range (kW)	2 - 10	4 - 20	20 - 100
gas flow range (m <sup>3</sup> /hr)	5 -27	11 - 53	53 - 267
gas heat flow at max (BTU/hr)	168,993	331,727	8,355,765
biomass consumption rate (kg/day)	160 - 320	320 - 640	640 - 3200
gasifier system footprint (excluding hopper) (ft)	2 x 4	2 x 4	4 x 7

The GEK Systems are offered at various integration stages as well as at different kit levels to make the equipment accessible at various price points. The kit 'Levels' refer to the completeness of the offered product. The levels are as follows:

- > Level I: free CAD files available online
- > Level III: Weld-It-Yourself kit (mild steel only)
- > Level IV: Assemble-It-Yourself kit (stainless steel only)
- > Level V: Completely Assembled and Integrated

**GEK Gasifier Models, Levels and Features Offered**

<i>Model</i>	<i>Sizes (kW)</i>	<i>Levels Available</i>	<i>Included Features</i>
Basic GEK	10, 20	I, III, IV	Reactor, gas filter only. Gas drive system: ejector
GEK TOTTI	10, 20, 100	III, IV	Basic GEK with Pyrocoil and Drying Bucket. Gas drive system: ejector
GEK Power Pallet	10, 20	V	GEK TOTTI, PCU, logic and components for automation, engine and generator. Gas drive system: blowers. Integrated on a 4x4 pallet. Available in 120V/208/240V AC, 60/50Hz, and in single, split, or three phase configurations.

### ***Biomass Requirements of the GEK Gasifier Systems***

Most downdraft gasifier systems require specified feedstock characteristics and can be sensitive

to feed stocks that lie outside of the required specifications for the given equipment. Across all of the GEK Models above, ALL Power Labs has implemented designs in both the reactor and the bulk handling systems that broaden the allowed feedstock characteristic requirements of typical systems of its size. Below are the suggested ranges for given feedstock characteristics to be used in the GEK systems.

#### **Biomass Requirements**

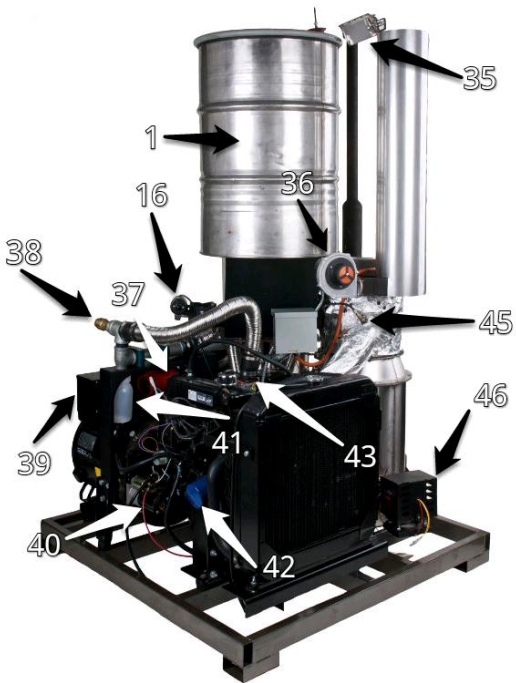
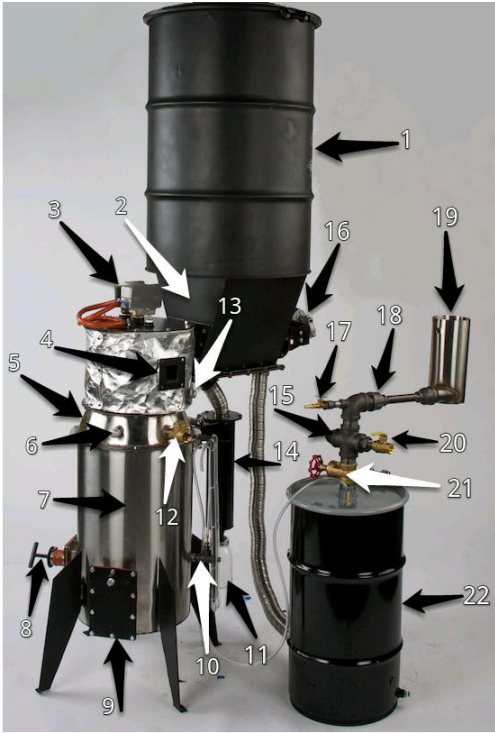
particle size (in)	.5 - 1.5
moisture content (% by dry weight)	<25
fixed to volatile ratio	>0.25
ash content (%)	>5

*Please refer to the Feedstock Requirements and Preparation Guide for more information.*

The GEK Systems are designed for raw biomass and organic-based feed stocks. Experimental feed stocks lying outside of the suggested ranges may require modification of the equipment and testing of the gas quality produced. For experimental and research, ALL Power Labs offers a **Research Experimenters Kit** with test and control equipment valuable for gas testing or further development off of the base systems. Contact [sales@allpowerlabs.org](mailto:sales@allpowerlabs.org) for more information.

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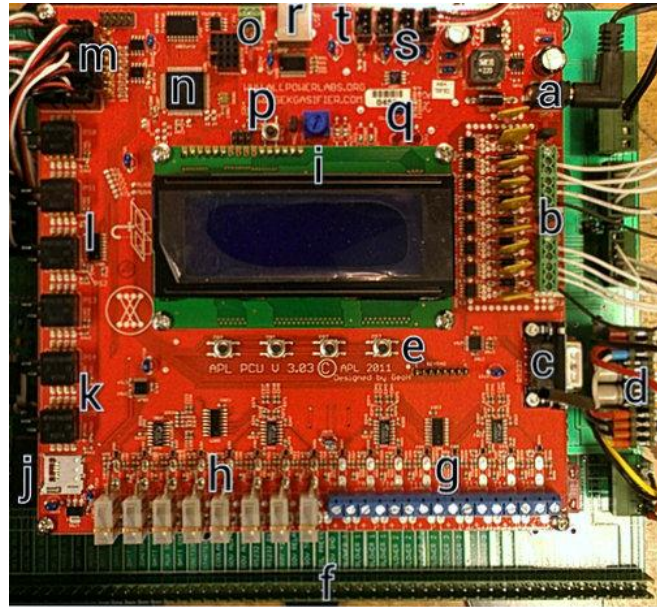
## II. Identifying the GEK System Components



**GEK System Components con't**

1. Feedstock Hopper	26. Engine Radiator Coolant Port
2. Drying Bucket	27. Engine Alternator
3. Fuel Level Switch	28. 12V DC Car Battery (not included)
4. Pyrocoil Exhaust Port	29. Fuel Level Switch
5. Reactor	30. Pyrocoil and Exhaust Insulation Jacket
6. Auxiliary Port	31. Engine Exhaust
7. Gas Cowling	32. Engine Gas Valve
8. Manual Grate Shaker	33. Packed Bed Gas Filter Lid Access
9. Ash Port	34. Filter Condensate Drain Port
10. Dual Channel Manometer and Thermocouple Port	35. Automatic Flare Igniter
11. Cyclone Condensate Jar	36. Air Blower
12. Air Inlet Check Valve	37. Air Filter
13. Lighting Port	38. System Safety Relief Valve
14. Cyclone	39. Generator and Electrical Connection Box
15. Gas Service Connection Port	40. Engine Starter Motor
16. Biomass Feed Auger	41. Engine Condensate Trap
17. Ejector Compressed Air Connection	42. Engine Oil Filter
18. Ejector Gas Drive	43. Governor and Engine Throttle
19. Swirl Burner	45. Oxygen Sensor
20. Manual Air-Premix Valve	46. Automated Grate Shaker
21. Gas Shut-off Valve	47. Feedstock Hopper View Port
22. Packed Bed Gas Filter	48. Dual Gas Blower
23. Hopper Barrel Puff Bung	49. Pyrocoil Heat Exchanger
24. Flare Stack	50. Gas Line Access Port
25. Air Blower	51. Process Control Unit (PCU) and Control Logic
	52. Main Operation Panel

### III. Identifying the Power Pallet Control Panel and PCU Components



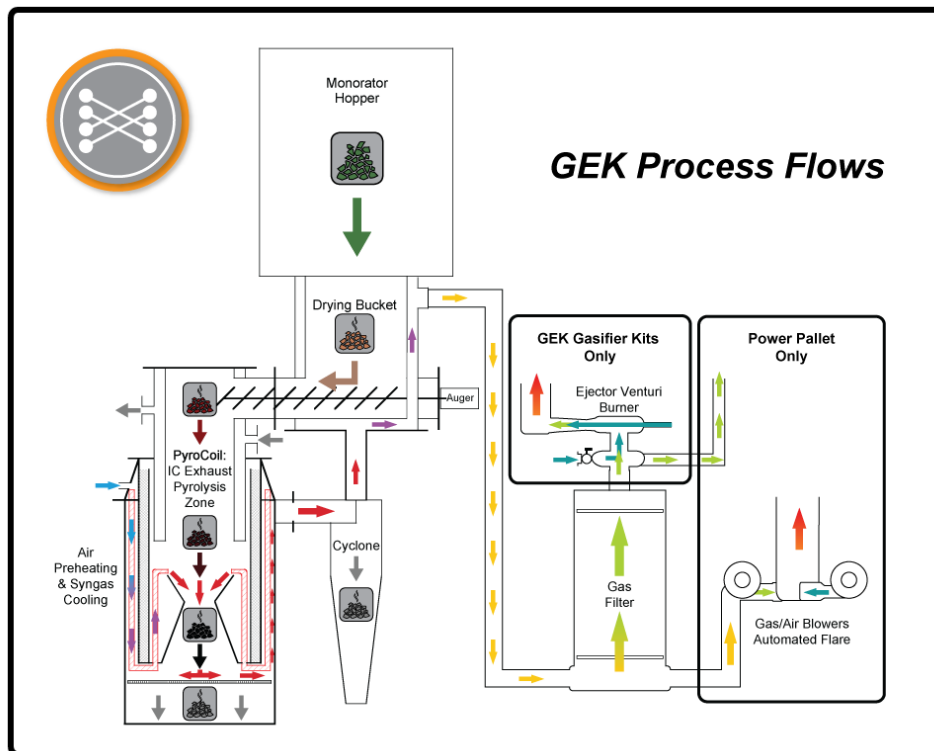
53. Hour Meter  
 54. Oxygen Sensor Air/Fuel Ratio Dial  
 55. LCD Display  
 56. 4 Input Buttons  
 57. System Main Power  
 58. Engine Key Switch  
 59. Dual Gas Blower Adjustment Knob  
 60. Air Blower Adjustment Knob  
 61. PCU USB Connection Port  
 62. Warning Alarm

a. Power Input  
 b. FETs  
 c. RS232 Communication Port  
 d. ATX Power Supply  
 e. Input Buttons and Keypad Off-board Connection  
 f. Relay Board I/O Connectors  
 g. Thermocouple Screw Terminal Connectors  
 h. Thermocouple Standard Connectors  
 i. LCD Display and Contrast Knob  
 j. Micro SD card

k. Low Range Pressure Sensors  
 l. High Range Pressure Sensors  
 m. Analog Inputs  
 n. ATmel MicroProcessor  
 o. CAN Bus Communication Port  
 p. Reset Button  
 q. Status LEDs  
 r. USB Communication Port  
 s. Servo Control Ports  
 t. Timer

#### IV. Description of the GEK Gasifier Process Flows

The GEK Process starts with the introduction of feedstock into the hopper. After the hopper, the feedstock passes through an auger and enters the gasifier. The auger is controlled by a level switch incorporated into the reactor lid. The feedstock fills the GEK reactor and stages needed for passes through the stages of gasification: drying, pyrolysis, combustion, and reduction. The hot gas exits the reactor and passes through a cyclone to separate char particulates. The GEK Gasifier systems are designed to utilize the heat from the gas produced to dry the incoming feedstock through the Drying Bucket. After the Drying Bucket, the gas passes through the gas filter and gas drive system. The GEK Gasifier systems have two main valves to switch between one of two operational modes: Flare or Engine Mode (or other gas utilization mode). For Engine Mode, the Pyrocoil heat exchanger, included in the TOTTI design, increases the efficiency of the reaction by supporting the heat needed for the pyrolysis zone by utilizing the waste heat from the exhaust of an engine or other process.



The GEK Gasifier Kits and the Power Pallet have different gas drive systems as shown in the GEK Process Flow diagram above. For the GEK Kits, the gas enters the gas filter, and passes through the ejector gas drive system. Here the air is then mixed for the flare. For the Power Pallet, the gas by-passes the filter on start-up and the blower system provides gas and air for the flare. After start-up, the flare is then shut off and the engine pulls gas through the gas filter. The Basic GEK Kit does not include the Drying Bucket, Pyrocoil, or Auger shown in the diagram above. The Basic GEK Kit has a simple lid on top of the reactor and is to be filled manually. The Basic GEK Kits are offered as the most simple experimental development platform.