

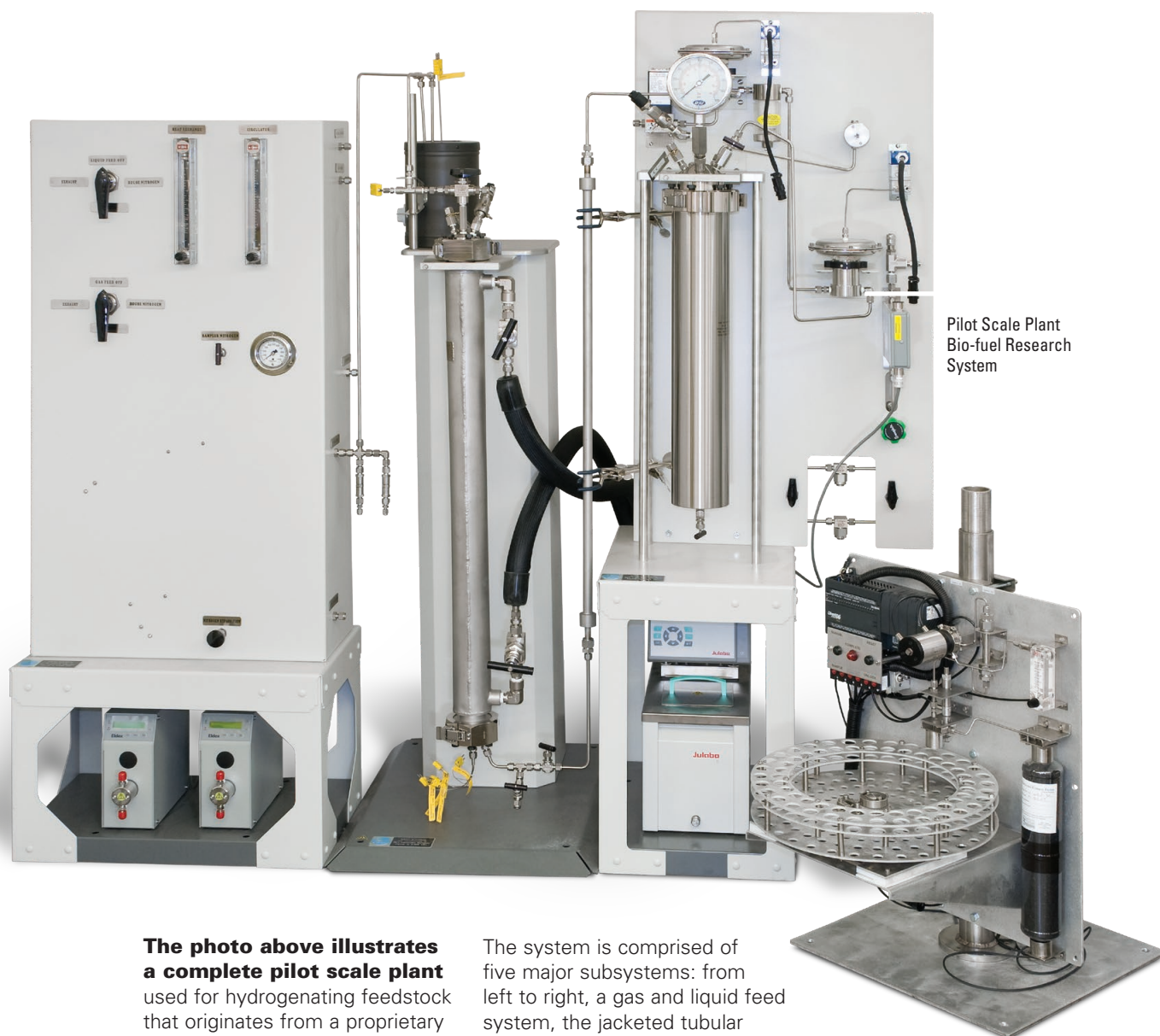
# Bio-Fuels & Alternative Fuels Research Systems



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*Specialty Systems that Embody the Spirit of Innovation*

**Parr Instrument Company manufactures non-stirred vessels for the decomposition of biomass in ammonia and steam.** Parr stirred reactors, including a new horizontal reactor technology, have been designed for research processes that include hydrogenation, isomerization, and metathesis reactions. In addition, a fully customizable continuous-flow tubular reactor system has been developed with continuous reactant feed and product handling capabilities.



Pilot Scale Plant  
Bio-fuel Research  
System

**The photo above illustrates a complete pilot scale plant** used for hydrogenating feedstock that originates from a proprietary fermentation process. The system is used to develop and optimize the process conditions necessary for a much larger demonstration-scale system, ultimately leading to full-scale production of renewable fuels.

The system is comprised of five major subsystems: from left to right, a gas and liquid feed system, the jacketed tubular reactor module including a reactant pre-heater and circulating bath, product recovery and backpressure control, an auto-sampler and a Parr® 4871 Control System (not pictured). The system is completely automated

and includes an auto-sampling subsystem that periodically samples the reactor output stream in order to accurately monitor product quality.



**For continuous flow systems,** Parr tubular reactors have been developed with continuous reactant feed, a variety of pre-heat and heating options with sample collection systems and product handling. Varying degrees of automation and data collection are available. For more information on Tubular Reactor systems, like the one shown here, please visit the 5400 Continuous Flow Tubular Reactors section at [www.parrinst.com](http://www.parrinst.com).



**Tubular Reactor System  
with 3-zone Heater**



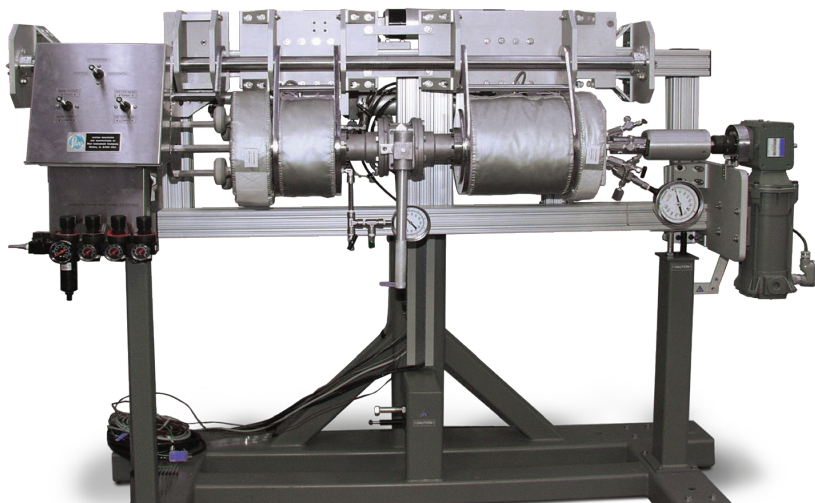
**Horizontal Reactor on Movable Floor Stand**

**Stirring biomass such as straw or grasses is not easy to do in a vertical reactor.**

A new technology has been developed to do it horizontally. In the system pictured to the left, a one-liter reactor can be disconnected to tilt vertically for loading or tilt horizontally for stirring. A heavy-duty stirring motor and double anchor stirrers are used. Another option would be to tilt upside down for discharge. A 4848 Controller monitors the temperature and pressure and controls the stirring speed. A flexible mantle heater (not pictured) is used to obtain temperatures up to 350 °C. Maximum pressure is 1900 psig for this system.

**The horizontal function is also available on our large capacity reactor systems.**

The reactor shown below has a five gallon capacity and is used for stirring vertically or horizontally. Pneumatic controls can tilt the system upright to open the bottom drain valve. The product is filtered and collected in the lower heated sample collection vessel. This system is used for producing synthetic fabric from biomass as an alternative to a petroleum-based process.



**Horizontal Reactor Floor Stand in Horizontal Loading Position**



**Horizontal Reactor Floor Stand in Upright Loading Position**

# The Parr Limited Warranty

**Parr Instrument Company (Parr)** combustion bombs, calorimeters, reactors, pressure vessels and associated products are designed and manufactured only for use by or under the direct supervision of trained professionals in accordance with specifications and instructions for use supplied with the products. For that reason, Parr sells only to professional users or distributors to such users. Parr produces precision equipment and associated products which are **not intended for general commercial use**.

## EXCLUSIVE WARRANTY

To the extent allowed by law, the express and limited warranties herein are the sole warranties. **Any implied warranties are expressly excluded**, including but not limited to implied warranties of merchantability or fitness for a particular purpose.

## WARRANTY CONDITIONS:

- 1. Non-assignable.** The warranties herein extend only to the original purchaser-user and to the distributors to such users. These warranties or any action or claims based thereon are **not assignable or transferable**.
- 2. Use of product.** The warranties herein are applicable and enforceable only when the Parr product:
  - a. Is installed and operated in strict accordance with the written instructions for its use provided by Parr.
  - b. Is being used in a lawful manner.
  - c. Has not been modified by any entity other than Parr Instrument Company.
  - d. Has been stored or maintained in accordance with written instructions provided by Parr, or if none were provided, has been stored and maintained in a professionally reasonable manner.
- 3. The user's responsibility.** Parr engineers and sales personnel will gladly discuss available equipment and material options with prospective users, but the final responsibility for selecting a reactor, pressure vessel or combustion bomb which has the capacity, pressure rating, chemical compatibility, corrosion resistance and design features required to perform safely and to the user's satisfaction in any particular application or test must rest entirely with the user – not with Parr. It is also the user's responsibility to install the equipment in a safe operating environment and to train all operating personnel in appropriate safety, operational and maintenance procedures.

- 4. Warranty period.** Unless otherwise provided in writing by Parr, the warranties herein are applicable for a period of one year from date of delivery of the product to the original purchaser/user. Note, however, that there is no guarantee of a service life of one year after delivery.
- 5. Notification.** To enforce any express warranty created herein, the purchaser/user must notify Parr in writing within thirty (30) days of the date any defect is detected. Upon request of Parr, the part or product involved must be returned to Parr in the manner specified by Parr for analysis and non-destructive testing.

## EXPRESS WARRANTIES

Subject to the above Conditions, Parr expressly warrants that its products:

1. Are as described in the applicable Parr sales literature, or as specified in Parr shipping documents.
2. Will function as described in corresponding Parr sales bulletins or, for specially engineered assemblies, as stated in the sales proposal and purchase agreement.
3. Will remain free from defects in materials and workmanship for the Warranty Period.

## LIMITATIONS ON THE PARR WARRANTY

As to the original purchaser/user and to the distributors to such users, Parr limits its liability for claims other than personal injury as follows:

- 1. Replacement or repair.** With respect to express warranties herein, Parr's only obligation is to replace or repair any parts, assemblies or products not conforming to the warranties provided herein.
- 2. Disclaimer of consequential damages.** In no event shall Parr be liable for consequential commercial damages, including but not limited to: damages for loss of use, damages for lost profits, and damages for resulting harm to property other than the Parr product and its component parts.

## INDEMNITY AND HOLD HARMLESS

Original purchaser-user agrees to indemnify and hold Parr harmless for any personal injuries to original purchaser-user, its employees and all third parties where said injuries arise from misuse of Parr products or use not in accordance with specifications and instructions for use supplied with the Parr products.



**Parr Instrument Company**

211 Fifty Third Street Moline, Illinois 61265-1770

1-800-872-7720 | 1-309-762-7716 | parr@parrinst.com | www.parrinst.com