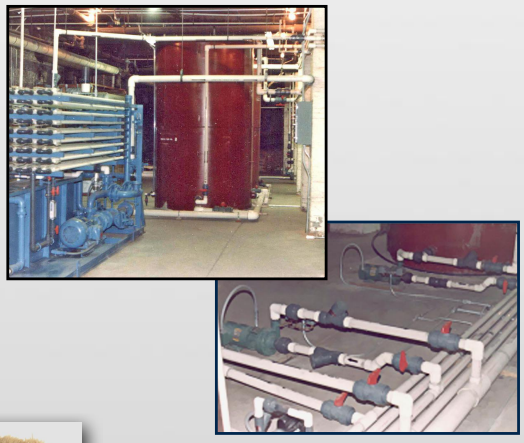
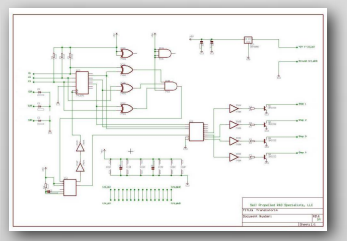
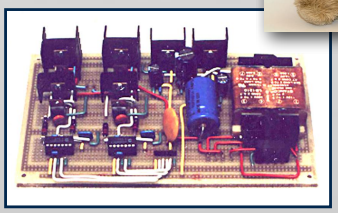
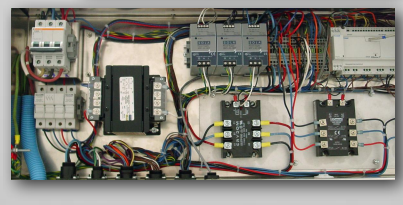
Self Propelled Scientific

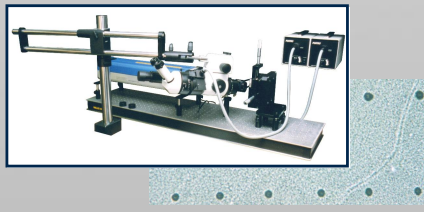
Research, Engineering, Innovation



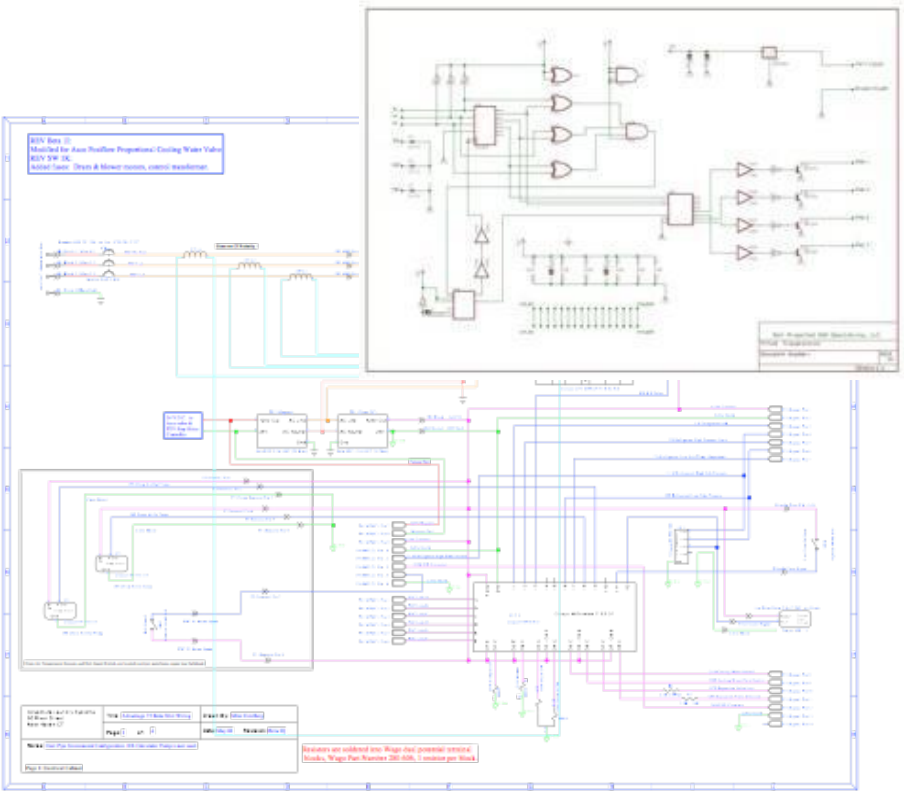








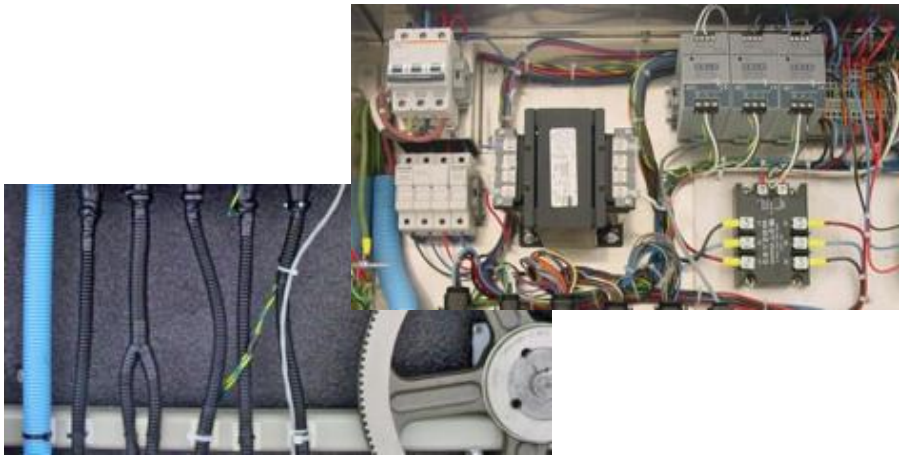
Engineering Disciplines



New Product Design
Mechanical Engineering
Electrical Engineering
Thermodynamics
Heat Pumps
Prototyping

Manufacturing
Factory Floor Automation
Design for Manufacture
Systems Integration

Automation
PLC & Microprocessor Development
Machine, Process, & Motion Control
Instrumentation, Data Acquisition
High Power Drive Electronics
Custom Test Equipment



Energy Consumption Mitigation
Industrial Energy Recovery
Process Optimization

Selected Clients

Columbia Gas	Harris Semiconductor	Prada Group
Dresser Instruments	Lucent	Raytheon
Duracell	National Grid	The Stanley Works
Gulf Oil	Eversource	University of Connecticut

Portfolio and Abstracts Commence on Next Page

Breathing Teddy Bear for NICU

A university neonatal sleep lab developed a breathing teddy bear for use in incubators with infants that were as much as two months premature. Severely premature infants are born with incomplete lung development, and are extremely prone to SIDS. The researchers found that if a breathing teddy bear was placed in the incubator, the baby's breathing would reliably synchronize with the bear.

They implemented the breathing function by inserting a balloon in the bear's abdomen, and running a thin flexible hose out through the bear's behind. This hose was routed out of the incubator to a veterinary respirator pump on the floor. This was functional, but was difficult to control, and the motor and gear noise from the pump traveled up the tube directly to the baby. Noise of this type causes neurological damage to infants, and was patently unacceptable.

SPS developed a custom all electronic breathing system for the bear. It comprises an 8" 150 watt liquid cooled speaker, mounted on an aluminum plate, acting as the pump. The air tube from the bear is connected to a port at the center of the plate.

An integrated digital signal generator allows the attending doctor to key in the desired breathing rate and amplitude. A 150 watt D.C. coupled amplifier drives the speaker with a clean sine wave, at 0.05 to 0.5 Hz and up to 1" stroke. It is completely silent.

Foley Catheter Pilot Production Line

Turnkey pilot production line for producing seamless Foley catheters with integrated balloons.

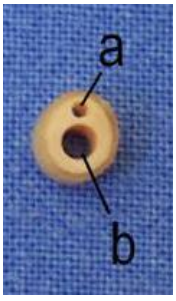
This was the model for a large scale facility, to replace existing production in which the balloon was attached with wire.

Per the client's mandate, the line comprised separate manual and automatic stations for individual tasks such as:

- Tubing Cut to Length
- Automatic Two Part Silicone Blending
- Tip Seal Dip
- Mold Resist Apply
- Balloon Forming Dip
- Thermoset Tunnel Oven
- Insert Injection Molding of Y Connector
- Balloon Leak Test, 1 mL / Week Sensitivity
- Automatic Packaging

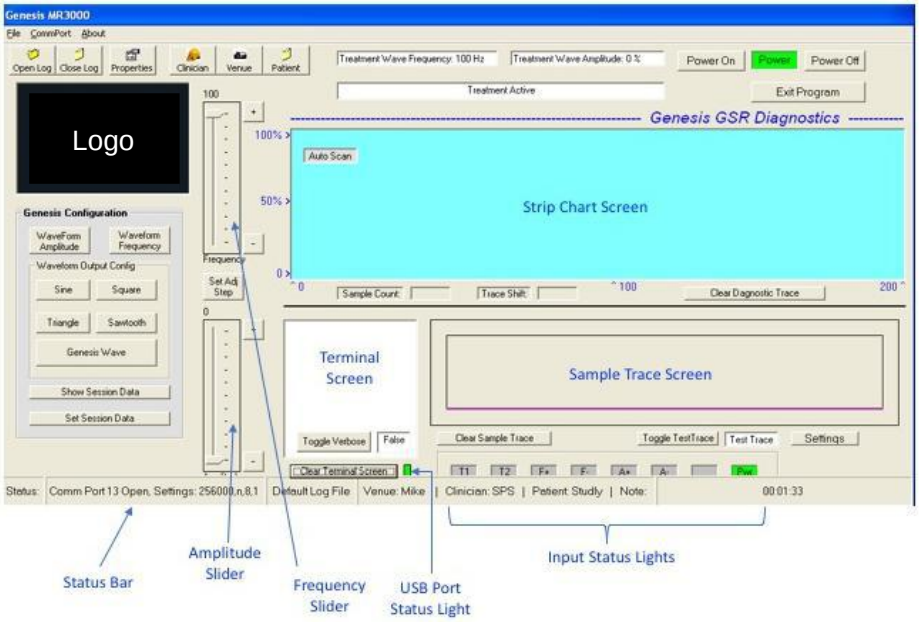
Nominal design capacity, 1,000 units per day.

Typical Foley Catheter with Balloon Inflated



a: Balloon Inflation Lumen
b: Subject Fluid Lumen

Veterinary TENS Unit



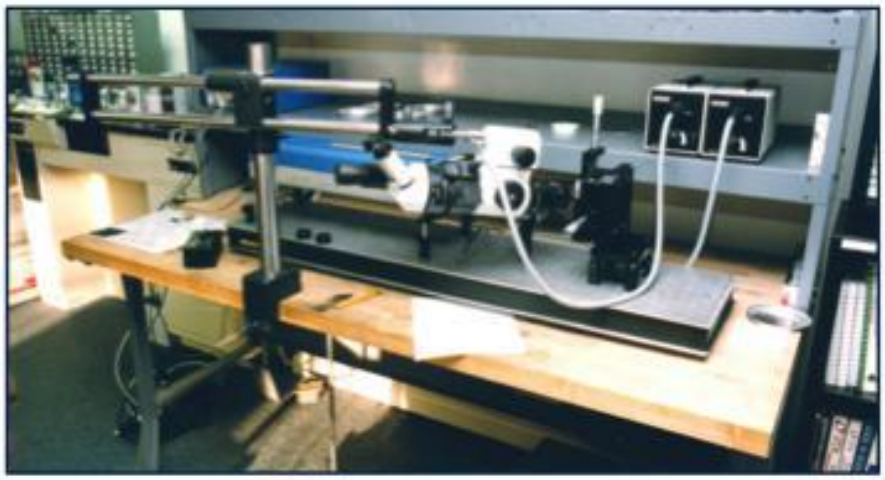
Developed for large animals, with focus on horses, this unit provides high output, programmable arbitrary waveform, variable frequency and amplitude, realtime strip chart, and comprehensive data logging.

Microprocessor Controlled Medical / Laboratory Dispenser / Diluter

A leading maker of laboratory equipment wanted to improve an existing product which they felt was stagnant. SPS redesigned the product, implementing numerous performance improvements and cost reductions. We handled all phases of design, including electronics, firmware, and user ergonomics. We worked closely with the client to produce a final design that met all of their needs. The new dispenser is more attractive, offers numerous new features, and is easier to use. The updated product enjoyed excellent market response.

Zero Contact Microscopic Marking System

A multinational semiconductor manufacturer was testing a novel glass substrate for a new device they were developing. It was necessary for them to strain profile the substrate under stress.



This is normally accomplished using a typical material testing machine, in which a sample is subject to increasing linear tension while the overall strain is measured.

They were unable to do this, because the substrate had surface topography that caused uneven strain across the length of the test piece.

A method was needed for applying a visible grid to the test piece, so the strain distribution could be measured optically. It was further necessary to apply this grid without contacting the test piece.

SPS developed a custom marking system that applies 10 micron diameter dots to the glass, on 0.005" centers in an X/Y grid, without contacting the substrate. The system employed a helium/cadmium UV laser, all quartz optics, and very high precision X/Y positioning.

Production Smart Battery Tester

This device was designed to test incoming smart rechargeable battery packs at a manufacturer's global warehouses. Smart battery packs have an on board microprocessor, as well as voltage and current sensing capability. They respond to over 40 interrogation commands, providing smart discharge management and controlled high speed recharging. The pack has a proprietary serial data port through which a laptop computer, or other battery powered appliance may communicate while in use.

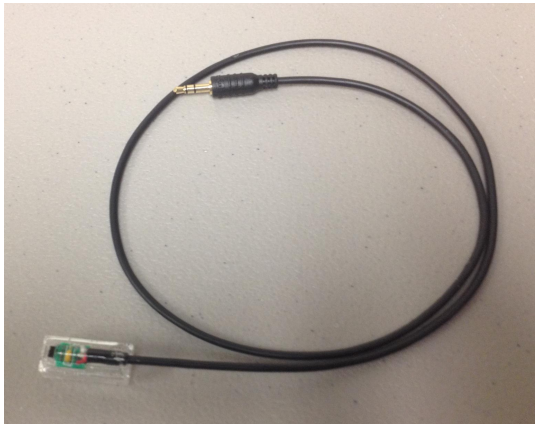
The tester comprises a laptop PC with dedicated software, and a custom designed electronics module, which attaches to the laptop and the battery under test. The software generates real time signals for interrogating the microprocessor in the battery pack, and displays both Pass/Fail and test details.

All test results are archived, and complete statistical functions are provided. The electronics module has its own current and voltage measurement capability, as well as programmable dummy loading, for complete comparison diagnosis of pack and processor performance.

Seven units were built and shipped to the client's distribution facilities.

Relay State Detection

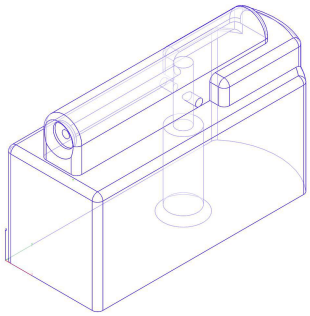
SPS developed isolated relay state sensors, encapsulated in relay specific custom molded silicone boots, and a fabrication method for same. The boot slips easily and snugly over each subject relay housing. Once a sensor is in place it is stable; it will not fall off during equipment operation. Sensors are easily removed, leaving no trace.



The sensor assembly comprises a small Hall effect device, and simple support circuitry, on a 4mm x 6mm x 0.015” PCB, encapsulated in the boot. This generates an analog output signal that indicates the subject relay state, idle or energized.

The sensors drive a companion data acquisition interface with corresponding analog inputs, calibrated for the target relays before shipping. They are easily recalibrated in the field as needed.

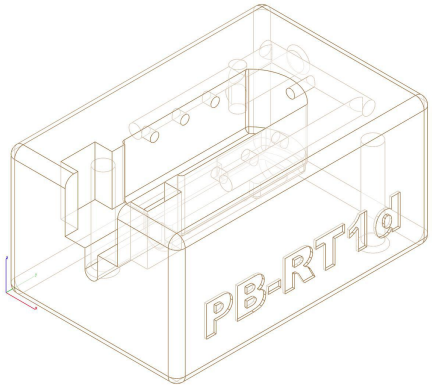
Relay specific vacuforming molds, generated in CAD and 3D printed, are used to fabricate the boots.

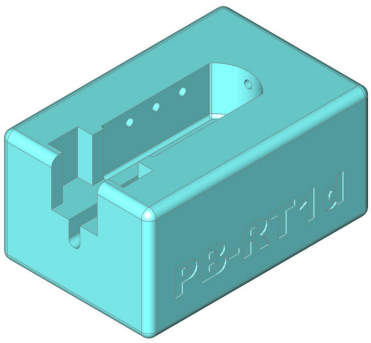


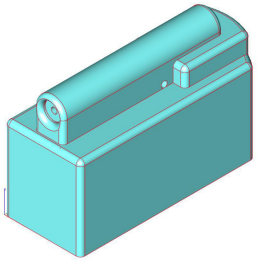
The boots are then placed in 3D printed cavity fixtures, in an inverted position. A vacuum is drawn on the cavity fixture, causing the boot to conform precisely to the cavity shape.

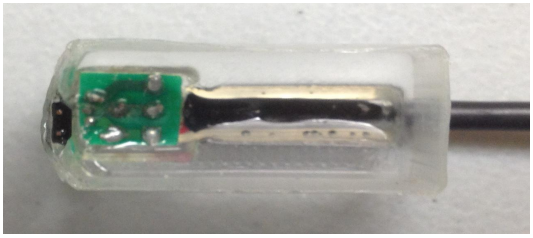
The PCBA, including the Hall effect device, support circuitry, and signal cable, is gently snapped into place in the cavity. A controlled volume of UV curable urethane is injected into the cavity, encapsulating all components.

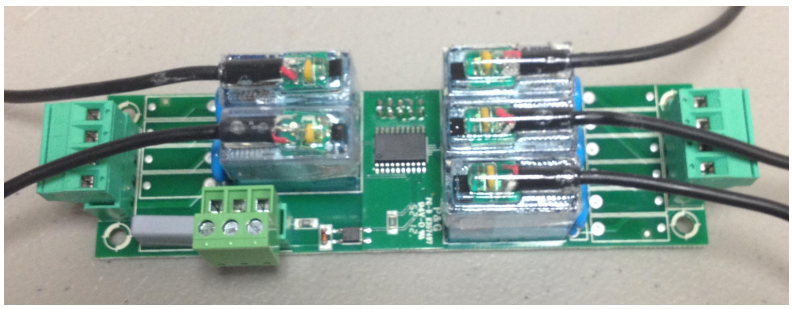
A 3000 watt UV curing station fully cures the encapsulation in 8 seconds.

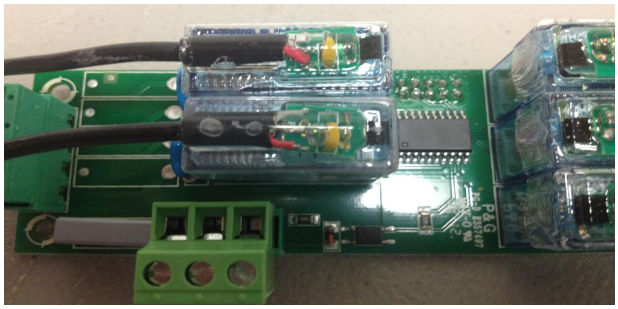








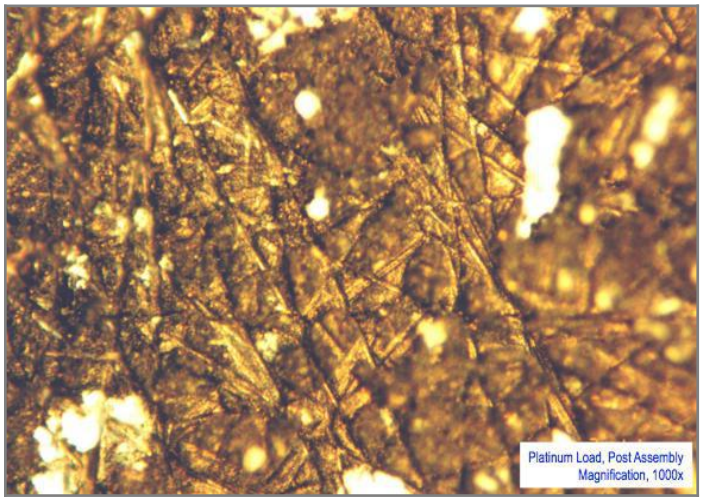




Fuel Cell Failure Analysis and Resolution

A PEM fuel cell manufacturer was experiencing process difficulties with a novel method of populating their carbon substrate with platinum catalyst. Their process presented excellent potential for platinum load reduction, but the finished electrodes exhibited unusually short life, typically less than an hour. Electrical properties were largely unaffected, but hydrogen flow failed rapidly without explanation.

Microscopy of sample electrodes and base materials revealed that, under the compression generated by the stack tie rods, the soft platinum particles slowly fused into relatively large areas of homogeneous foil. These foil areas were non porous and nonpermeable, reducing the gas flow area by several orders of magnitude. The microscopy photographs and our accompanying report were included by the client in a successful federal grant proposal, and the problem was subsequently resolved.



Lightning Tolerant Military Communications

These devices were developed for the U.S. Military COTS program. The unit shown on the left accepts standard mil spec unsheathed twisted pair field wire at the terminal posts. An RJ45 jack at the bottom accepts a standard ISDN telephone cord. The unit shown on the right is an 18 VDC power supply for conventional PC laptops, and includes a separate pass through for a category 5/6 LAN.

Both units will survive five hundred consecutive lightning strikes, with no damage to attached equipment.

Twisted Pair Field Wire to RJ45
Military ISDN Telset Terminator

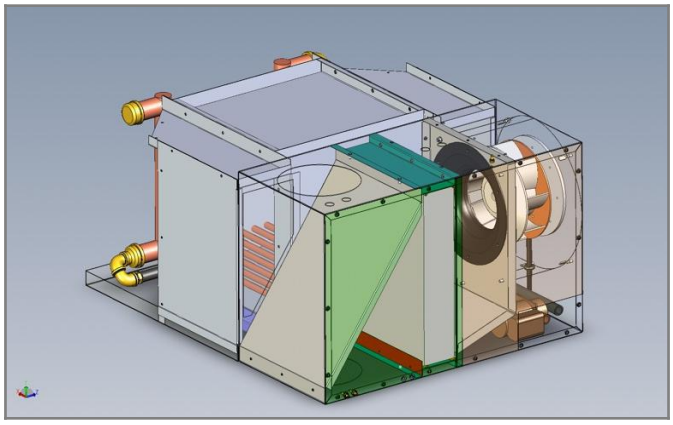
Military Field Laptop Power Supply
with Ethernet LAN Port

Commercial Laundry Research Lab

All operational parameters recorded in real time.

SPS designed and built a complete research and development lab for analyzing and mitigating energy consumption in commercial laundry equipment. The lab comprised two 30 pound commercial washers, and three 30 pound commercial dryers. All machines were fully instrumented, with focus on the dryers. Monitored parameters included dryer mass airflow, incoming air temperature and rH%, exhaust air temperature and rH%, and pressure. Hot and cold water volume flow and temperature were monitored separately for each washer. All electrical circuits had separate dedicated watt hour transmitters.

This lab was initially focused on development of a dryer mounted exhaust air recovery system. On the dryers under test, each unit recovered approximately 40,000 BTU/Hour, producing a surplus of hot water for the washers.



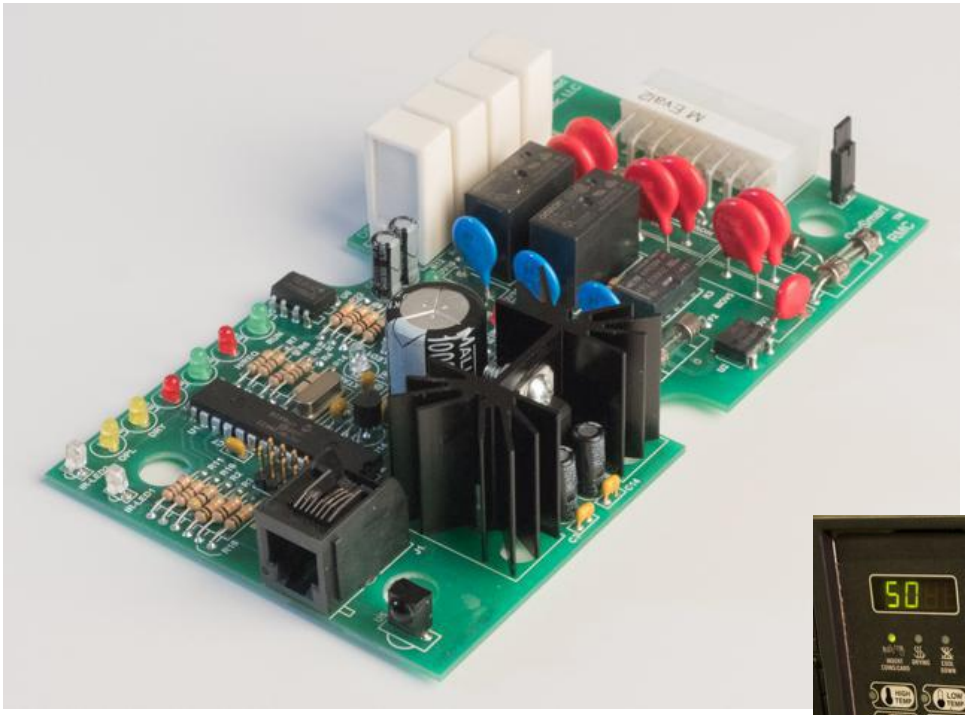
Data Acquisition Display

DrySmart

The laundry lab of the previous section was subsequently used for the development of *DrySmart,* a retrofit electronic residual moisture control (RMC) for commercial dryers. Most commercial dryers, unlike residential models, do not have automatic shutoff, they rely exclusively on a timer. As a result, these dryers typically run 10 ~ 12 minutes longer than needed. The DoE estimates that this wastes approximately 2.5 quadrillion BTU per year.

DrySmart is a plug and play device that installs in most commercial dryers in about 15 minutes. It determines laundry moisture content in real time, performing mathematical trend analysis on the gas valve cadence, and stops the dryer when the laundry is dry.

SPS performed the original R&D in the laundry lab, developed the moisture control algorithm, designed the electronic hardware, and wrote the firmware. We generated schematic capture, net list, and BoM, and supervised outside vendors, e.g., bare PCB foundries and contract assembly houses. DrySmart has been audited and approved for incentive rebates by eight major gas utilities.



Novel Child Car Seat

A lay client conceived a child car seat that is easily disassembled for cleaning in a conventional dishwasher. It has the added feature of storing flat in a briefcase style carry case.

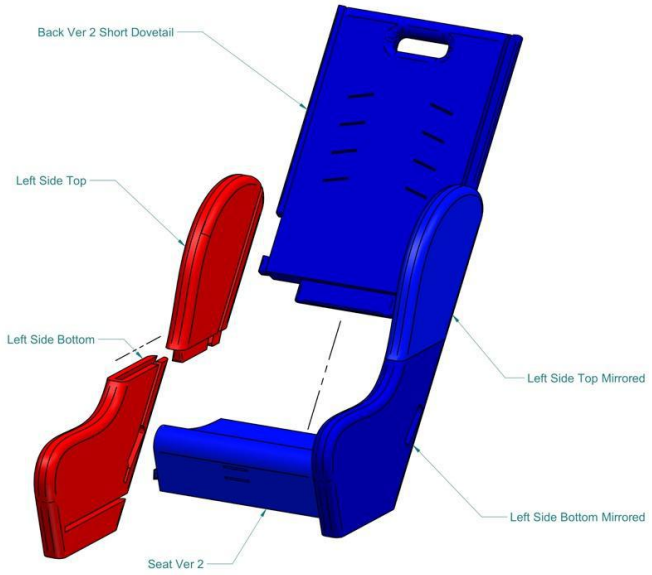
SPS engineered a practical design, produced functional prototypes, and had the design formally tested at an NHTSA certified crash test lab.

We developed a dovetail joint design that can be assembled and disassembled in about a minute with no tools, while meeting all requisite crash test specifications.

The design process comprised multiple iterations of FEA, modification and optimization, and full scale 3D printing.

We wrote the patent application and managed prosecution.

The completed design received a perfect NHTSA test score.



Child Restraint Alpha

HYGE Sled Test
Preliminary Data Summary

National Highway Traffic Safety Administration

NHTSA FMVSS TP213

Bottom Foam (2"x20" and 4"x20")	-	-	Back Foam (2"x24" and 4"x24")	-	-
Test	***Compliance Requirement***			***Test Result***	***Pass/Fail***
Structural integrity:	(S5.1.1(a) of CFR 571.213 2015) No Complete Separation			No Separation	Pass
	(S5.1.1(a) of CFR 571.213 2015) No Partial Separation with Exposed Edge Radius < 6.4mm (1/4")			No Exposed Edge	Pass
	(S5.1.1(a) of CFR 571.213 2015) No Partial Separation with Protrusion> 9.5mm (3/8")			No Protrusion	Pass
Adjustment Positioning During Impact:	(S5.1.3.2 of CFR 571.213 2015) No Change			No Change	Pass
Head Excursion:	(S5.1.1(a) of CFR 571.213 2015) Head CG not beyond the forward-most edge of the restraint system			Not Beyond	Pass
Max. Back Support:	(S5.1.4 of CFR 571.213 2015) Equal to, or less than 70 degrees			NA	NA
Thorax Acceleration:	(S5.1.2.1(a) of CFR 571.213 2015) Upper Thorax Resultant Acceleration to be < 60 G's or > 60 G's for a Total Accumulated Time of not More Than 3 ms (not applicable for tests using weighted 6-year-old dummy)			43.8	Pass
Head Acceleration:	(S5.1.2.1(b) of CFR 571.213 2015) Head resultant acceleration to be < 80 G's or > 80 G's for a total accumulated time of not more than 3 ms (not applicable for tests using weighted 6-year-old dummy)			39.3	Pass
Forward Head Excursion	(S5.1.3.1(a)(1) of CFR 571.213 2015) Allow any portion of the head to go more than 28.3 in. past Z-point			21.5	Pass
Forward Knee Excursion	(S5.1.3.1(a)(2) of CFR 571.213 2015) Allow knee pivot point to go more than 36 in. past Z-point			19.1	Pass

Waste Oil Recovery Facility

SPS designed a turnkey commercial facility for recovering water soluble waste oil from machining operations. The facility employed parallel settling tanks with custom designed floating skimmers, stratified sand filtration, and molecular sieve ultrafiltration. The discharge oil was resalable, and the discharge water stream was approved for direct sewer connection.

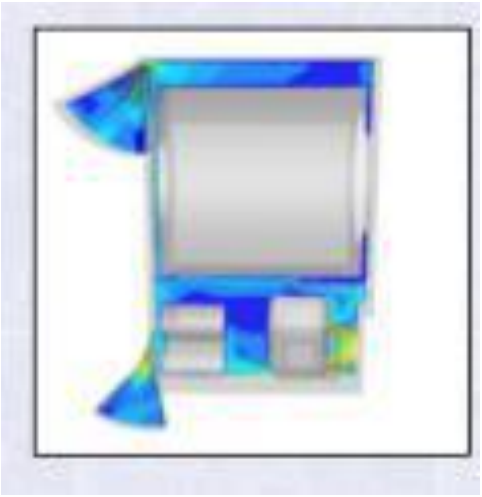
We designed all process flow, controls, specified components, and supervised a team of contractors, including concrete, electrical, and plumbing personnel. We wrote the facility documentation, and assisted with the state licensing process.

Heat Pump Clothes Dryer

SPS developed a novel heat pump clothes dryer, under contract with Eversource.

This dryer has the following salient features:

- Consumes less than half the energy of conventional dryers.
- Drying time is equal to or less than conventional dryers.
- Ventless, no makeup air, may be installed anywhere.
- Operates at very low temperatures, long fabric life.
- Generates all necessary hot water for a companion washer.



Initial development of a residential class dryer was completed early and under budget. Trade show quality prototypes were built and demonstrated to the Eversource board.

All prototypes were fully instrumented, and operation parameters recorded in real time.

After the Eversource contract was successfully completed, subsequent in house development of a 75 pound commercial version was completed, and the IP was licensed.

Self Service Gasoline Point of Sale System, Wireless Telemetry

SPS designed and prototyped a complete wireless telemetry system for self service gasoline stations. This system performs all the functions required by such installations. It transmits sale data to a central console, provides complete control of all pumps from the console, and provides voice intercom to the pump islands.

Because it is wireless, there is no need to close the station and dig up the yard; installation is exceptionally easy and inexpensive. The system is patented, and was sold to Gulf Oil.

Cordless Drill Drivetrain

A large manufacturer of power tools encountered serious noise and wear issues with the gear train of a new cordless electric drill. The noise was so severe, that production was halted, and the product was recalled.

SPS diagnosed the problem, identified two unrelated design flaws, and specified design changes. We provided drawing modifications, working prototypes of the new design, and detailed written documentation. The new design is very quiet, very reliable, and is less expensive to manufacture than the original.

Jet Engine & Turbine Wheel Spin Test Systems

These systems spin turbine wheels to destruction velocity, and precisely record the speed at which they explode. The manufacturer was experiencing difficulty with the automatic speed control, a critical issue in destructive testing.

SPS redesigned the digital PID speed control, providing precise regulation of a compressed air sourced 400 HP drive turbine. The new system controls a test wheel from startup to 120,000 RPM at <1% accuracy with zero overshoot.

Cycle time from idle to 120,000 RPM and back to idle is 11 seconds.

Fiber Optic Cable Production Process

SPS designed an automated hydrofluoric acid etch process for final cleaning of fiber optic preforms for a multinational telecom client.

The system comprised a series of vertical dip tanks that sequenced water wash, hydrofluoric acid dip, water rinse, and ethanol drying rinse. Preforms entered the system in dedicated carriers suspended from an all stainless steel overhead conveyor.

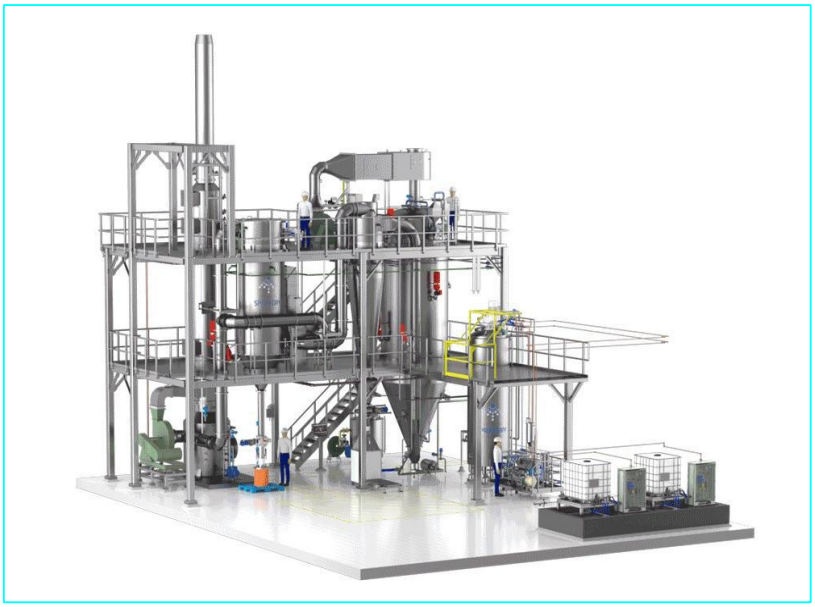
The system automatically indexed the carriers, lowered them into the tanks, timed the dwell, raised the carriers, and indexed to the next tank. Provisions for safe handling of hydrofluoric acid and ethanol were integrated into the system.

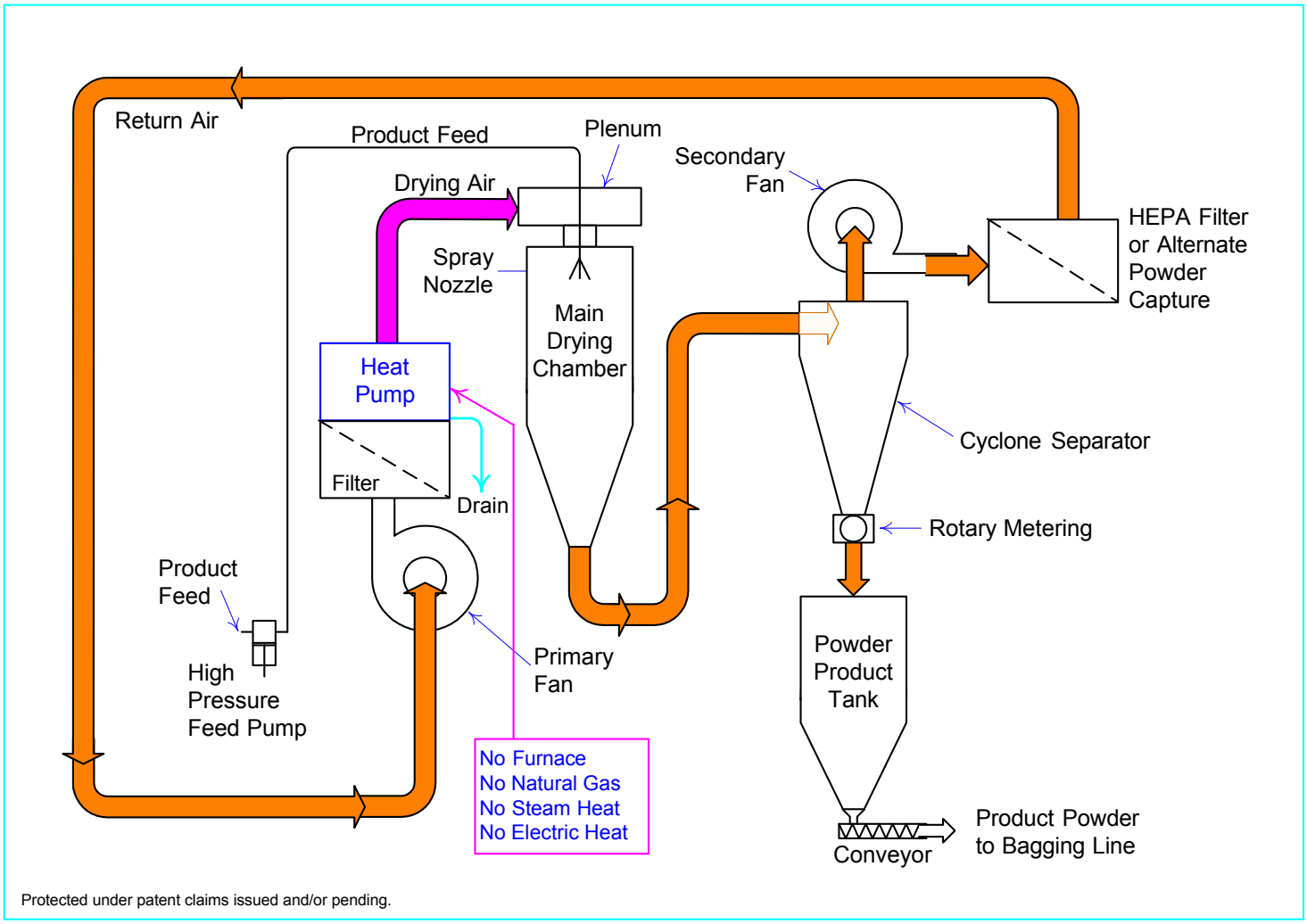
Typical Fiber Draw Tower

Heat Pump Closed Loop Spray Drying

Environmental Benefits, United States
Natural Gas Mitigation, Therms per Year: 7.7 Billion
CO_2 Mitigation, Tons per Year: 46.7 Million

End User Benefits, Food and Dairy Sector
Operating Cost Saved per Dryer Year: $1.2 Million
Typical ROI: < 3 Years





Protected under patent claims issued and/or pending.

Equals or exceeds conventional dryer performance, at low temperature, using half the energy.

United States Patent **3,897,887**

August 5, 1975

Remotely Controlling and Metering Liquid Dispensation

Abstract

A system for remotely controlling and metering gasoline dispensation includes a self-contained master console to be installed at a remote location and a package to be installed inside each controlled and metered pump with control and metering signals exchanged over the power lines on two tone-modulated carriers being an A channel for carrying volume and cost data signals from the pumps to the master console, and a B channel for carrying command signals from the master console to cause the designated pump to transmit volume and cost signals, and to cause power to be applied to the selected pump motor, and for carrying intercom control signals from the master console. Separate digital counters triggered by a pulser mounted on the mechanical computer inside the gasoline pump accumulate volume and cost data signals which are transmitted upon command to a shift register and then to the remote location. A logic circuit prevents simultaneous data transmission from controlled pumps.

United States Patent **4,603,489**

August 5, 1986

Heat Pump Closed Loop Drying

Abstract

A dryer includes a rotating drum having an inlet and an outlet. A blower withdraws air from the outlet. A heat pump has an evaporator and condenser interconnected by a compressor and an expansion valve. The outlet of the condenser is connected to the inlet of the rotating drum. The water collection tray drains into a sump having a sump pump. In a closed loop form the outlet of the rotating drum is coupled to the inlet of the evaporator and is thermally coupled to a wet air heat exchanger.

United States Patent **4,7444,228**
May 17, 1988

Agitatorless Clothes Laundering

Abstract

A washing machine has a stationary tub with drain outlets at the bottom periphery. A venturi conduit extends from the bottom of the tub opening upward along the axis of the tub to produce a toroidal flow of water in an open basket in the tub seated on an annular disk surrounding the venturi opening. The annular disk is mounted on rollers at the bottom of the tub and carries permanent magnets. An annular driving member also carrying magnets is located below the bottom of the tub surrounding the conduit connected to the venturi and carries permanent magnets opposite those on the annular disk inside the tub. A pulley at the bottom of the driving member is coupled by a belt to the pulley on a drive motor. A pump is connected between the venturi and the tub outlets. A selectively operable valve controls the flow of water between the venturi and a drain outlet. This assembly is contained in a cabinet having an opening covered by a lid. The opening is large enough to allow removal and insertion of the open basket. A companion dryer has a rearward tilted drum that receives the open basket with the laundered clothes. Alternatively, the dryer may have a lid that opens from the top with the basket inserted between stationary guides to rest on a carriage of rollers in the mid portion of the dryer cabinet. A drive motor drives the roller carriage which rotates the basket. When the lid is closed, a conduit is defined which passes drying air through the basket as it rotates.

United States Patent **5,416,569**
May 16, 1995

Electrographically Making Devices Having Electrically Conductive Paths Corresponding To Those Graphically Represented On A Mask

Abstract

Devices having conductive paths are fabricated by electrographically transferring conductive toner to an insulative copy sheet imaging desired conductive paths graphically represented by an electromagnetic signal. A system for making devices having electrically conductive paths corresponding to those graphically represented on a mask has an electrographic machine having electrically conductive toner and a bonder for bonding the electrically conductive toner to a copy sheet. An insulative copy sheet is configured to pass through the electrographic machine bonder and receive the electrically conductive toner only on paths corresponding to those graphically represented on the mask. The electrically conductive toner has a conductivity sufficiently high so as to provide electrically conductive paths along a copy sheet bearing an electrographically transferred image of the mask with the electrically conductive toner bonded to the copy sheet along the electrically conductive paths with the resistance between points along the conductive paths being many times less than that of regions adjacent to the electrically conductive paths.

United States Patent **7,055,262**

June 6, 2006

Heat Pump Clothes Dryer

Abstract

A drying apparatus for drying articles such as clothing is provided. The drying apparatus includes a chamber for containing articles to be dried and a system for supplying heated dry air at a first temperature to the chamber. The air supplying system comprises an air flow pathway having an evaporator for removing moisture from air exiting the chamber and for decreasing the temperature of the air to below dew point temperature. The air supply system further has a condenser for increasing the temperature of the air exiting the evaporator to the first temperature. The drying apparatus further has a heat pump system having a refrigerant loop which includes a compressor, the condenser, a TEV valve, and the evaporator.

United States Patent **7,665,225**

February 23, 2010

Heat Pump Clothes Dryer

Abstract

A drying apparatus for drying articles such as clothing is provided. The drying apparatus includes a chamber for containing articles to be dried and a system for supplying heated dry air at a first temperature to the chamber. The air supplying system comprises an air flow pathway having an evaporator for removing moisture from air exiting the chamber and for decreasing the temperature of the air to below dew point temperature. The air supply system further has a condenser for increasing the temperature of the air exiting the evaporator to the first temperature. The drying apparatus further has a heat pump system having a refrigerant loop which includes a compressor, the condenser, a TEV valve, and the evaporator.

United States Patent **8,550,562**

October 8, 2013

Washable Child Car Seat Subframe

Abstract

A child car seat subframe that is easily disassembled into component sections for washing within a residential-sized dishwasher. The car seat subframe can be disassembled by hand, and each individual component is capable of fitting in a residential-sized dishwasher individually and collectively. The component sections are attached by a combination of registration tabs and slots, and held tightly together by fasteners, or attached by a combination of tongue and groove joints. Hanging devices, such as hooks, may be formed on one side of each component section to facilitate hanging on racks in a dishwasher. The car seat subframe back panel and side panels are disassembled into a plurality of segments for easily fitting in a dishwasher.

United States Patent **12,130,083**

October 29, 2024

Heat Pump Closed Loop Process Drying

Abstract

Methods, apparatuses, and systems for a closed loop product drying process are disclosed. Heated dry air enters a drying chamber, extracts moisture from a product to be dried, and exits the drying chamber, cooler and wetter. A heat pump air handler dries and warms the air from the drying chamber exhaust, and returns it to the drying chamber, in a closed air loop. The heat pump air handler includes a dehumidifier means in the closed air loop flow path. The dehumidifier means removes entrained moisture from wet air exiting the drying chamber, reheats the air, and returns it to the drying chamber.