

Equipment Catalog 2025

Presses – Injection Systems – Molds Software 4.0 & Services



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COEXPAIR SERVICES AND PRODUCTS

Coexpair - Composites Expertise for Aircraft – leads the market of RTM & SQRTM equipment and technologies in partnership with Radius Engineering, USA. Coexpair combines equipment development and fabrication with engineering of composite parts. Our shop is the right location for equipment demonstration, training and first part production (no serial production).

Gathering a high level of aeronautics background and focusing our expertise on Out of Autoclave Net Shape Process (RTM, SQRTM, IPM), we offer a unique solution for the development of advanced composites for engine & airframe components. We transfer technologies to our customers so they enter smoothly and quicker in serial production.

- Engineering Services Design, Analysis, M&P
- Process Set-up to First Part Qualification
- Mold Design & Fabrication
- Equipment Injection Systems, Workstations (Presses), Software
- Trainings : 3 days introduction to RTM or SQRTM







RTM & SQRTM MOLDS

Design (130+ Mold designed at Coexpair)

The ambition of RTM mold design phase is to define molds that can produce a large number of parts, with a minimal production cycles and a low scrap rate. More than 30 years ago, Radius Engineering defined the design principles and criteria that make its molds as the reference on the market. The main advantages of the RTM molds we propose are described here after:

- Full impregnation is reached with only one inlet & outlet. This right level of impregnation is directly obtained without making a lot of injections (cost and time savings in comparison with other mold suppliers)
- High dimensional tolerance with a standard minimum of +/- 0.15mm on part thickness to ensure the right fiber volume fraction (V_f) everywhere in the part. Better tolerance is possible as needed ;
- State-of-the-art accessories to ensure high production rates (i.e. injection ports, provision for thermocouple, pressure and vacuum sensors, seals, de-molding features, hoisting point, thermal isolation)
- De-molding operation and related accessories optimized to avoid any damage to the tool or to the molded part
- Easy cleaning with no sharp radius, no resin trapped area, specific injection ports and polished surfaces
- Low scrap rate achievable when used in combination with Radius systems (injection and presses). Scrap rates of less than 1% is state of the art
- Project management by experienced team to design quality, give visibility to the customer (schedule, milestones, risk assessment) and the right follow-up of design and production. Delivery of high quality molds on schedule is our mission



EN9100 qualified design process



Part design for fabrication





Thermal simulation



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RTM & SQRTM MOLDS

Regarding **SQRTM**, the mold design is more complex than for RTM. For RTM, only about 60% of the composite material is present in the tool before injection (the fiber). But for SQRTM, more than 100% of the material of the part is present into the tool before closure (prepreg material features a little bit of resin in excess). The tool closure kinematics and usage of a floating bed pneumatic press has to be fully understood in the tool design.

One other key point is the resin runner sizing to allow filling of the mold on time. Also the sizing of the resin gates that will be used to pressurize the part is relevant. Kinematics, runners, gates and other parameters are always specific to a part geometry and size. These parameters cannot be easily extrapolated from one design to another.

Material

The molds we propose are manufactured out of steel or of a specific aluminum alloy selected for its mechanical performances up to 180°C (350°F) and for its capacity to sustain heating and cooling cycle without deformation. The selection of aluminum and the pre-machining operations we perform are the basis of the quality of large aluminum tools.

Qualified Machine shops (6)

The accurate machining is performed in partner shops we have selected and qualified to take part to the production of our molds. Working with partners ensure a good understanding of requirements between designers and operators, what is mandatory to produce unique parts like mold elements. This allows us also to provide quality assurance and for example three different measuring methods are used during the mold production stages.





RTM & SQRTM MOLDS

Finishing & Surface Treatment

Our mold elements are carefully adjusted so each element fits in its location for the whole life of the tool. This operation requires skilled operators who measure, compare and manually adjust the elements. Once all the mold elements fits perfectly together they are hand polished before surface treatment is applied. In case of Aluminum, hard anodizing gives to the mold element a scratch resistance equivalent to steel.



Maintenance and Repair



Analyse EBSD – Microscopie électronique à balayage



Our services includes maintenance and repair of our aluminum high-rate molds This includes edge notch repairs, surface damage repairs and full surface restoration. Advanced surface analysis for quality assurance.

Packaging – Turnkey

Our molds are carefully packaged to avoid any damage during transportation or unpacking at customer premises. The delivery includes the user manual with maintenance recommendation and all accessories needed to operate to tool immediately (seals, o-ring, screws, injection blocks, fittings, etc).





Series Overview

The advantages of our Presses come from 30 years of composite processing experience and equipment knowledge:

- Accurate Control of Heating and Pressure Parameters
- Reliability with Extremely Low Rate of Rejects Parts
- Fully Operational in Industrial Production Environment
- Compact Equipment
- Very Low Maintenance Cost. No Oil in Composites Shop
- Worldwide High Quality Support
- Accurate control of vacuum (0-27 mbar)
- Water Cooling systems on request
- <u>No foundation needed</u>, whatever the size.

7 Coexpair workstations are operating in 3 shifts at Spirit Aerosystems at exceptional availability rate and minimal maintenance cost.





BASIC PRESS 70 or 110 Tons



- Typically used for flat panel or small part production
- The clamping area is 1000mm x 650mm. Available Clamping force from 70 to 110 metric tons
- Threaded rod construction to quickly adjust the daylight between platens from 25mm to 400mm
- Insulation to reduce heat transfer into the bolsters
- 28 kW heating capacity. Maximum temperature is 200°C (390°F). Capacity sized to heat a 150mm thick aluminum tool @ 3°C/min
- Heating platens are flat and parallel to < 0,15mm. The maximum bolster deflection is <0,15mm under 10 bars clamping pressure (145 psi)
- Rotary vane vacuum pump with trap, valves and a 0-26 mbar (20 torr) vacuum transducer
- Tool loading / unloading station that includes an external 1,25m rail system



- Siemens S7-1515 PLC with Profinet communication to data acquisition computer
- Siemens 12" color touchscreen with trending
- 12 Tool thermocouple inputs (Type J)
- 15 step, ramp/soak heating profile
- Controller with recipe storage and recall from PC hard drive



- Floware[™] Software with integrated control and data acquisition for Injection Systems
- Electric Utility: 400 VAC, 3 phases, 50 Hz, 50 Amps
- Pneumatic Utility: 15/25 bar, clean, dry air
- The clamping station lies on 4 adjustable feet. Its installation could be done on any standard industrial floor (no need of construction work).

ELECTRIC DAY-LIGHT ADJUSTMENT

Typically used for flat panel or small part production, the electric daylight adjustment is perfectly adequate for production with variable tool thicknesses.





PRESS 195 Tons with WATER COOLING System



- Typically used for production where compacity and short cycle time is needed
- 72 kW heating capacity. Maximum temperature is 220°C (428 °F).
- The clamping area is 1,5m x 0,65m.
- Manual Tool loading / unloading station that includes an external 1,75m rail system
- Recipes, Tool TC monitoring, Floware[™] and data collection.
- Automation available : Master[™] synchronized injection and Maestro[™] SCADA system
- Rotary vane vacuum pump with trap, valves and a 0-26 mbar (20 torr) vacuum transducer
- Siemens 12" color touchscreen with trending
- 16 Tool thermocouple inputs (Type J)
- The clamping station lies on 6 adjustable feet. Its installation could be done on any standard industrial floor (no need of construction work).



PRESS 240 Tons with AUTOMATED TROLLEY



- Typically used for production in highly automated workshops.
- Welded upper steel bolster construction.
- 128 kW heating capacity. Maximum temperature is 200°C (390 °F).
- The clamping area is 2,4m x 1m.
- Automatic Tool loading / unloading station that includes an external 2,5m rail system.
- Recipes, Tool TC monitoring, Floware[™] and data collection.
- Automation available : Master[™] synchronized injection and Maestro[™] SCADA system
- Rotary vane vacuum pump with trap, valves and a 0-26 mbar (20 torr) vacuum transducer
- Siemens 12" color touchscreen with trending
- 12 Tool thermocouple inputs (Type J)
- The clamping station lies on 8 adjustable feet. Its installation could be done on any standard industrial floor (no need of construction work).



PRESS 400 Tons with Manual Trolley



- Typically used for production for high injection pressure.
- Welded upper steel bolster construction. The deflection of the upper bolster is less than 0,15mm/m under 25 bars air clamping pressure
- 128 kW heating capacity. Maximum temperature is 200°C (390 °F).
- The clamping area is 2,4m x 1m.
- Automatic Tool loading / unloading station that includes an external 2,5m rail system.
- Recipes, Tool TC monitoring, Floware[™] and data collection.
- Automation available : Master™ synchronized injection and Maestro™ SCADA system
- Rotary vane vacuum pump with trap, valves and a 0-26 mbar (20 torr) vacuum transducer
- Siemens 12" color touchscreen with trending
- 12 Tool thermocouple inputs (Type J)
- The clamping station lies on 8 adjustable feet. Its installation could be done on any standard industrial floor (no need of construction work).



PRESS 270 Tons with ELECTRIC DAY-LIGHT ADJUSTMENT



- Typically used for production with variable tool thicknesses
- Welded upper steel bolster construction
- The clamping area is 1,8m x 1,3m. The maximum bolster deflection is less than 0,125mm under 11 bars clamping pressure (150 psi).
- Electric bolster actuation using (6) electric screw jacks. Daylight from 25mm to 600mm
- Capacity to heat a 1800mm x 1320mm x 300mm aluminum tool @ 1,75°C/min with 84kW.
- Heating platens are flat and parallel to less than 0,125mm
- Available clamping force of 270 metric tons
- 5 metric tons wheeled tool loading / unloading cart with pneumatic docking to the press
- Siemens or Telemecanique PLC and controls with 12" color touchscreen
- PC with control and data acquisition software
- 12 Inputs for thermocouples type J
- The clamping station lies on adjustable feet. Its installation could be done on any standard industrial floor (no need of construction work).



PRESS 384 tons, LENGTH: 4.8 meters



- Threaded rod construction to quickly adjust the daylight between platens from 25mm to 500mm
- Welded upper steel bolster construction.
- 224 kW heating capacity. Maximum temperature is 200°C (390 °F).
- The clamping area is 4,8m x 0,8m.
- (optional) Automatic Tool loading / unloading station that includes an external 5m rail system.
- Recipes, Tool TC monitoring, Floware[™] and data collection.
- Automation available : Master[™] synchronized injection and Maestro[™] SCADA system
- Siemens 12" color touchscreen with trending
- 12 Tool thermocouple inputs (Type J)
- PC with control and data acquisition software
- The clamping station lies on adjustable feet. Its installation could be done on any standard industrial floor (no need of construction work). Installation could be done in 4 days on site.



PRESS 630 Tons with ELECTRIC DAY-LIGHT ADJUSTMENT



- Illustrating the modularity of our press concept, the 630 Tons press is an assembly of a 270 Tons press module and a 360 Tons module
- Welded upper steel bolster construction
- The clamping area is 4,2m x 1,3m. The maximum bolster deflection is less than 0,125mm under 11 bars clamping pressure (150 psi)
- Electric bolster actuation using (14) electric screw jacks. Daylight from 25mm to 600mm
- Capacity to heat a 4200mm x 1320mm x 300mm aluminum tool @ 1,75°C/min
- Heating platens are flat and parallel to less than 0,125mm
- Available clamping force of 630 metric tons
- 5 metric tons wheeled tool loading / unloading cart with pneumatic docking to the press
- Siemens PLC and controls with 12" color touchscreen
- PC with control and data acquisition software
- 12 Inputs for thermocouples type J
- Electric Utility: 400 VAC, 3 phases + Neutral + Earth, 50 Hz, 330 Amps
- Pneumatic Utility: 6 bar, clean, dry air



LARGE PRESSES 1400 Tons, 8 x 1.8 meters





- Press construction is scalable to large sizes
- Reliability & low maintenance costs
- Proven efficiency for serial production of RTM / SQRTM aerospace components



V-SHAPE LARGE PRESS 1500 tons, 12 x 1 meters WING OF TOMORROW SPAR - AIRBUS





- Lateral loading
- 12m long equipment workstation with aluminum mold



WORLD LARGEST PRESS FOR RTM AEROSTRUCTURES 4000 tons, 9 x 4 meters; 1000 Amps

Original MOLD concept for COMPLEX SKIN PANEL





THERMOPLASTIC PRESSES

- Thermoplastic Press for consolidation
- Single station or dual station

Radius Engineering Solution



Coexpair Multi-Stage Concept





Series Overview



Our Resin Transfer Molding (RTM) Injection Systems are the industry's premier injection systems, engineered with over 25 years of RTM processing expertise. Each system is designed to inject both single and multi-component resins while simultaneously providing precise PID processing control throughout.

Every injection system is built around our unique dual polyseal piston design that enables the low vacuum and high pressure processing required in RTM manufacturing. Standard models offered in either Electric or Pneumatic versions are available in capacities of 2100, 5000, or 10000 cc's. All injection systems can be customized to the specific application at hand. Additionally, we offer an innovative range of optional features such as resin degassing, end cap and line heating, and auxiliary sensor monitoring.

RTM Injection Systems provide the very best in injection process control worldwide

- Precision Design utilizes positive displacement piston for precise pressure and flow control. Every system is designed to achieves less than 0,13 mbar (0,1 Torr) vacuum sealing and 27,5 Bar (400 psi) pressure sealing at operating temperatures up to 180°C (350°F)
- Processing controls are provided by means of an industrial programmable logic controller (PLC) for the PID control of all injection system processes
- Real Time Data user-friendly displays of all injection processes are provided through the 11-inches Color Touch Screen controls interface. Complete system data acquisition is provided by Floware[™] software running on an external PC
- Injection Software Tools our toolkit streamlines the manufacturing process with features such as recipe creation for automated system settings, an automated vacuum leak rate calculator, a vacuum degassing timer, and a resin cure monitor



Control interfaces



Graphical data display



System Features



Positive-Displacement Design



In cylinder degasser



Vacuum piping with highprecision sensors

ELECTRIC SERIES

- Offered in standard volume capacities of 2100, 5000, and 10000 cc
- Pressure and Flow Control The system injects resin at a specified flow rate until the pressure approaches the set-point and then gradually reduces the flow rate as the mold is filled
- Heated Resin Cylinder for operations up to a maximum of 180°C (350°F)
- Positive-Displacement piston driven by a precision DC stepper motor
- Aluminum piston with dual polyseal design ensures vacuum and pressure integrity
- Inputs provided for (8) RTM Tool J-Type thermocouples
- PLC Control of all injection processes
- Complete Data Acquisition via Floware[™] software (provided).
 Floware[™] enables complete control of the injector from the external PC, as well as offering User Management & Recipe controls
- Simple piston access for quick and easy cleaning and maintenance

PNEUMATIC SERIES

- Lower priced version with the same specifications as listed in the "Electric Series" with the exception of resin flow control
- Positive-Displacement piston is driven by a pneumatic actuator
- Economy versions also available (offered without PLC control or DAQ)

OPTIONAL FEATURES (Electric and Pneumatic)

- In-Cylinder Degassing and high-quality vacuum system
- Heated Cylinder End-Plugs (SQRTM)
- High Temperature Processing
- UPS for Data



General Specifications

Capacities:	2100 / 5000 / 10000 / 15000 cc's
Model Versions:	Electric / Pneumatic
Pressure Rating:	Electric – 30 Bar (435 psi)
	Pneumatic – 17,0 Bar (250 psi)
Vacuum Rating:	< 0,13 mbar (0,1 Torr) Absolute Pressure
Flow Rate Rating:	Up to 750 cc/min
Max. Temperature:	180°C (350 °F)
Power Requirements:	380V - 3 Phases - 50 Hz (Amperage varies)
Typical Dimensions:	110 cm (L) x 110 cm (W) x 180 cm (H)
Typical Weight:	320 kg (800 lbs)





2,100cc PNEUMATIC RTM Injection System

The 2,100cc RTM pneumatic injector is a pressure controlled system, designed to inject single component or premixed multi-component resin systems.

- Pneumatic pressure actuates piston to inject resin at a 1.8:1 ratio
 - Maximum output pressure is 17 bar (250 psi)
- Heated resin cylinder and injection line sleeve (max temperature 180 °C (350 °F))
 - Maximum temperature of 180 °C (350 °F)
- Aluminum piston with two polyseals for vacuum and pressure integrity
 - Seal design for vacuum sealing to < 0.25 mbar (<0.2 Torr)

Data Acquisition System Option

- PLC based control of all injection processes
- 7.5" color touch screen for system control and monitoring
- of all injection parameters
- Local graphical trending of all injection process parameters
- Inputs provided for monitoring / trending (4) user provided tool temperature sensors
- Includes tool pressure transducer input and sensor
- Alarm display and history logging
- Serial communications via Profinet protocol
- Record Injection data, alarms and operator notes to the computer hard drive
- Operator can create, store and recall injection recipes
- Simplified part cure timing based on tool temperature sensors
- Floware software and PC for data logging of all injection system parameters and inputs including: pressures, flow rate, vacuum level, temperatures, events, alarms and operator notes





2,100cc ELECTRIC RTM Injection System

The 2,100cc RTM electric injector is a flow and pressure controlled system, designed to inject single component or premixed multi-component resin systems.

- Injects resin at a specified flow rate until the pressure approaches the pressure set point and begins to gradually slow the flow rate
 - Maximum resin pressure 27.5 bar (400 psi)
 - Maximum resin flow rate 500 cc/minute
- Heated resin cylinder and injection line sleeve
 - Maximum temperature 180 °C (350 °F)
- Positive-displacement piston driven by a precision DC stepper motor system
 - Maximum resin injection volume of 2,100 cc's
 - Fully retracts to 2,600 cc's to provide additional volume for in-cylinder degassing
- Aluminum piston with two polyseals for vacuum and pressure integrity
 - Seal design for vacuum sealing to less than 0.25 mbar (<0.2 Torr)
- 7.5" color touch screen for system control and monitoring of all injection parameters
- PLC based control of all injection processes
- Local graphical trending of all injection process parameters, Alarm display and history logging
- Inputs provided for monitoring and trending of (8) user provided tool temperature T/C's
- Includes tool pressure transducer input and sensor
- Serial communications via Profinet protocol
- Operator can create, store and recall injection recipes
- Simplified part cure timing based on tool temperatures T/C's
- Floware[™] software and PC for data logging of all injection system parameters and inputs including pressures, flow rate, vacuum level, temperatures, events, alarms and operator notes





5,000cc ELECTRIC RTM Injection System

The 5,000cc RTM electric injector is a flow and pressure controlled system, designed to inject single component or premixed multi-component resin systems.

- Injects resin at a specified flow rate until the pressure approaches the pressure set point and begins to gradually slow the flow rate
 - Maximum resin pressure 27,5 bar (400 psi)
 - Maximum resin flow rate 750 cc/minute
- Heated resin cylinder and injection line sleeve
 - Maximum temperature 180 °C (350 °F)
- Positive-displacement piston driven by a precision DC stepper motor system
 - Maximum resin injection volume of 5,000 cc's
 - Fully retracts to 6,000 cc's to provide additional volume for in-cylinder degassing
- Aluminum piston with two polyseals for vacuum and pressure integrity
 - Seal design for vacuum sealing to less than 0.25 mbar (<0.2 Torr)
- 7" color touch screen for system control and monitoring of all injection parameters
- PLC based control of all injection processes
- Local graphical trending of all injection process parameters, Alarm display and history logging
- Inputs provided for monitoring and trending of (8) user provided tool temperature T/C's
- Includes tool pressure transducer input and sensor
- Serial communications via TCP/IP with Profinet protocol
- Operator can create, store and recall injection recipes
- Simplified part cure timing based on tool temperatures T/C's
- Floware[™] software and PC for data logging of all injection system parameters and inputs including pressures, flow rate, vacuum level, temperatures, events, alarms and operator notes



10,000cc ELECTRIC RTM Injection System

The 10,000cc RTM electric injector is a flow and pressure controlled system, designed to inject single component or premixed multi-component resin systems.

- Injects resin at a specified flow rate until the pressure approaches the pressure set point and begins to gradually slow the flow rate
 - Maximum resin pressure 11 bar (160 psi)
 - Maximum resin flow rate 1000 cc/minute
- Heated resin cylinder and injection line sleeve
 - Maximum temperature 180 °C (350 °F)
- Positive-displacement piston driven by a precision DC stepper motor system
 - Maximum resin injection volume of 10,000 cc's
 - Fully retracts to 12,000 cc's to provide additional volume for in-cylinder degassing
- Aluminum piston with two polyseals for vacuum and pressure integrity
 - Seal design for vacuum sealing to less than 0.25 mbar (<0.2 Torr)
- 7" color touch screen for system control and monitoring of all injection parameters
- PLC based control of all injection processes
- Local graphical trending of all injection process parameters, Alarm display and history logging
- Inputs provided for monitoring and trending of (8) user provided tool temperature T/C's
- Includes tool pressure transducer input and sensor
- Serial communications via TCP/IP with Profinet protocol
- Operator can create, store and recall injection recipes
- Simplified part cure timing based on tool temperatures T/C's
- Floware[™] software and PC for data logging of all injection system parameters and inputs including pressures, flow rate, vacuum level, temperatures, events, alarms and operator notes





10,000cc ELECTRIC RTM Injection System – NEW 30 bars

The 10,000cc RTM electric injector is a flow and pressure controlled system, designed to inject single component or premixed multi-component resin systems.

- Injects resin at a specified flow rate until the pressure approaches the pressure set point and begins to gradually slow the flow rate
 - Maximum resin pressure 30 bar (435 psi)
 - Maximum resin flow rate 1000 cc/minute
- Heated resin cylinder and injection line sleeve
 - Maximum temperature 150 °C (320 °F)
- Positive-displacement piston driven by a precision DC stepper motor system
 - Maximum resin injection volume of 10,000 cc's
 - Fully retracts to 12,000 cc's to provide additional volume for in-cylinder degassing
- Aluminum piston with two polyseals for vacuum and pressure integrity
 - Seal design for vacuum sealing to less than 0.25 mbar (<0.2 Torr)
- 7" color touch screen for system control and monitoring of all injection parameters
- PLC based control of all injection processes
- Local graphical trending of all injection process parameters
- Inputs provided for monitoring and trending of (8) user provided tool temperature T/C's
- Includes tool pressure transducer input and sensor
- Alarm display and history logging
- Serial communications via TCP/IP with Profinet protocol
- Operator can create, store and recall injection recipes
- Simplified part cure timing based on tool temperatures T/C's
- Floware[™] software and PC for data logging of all injection system parameters and inputs including pressures, flow rate, vacuum level, temperatures, events, alarms and operator notes





15,000cc ELECTRIC RTM Injection System

The 15,000cc RTM electric injector is a flow and pressure controlled system, designed to inject single component or premixed multi-component resin systems.

- Injects resin at a specified flow rate until the pressure approaches the pressure set point and begins to gradually slow the flow rate
 - Maximum resin pressure 11 bar (160 psi)
 - Maximum resin flow rate 1000 cc/minute
- Heated resin cylinder and injection line sleeve
 - Maximum temperature 180 °C (350 °F)
- Positive-displacement piston driven by a precision DC stepper motor system
 - Maximum resin injection volume of 15,000 cc's
 - Fully retracts to 15,500 cc's to provide additional volume for in-cylinder degassing
- Aluminum piston with two polyseals for vacuum and pressure integrity
 - Seal design for vacuum sealing to less than 0.25 mbar (<0.2 Torr)
- 7" color touch screen for system control and monitoring
- of all injection parameters
- PLC based control of all injection processes
- Local graphical trending of all injection process parameters
- Inputs provided for monitoring and trending of (8) user provided tool temperature T/C's
- Includes tool pressure transducer input and sensor
- Alarm display and history logging
- Serial communications via TCP/IP with Profinet protocol
- Operator can create, store and recall injection recipes
- Simplified part cure timing based on tool temperatures T/C's
- Floware[™] software and PC for data logging of all injection system parameters and inputs including pressures, flow rate, vacuum level, temperatures, events, alarms and operator notes





25,000cc PNEUMATIC RTM Injection System

A 25,000cc pneumatic actuated injection station comprised of (2) two individual 12,500cc resin cylinders. The specifications of this station are provided below:

- (2) Two 12,500cc resin cylinder assemblies
 - Combined volume capacity of 25,000cc's
- Pneumatic pressure actuates the resin cylinder piston to inject at a 1:1 ratio
 - Maximum resin output pressure is 10 bar (150 psi)
- Injects resin at a semi-controlled flow rate until the resin pressure approaches the pressure set point and begins to gradually slow:
 - Typical flow rate control range from 400cc/min to 2000cc/min per cylinder.
 - Typical flow rate control range from 800cc/min to 4000cc/min for the system.
- Heated resin cylinder and injection line sleeve
 - Max temperature 180°C (350 °F)
- Dual polyseal piston design for vacuum and pressure integrity
 - Vacuum sealing to < 0.25 mbar (<0.2 Torr)
- 12" color touch screen for system control and
- monitoring of all injection parameters
- Inputs provided for monitoring and trending of (4) user provided tool temperature T/C's
- Local graphical trending of all injection process parameters
- Alarm display and history logging
- Serial communications via TCP/IP with Profinet protocol
- Floware[™] software and PC for data logging of all injection system parameters and inputs including pressures, flow rate, vacuum level, temperatures, events, alarms and operator notes





25,000cc ELECTRIC RTM Injection Station

A 25,000cc electrically actuated injection station comprised of (2) two individual 12,500cc resin cylinders. The specifications of this station are provided below:

- (2) Two 12,500cc resin cylinder assemblies
 - Combined volume capacity of 25,000cc's
- Injects resin at a specified flow rate until the resin pressure approaches the pressure set point and begins to gradually slow
 - Maximum resin pressure 11 bar (160 psi)
 - Maximum resin flow rate 1000 (cc/min) for each cylinder
- Heated resin cylinder and injection line sleeve
 - Max temperature 180°C (350 °F)
- Dual polyseal piston design for vacuum and pressure integrity
 - Vacuum sealing to < 0.25 mbar (<0.2 Torr)
- 12" color touch screen for system control and monitoring of all injection parameters
- Inputs provided for monitoring and trending of (4) user provided tool temperature T/C's
- Local graphical trending of all injection process parameters
- Alarm display and history logging
- Serial communications via TCP/IP with Profinet protocol
- Floware[™] software and PC for data logging of all injection system parameters and inputs including pressures, flow rate, vacuum level, temperatures, events, alarms and operator notes
- 2K automation available in option.





45,000cc ELECTRIC RTM Injection Station

A 45,000cc electrically actuated injection station comprised of (3) three individual 15,000cc resin cylinders. The specifications of this station are provided below:

- (3) Three 15,000cc resin cylinder assemblies
 - Combined volume capacity of 45,000cc's
- Injects resin at a specified flow rate until the resin pressure approaches the pressure set point and begins to gradually slow
 - Maximum resin pressure 11 bar (160 psi)
 - Maximum resin flow rate 1000 (cc/min) for each cylinder
- Heated resin cylinder and injection line sleeve
 - Max temperature 180°C (350 °F)
- Dual polyseal piston design for vacuum and pressure integrity
 - Vacuum sealing to < 0.25 mbar (<0.2 Torr)
- 12" color touch screen for system control and monitoring of all injection parameters
- Inputs provided for monitoring and trending of (8) user provided tool temperature T/C's
- Local graphical trending of all injection process parameters
- Alarm display and history logging
- Serial communications via TCP/IP with Profinet protocol
- Floware[™] software and PC for data logging of all injection system parameters and inputs including pressures, flow rate, vacuum level, temperatures, events, alarms and operator notes
- All documentation provided in the English language
- 2K automation available in option.





LARGE SYSTEMS – In Production Use & leasing available





Tri-cylinder platforms for large injection

3 x 45 L platforms + other standard cylinders (5L/10L)

120+ L injection capacity

are available for Buy or Lease

0 week lead time

subjected to availability



ADVANCED SYSTEMS 285°C & 2K-resin

5,000cc RTM HIGH TEMPERATURE Injection System

The 5,000cc High temperature RTM electric injector is a flow

and pressure controlled system, designed to inject single component or premixed multi-component resin systems.

- Injects resin at a specified flow rate until the pressure approaches the pressure set point and begins to gradually slow the flow rate
 - Maximum resin pressure 27 bar (391 psi)
 - Maximum resin flow rate 500 cc/minute
- Heated resin cylinder and injection line sleeve
 - Maximum temperature **285 °C** (550 °F)
- Positive-displacement piston driven by a precision DC stepper motor system
 - Maximum resin injection volume of 5,000 cc's
 - Fully retracts to 6,000 cc's to provide additional volume for in-cylinder degassing

2-Components Injection System

Coexpair injection system have a very accurate flow control which allows to build 2K-resin injection systems. A specific development box is also available.









In-Cylinder DEGASSING MIXER ASSEMBLY

The in-cylinder degassing assembly for injection systems allows for degassing, agitation, and heating of resin at temperatures up to 180 $^{\circ}$ C (350°F) directly inside of the resin cylinder.

- In-cylinder degassing attachment with integral mixing motor and resin thermocouple
- In-cylinder degasser and resin cylinder vacuum sealing rated to less than 0.25 mbar (0.2 Torr)
- Integration of a vacuum transducer inside of the injector control cabinet for monitoring of vacuum levels from 26 0.01 mbar (20 0.01 Torr)
- Corrosion resistant, dual-stage, rotary vane vacuum pump provided, capable of achieving <0.01 mbar (0.01 Torr) absolute pressure.
- Vacuum intake trap and vacuum line header
- Includes vacuum level data acquisition, real-time trending at injector and PC with 1-hour history, degassing timer software, tool leak rate calculator software



In-cylinder degassing head

SQRTM - Heated End Plug For Injection

The heated end plug is designed to provide PID controlled heat to the resin as it exits the injection system.

- PID temperature control to 180°C (350°F)
- Temperature controlled by injection system PLC
- Temperature recorded by injection system DAQ

On-Site Training & Support

This consists of one day of on-site support by Coexpair for equipment startup and operator training. On request, RTM simple parts can be typically fabricated after the commissioning the visit to demonstrate equipment operation and RTM processing.





CUSTOM Systems

RTM Degassing and Transfer Carts

- High Vacuum Level Degas (<0.1 mbar)
- 'PID" Temperature Controlled Resin Heating
- Dual Stage Rotary Vane Pump
- Available in 3.5 Liter and 10 Liter Capacities

Radius RTM Pail Injectors

- Inject pre-degassed resin directly from shipping pail
- "PID" Pressure Control and Platen Heating
- Gerotor pump for high volume & high pressure capability



3.5 Liter degassing station



20L pail injection system

Custom Injection Equipment

- We can offer completely customizable resin injection solutions based on project requirements
- Examples of Radius Developments Include:
 - Custom 1900 Liter Injection System
 - 25 Liter Resin Degas & Transfer Cart



Custom 1900L injection system

Degassing Station

- We can offer degassing stations with very high vacuum level
- Injection systems could be filled directly from the degassing station



2 bucket degassing station



Comparison Sheet

Radius Injection Systems provide superior operating and safety features compared to alternatives

Features Radius RTM SORTM Intection Systems Redus RTM SORTM Intections POTSYSTEMS Neter Mit Systems Description						
s	Injection pressures up to 27 Bar	0	-	X	0	High tolerance precision honed
li i	Precise flow rate control	0	x	x	x	components and unique dual polyseal
icat	(5cc/min up to 1500cc/min)	Ľ	^	^	<u>^</u>	design provides pressure (27 Bar) and vacuum (<0.1 Torr) sealing that is critical
cif	Flow rate resolution (1cc/min)	0	X	X	X	to the SQRTM/RTM processes and
be	Standard temperature range (180 C)	0	0	-	-	unmatched by competitors
	High temperature option (280 C)	0	X	X	X	
ji ji	Vacuum Sealing (<0.1 mbar)	0	Х	X	N/A	Radius is the only production proven
ech	SQRTM processing capability	0	Х	X	X	market
⊢	High viscosity resin processing	0	-	X	0	- mance.
	Low Exothermic Risk	0	-	X	0	Radius' control system constantly monitors
et	Low Burst Risk (Potential Energy Storage)	0	0	X	0	process values for exotherm identification
Saf	Automated Process Monitoring	0	X	-	-	and mitigation
	Direct In-cylinder Pressure Monitoring	0	-	0	N/A	

Radius Injection Systems offer full integration with Radius work cells and offer extensive design features

Features Radius RIM Competitor's Neter Mit Systems Description							
5	ion	Single PC control of entire workcell operation	0	X	X	X	Only Radius can offer fully integrated
	at a	Full integration with RTM press software	0	-	X	X	production proven SQRTM work cells.
	leg v	Complete workcell data-acquisition	0	X	X	X	Single source data acquisition and
2	<u> </u>	Similar controls components for easy maintenance	0	X	X	X	equipment control
		In-cylinder degassing option	0	X	-	N/A	Radius injectors are fully customizable with
		Auxiliary heating control option	0	-	X	-	auxiliary process options.
	Les	Auxiliary sensors for Tool temperature & vacuum	0	-	X	-	Unique Radius injector seal design allows
	atu	Touchscreen controls interface	0	-	X	X	for quick cleaning and injector turn around
	Fe	Compact size, easy to move	0	-	0	-	 Eliminates the need for large volumes of solvent for cleaning
	ign	Fast cleaning time (< 15 minutes)	0	-	0	-	Mechanical design is optimized to provide
	Des	Easy seal replacement / cleaning	0	-	N/A	N/A	the lowest possible level of maintenance.
		No large quantities of solvent for cleaning	0	0	X	X	Radius offers full 1 year warranty on all
		Low maintenance mechanical design	0	-	0	-	equipment



Coexpair develops its own software suite Floware[™] and Maestro[™] fully compatible with the control & follow-up of (SQ)RTM composite manufacturing process and adaptable to each customer requirements.

Simple Workstation

- Floware[™] is a SCADA (Supervision Control And Data Acquisition) software on each machine:
 - records crucial data on each equipment : process data such as temperatures, pressures, vacuum, volume injected, ... and alarms, events, operator notes
 - allows remote control of the machine
 - allows to create and recall recipes for the machine

Multi Workstations

- Maestro[™] is a centralized system which aggregates data, allowing to derive extra-value from them:
 - Live and post-manufacturing process follow-up
 - Automatic reporting with comparison with qualified curing cycle and tolerances
 - Statistics for manufacturing and predictive maintenance
 - Connectivity to central system such as ERP

From AFP to RTM/SQRTM

- One software suite for all your composite shop :
 - One screen for all your composite activities
 - Full traceability
 - Enhanced productivity





FLOWARE™: SCADA with local production data & recipes

Floware[™] is a high-performance and intuitive software to control Coexpair injection presses and systems. Designed specifically for Coexpair equipment, Floware[™] installs on any Windows PC and gives **complete control over composite manufacturing process**.

On its ergonomic Human Machine Interface (HMI), Floware[™] allows to:

- Record crucial data:
 - Monitor all parameters of your injection system in real-time: pressures, flow rate, vacuum level, temperatures, and much more.
 - Have a complete history for in-depth analysis of your processes.
 - Manage events and alarms: Floware[™] records events, alarms, and operator notes for perfect traceability and quick problem solving.
- Control injection remotely:
 - Take control of your injection system directly from your PC. Gain efficiency and accuracy with a clear and user-friendly interface.
 - Create and manage injection and press recipes:
 - Pre-program pressure and flow rate changes during the injection process with customizable recipes. Ensure perfect repeatability of productions and optimize your results.

Press	User: Injector ID: Data File: Log Interval:	John R-11-1303-A C:\Data\Test1_030311.csv 30 Seconds	Equipment St Injector:	atus Messages	Idle	Ingector Status Presi Contail Power © Conte Potos Home © Cucle- Invectori Active © Manua Deta Logging © Deta L	s Status d Power Active d Active d Active Locoling
0 *F		Totals Graphy L 100 - 100 <td>Aleren Her- Injertion</td> <td>Porter Linear Line</td> <td>Contrine Roles</td> <td>Telecter Nets [traph.lagen] Cylinder Nester Line Heater End-Riug Neeter Jogeton Pressure Tool Pressure Vaouen Cylinder Volume Resin Volume Enjected Resin Temperature Hasimum Tool Temperature</td> <td>Lone Actual 76 *F 0 *F 0 *F 0 PSI 0 PSI 21.0 tom 1.251 cc 0 *F 0 *F 0 *F</td>	Aleren Her- Injertion	Porter Linear Line	Contrine Roles	Telecter Nets [traph.lagen] Cylinder Nester Line Heater End-Riug Neeter Jogeton Pressure Tool Pressure Vaouen Cylinder Volume Resin Volume Enjected Resin Temperature Hasimum Tool Temperature	Lone Actual 76 *F 0 *F 0 *F 0 PSI 0 PSI 21.0 tom 1.251 cc 0 *F 0 *F 0 *F
Vinder On / Cft Ne On / Off On / Off Plug Setpo 75 75 75 75 75 75 75 75 75 75	int Actual +F 26+F int Actual +F 0+F int Actual +F 0+F	Injection Paramete Settoone Resin Flowrate Injection Pressure Tool Pressure Injection Volume Cylinder Volume	Actual 0 cc/min 0 PSI 0 9SI 6,749 cc 1,251 cc	Motic Setue Home Paton Zoro Ingetter Zoro Ingetter	n Commands Jonet Diem 1,251 cc Raw Value Scaled 0 PS1 0 PS1 0 PS1 0 PS1 STDP	Toolbox Leak Rate Dependent Initial Test Period 0.06 to Vacuum Level 0.00 to Reset Start Period	Can Time Actual 9 sec. 21.0 tom m/min

Floware[™]: an indispensable tool for efficient and controlled production.



FLOWARE™ Master: Multi-Equipment Synchronization

Floware[™] Master module allows perfect coordination between press and injection systems. No more juggling between different machines, the Floware[™] Master **automate the entire process** for an impeccable result.



Key features:

- **Synchronization screen** which allows following in real time the steps of the recipe for the injector and the press simultaneously.
- **Straightforward interface**: Screens allow easy selection of steps of the recipe to be synchronized.
- Automatic closing of outlet valve based on resin detection is also available.

Benefits:

- **Increased repeatability:** Get consistent and predictable results, reducing rejects and improving the quality of your parts.
- **Optimized traceability:** Track every step of the manufacturing process, from injection to demolding, for precise analysis and continuous improvement.
- **Maximized efficiency:** Free teams from repetitive monitoring tasks and allow them to focus on higher value-added activities. The Floware[™] Master alerts only when needed.





MAESTRO™: The power of data for composite production

Maestro[™] is a production data acquisition and exploitation software. It transforms production data into strategic advantage. It's a purpose-built data software designed to optimize your composite manufacturing from AFP to RTM/SQRTM injection.

Maestro[™] is specifically designed to aggregate composite manufacturing data from Coexpair presses, molds, and injection systems equipped with Floware[™]. This powerful tool **centralizes all your production** data in an SQL database, unlocking invaluable **insights and driving continuous improvement**.



Maestro[™] includes a web-based unified dashboard providing a clear, real-time view of the entire production process. No more manual data collection, no more disparate systems. Maestro[™] transforms data into actionable intelligence, empowering Materials and Process engineers, Quality Assurance and Maintenance teams to make informed decisions and optimize operations like never before.



Key Features:

- **Comprehensive data acquisition**: Captures a wide range of data points from injection systems, presses, vacuum and degassing stations, and more.
- Accessible anywhere: Maestro[™] is a web-based interface accessible from any device.
- **Real-time data:** LIVE synchronization with production equipment ensures to have the most up-to-date information.
- **Effortless statistics**: Centralized data enables easy analysis of multi-workstation data, such as all injections performed with a specific mold across multiple presses.
- **Automated traceability:** Streamlines QA validation, automatic reporting, KPI generation, and communication with ERP systems.



- **Composite at its core:** Maestro[™] is specifically designed for AFP, RTM and SQRTM processes. All analyses, traceability features, and parameters are tailored to these processes, eliminating the need to configure a generic system.
- Increased efficiency: Eliminate wasted time spent on manual data collection and analysis. Automated reporting empowers Material & Process and Quality Engineers to concentrate on root cause analysis of defects and production improvements: higher-value activities.
- **Cyber-safe:** Maestro[™] is installed on premise on a dedicated server safeguarding it from external threats.
- **Simplified maintenance:** Leverage statistical data for predictive maintenance, enabling better maintenance planning and reduced downtime.
- **Tailored solution:** As Coexpair develops its own software suite, Maestro[™] can be customized to meet your specific requirements and seamlessly integrated systems like ERP.



Maestro[™] : take full advantage of your composite manufacturing data. Maestro[™] makes analysis and reporting as efficient as your (SQ)RTM production!

CUSTOM EQUIPMENT

COEXDAQ – 48 TC & 2 Tool Pressure Sensors

Coexdaq is an external data acquisition system. It is useful to record large temperature and pressure data for monitoring of the process or heat surveys.

Key Features:

- Large quantity and variety of data acquired:
 - Display and recording of 48 TC type J.
 - Display and recording of two pressure sensors.
- Coexdaq can be networked with Coexpair presses and injectors.
- Coexdaq is **fully integrated** into Floware[™] software : Recording of the data is done in a common csv file (common to the press and injector) and can be reported to Maestro[™].

- **High traceability:** Data collection on a lot of inputs allow to have accurate measurements of tools and equipment.
- **Full integration:** Ease of data interpretation in a complete cycle.





Leak Rate Tester

Leak detection systems are specifically designed for our industrial equipment. This innovative system ensures precise monitoring, allowing for quick and efficient leak detection, thus minimizing downtime. It allows to test mold sealing inside clean room or molding area with very stringent criteria before going further into production.

Key Features:

- **Quick detection:** Our intuitive interface allows easily to know if the mold is within leak rate acceptance, ensuring rapid intervention.
- **High precision:** With state-of-the-art sensors, our system offers unmatched accuracy, reducing the risk of false alarms.
- Automated: Designed to easily integrate with your existing equipment, our system is compatible with a wide range of industrial machines and automates closing and opening of valves to check the leak rate accurately.

- **Cost reduction:** By detecting leaks quickly, the good condition of a mold can be check early and minimize hurdles in following steps.
- **Production optimization:** Less downtime means smoother and more efficient production.





Vacuum Forming Station – Custom Size

Our customs Vacuum Forming Stations are especially developed for R&D Laboratory, they are the perfect compromises between high quality manufacturing, flexibility and cost effectiveness. This main structure lifts and lowers a membrane (aero-qualified). In addition, the table allows a preform and a preforming tool to be easily moved in and out under the membrane.

Key Features:

- Maximum acceptable crank force : 100N
- Maximum acceptable force on the membrane: 7000N
- Vacuum Pump: This system allows to make high-quality vacuum under the membrane
- **Sensors:** traceability through 8 type-J integrated thermocouples in case of use in combination with preform heating system such as infrared lamps.
- Available size: up to 4300 x 2300 mm.

- **Cost management:** Specially designed for R&D laboratories, this equipment meets cost requirements, his highly flexible (a lot of different tools could be installed under the membrane).
- **Taylor made solution :** Made specifically according to your needs with high-quality standards.





FLOWARE[™] Master Box: Synchronizes one Injector & one External Press*

The Floware[™] Master box is a PLC and electrical cabinet which allows to synchronize Coexpair equipment such as injection system with non-Coexpair piece of equipment, such as an old press.

Key Features:

- **Real-Time synchronization:** Our advanced software enables press and injection systems to exchange data and steps of recipe
- **High Reliability:** With synchronization, the operational team is able to concentrate on the steps where he is needed, all the other steps are done automatically
- **Ease of Integration:** the Master[™] box is an additional electrical cabinet with PLC and HMI which could be fixed anywhere in your workshop

Benefits of our system:

- **Improved productivity:** no waste of time for manual synchronization of equipment's, full automation
- Simplified data management: one file for all your data
- Quality improvement: less human errors



*The press interface requires a feasibility study to make the solution compatible



Syncflow[™] Box – Multiple Injectors Synchronization

Syncflow[™] enables logical and intelligent synchronization between multiples cylinders during injection, with one cylinder as master and the others as slaves. For **large injection volume**, our solution synchronizes multiple injectors together like if they were a dedicated multicylinder. It's a flexible solution as cylinders can operate independently or for one dedicated injection, it's safer and fully automated.

Key Features:

- Automatization : Our advanced software enables injection systems to exchange data and steps of recipe. The Syncflow[™] box can also be connected to Coexpair press system to have one dataset for the injection.
- **Ergonomic solution:** Coexpair proposes a synchronization box containing a Siemens PLC and a screen 12", it's an intuitive and touch screen interface. This system is fully compatible with Floware™ local control.



- **High Reliability and Efficiency:** With synchronization, the operator is able to concentrate on the steps where he is needed, all the other steps are done automatically
- **Better manufacturing control:** Automatic recipes are key for success for large volume injection.



Mold Lid Reverser – 1000 mm to 2400 mm

The mold lid reverser is a station to clean, hold and rotate the lid (upper part of the tool). This station allows better accessibility and visibility on lid molding surface.

Key Features:

- **Ergonomic and safe**: All our designs (design, calculations, etc.) are based on the European CE standard (Machinery Directive).
- **Flexible:** our design is compatible with various tools within 1000mm to 2400mm. Custom design is available on request.



ltem	Description	ltem	Description
1	Mold support on crank side	5	Gratings
2	Distance adjustment pin	6	Fixed lid reverser support
3	Mold support	7	Manual Crank for max operator force 100N with 5000kg mold
4	Removable lid reverser support		

- **Cost Reduction:** Simplify the work and the handling by your operators.
- Adaptability: The design is suitable for a range of tool in a production with multiple references or could be dedicated.



ENGINEERING

Net-shape composites are an opportunity to improve performances: lower weight, lower cost, shorter manufacturing cycle. We support you by engineering for optimal performance, starting from functional requirements through to design for manufacturing (DFM).

ANALYSIS

Our Skilled Engineers are experienced with Samcef and Nastran FEA (static, stability, dynamic, thermal). They are distinguished by their hands-on experience of manufacturing (SQ)RTM parts themselves. Their engineering approach is built on understanding the key process elements that impact mechanical performance. Allowables generation including test campaign definition is also part of their job.



DESIGN

Designers use Catia V5 modeler both for composite part design and for tool design. The position of the office inside the prototyping facility gives the designer a great opportunity to combine 3D models and hands-on trials.





MATERIALS & PROCESSES

At the heart of our engineering services there are the selection of material and the set-up of process parameters for (SQ)RTM. Manufacturing of flat panels for coupons is a common task; tools are available in different sizes and thicknesses. More complex tools are used to validate the process and mechanical performances at higher level (sub-element level).



RTM & SQRTM PROCESSES

RTM (Resin Transfer Molding):

- Uses dry reinforcement to make preform
- Tooling is generally steel or Aluminum, on all surfaces
- Resin is thoroughly degassed and vacuum is drawn on tool
- Low viscosity RTM resin, < 500 cps, infuses entire preform
- Resin pressure maintained at 7 to 8 Bar during cure

SQRTM (Same Qualified Resin Transfer Molding):

- Allows use of program-specific prepreg ("same qualified"), including toughened systems such as Hexply 8552 [®], Hexply M21 [®], Cycom 977 [®], Cycom 5250-4 [®] BMI, Toray 3900-2 [®] (BMS 8-276)
- Fabrics or UD tapes previously laid by hand or using automatic devices (AFP, ATL)
- Tooling is Aluminum, steel or Invar
- High vacuum is drawn on tool
- As tool is heated, small quantity of prepreg resin is injected into tool to fill tool cavity around edges of part and maintaining resin hydrostatic pressure at 8 9 Bar during cure









FIRST PART FABRICATION

SQRTM Nose Landing Gear (NLG) door – Collaboration with Safran-SLCA



Coexpair provided:

- Project Lead
- Design
- Engineering support
- Molds
- Training

RTM Engine Lower Pressure Booster – Safran-Techspace Aero



Coexpair and Radius provided:

- Engineering support
- Molds
- First Parts Fabrication

SQRTM Pressure Floor – S.A.B.C.A.



Coexpair and Radius provided:

- Engineering support
- SQRTM Molds
- First Parts Fabrication



FIRST PART FABRICATION

Automated Fiber Deposition Services and Equipment Clean Zone Workshop Coexpair Dynamics Area





INTEGRATION RTM / SQRTM WORKSTATION

- We propose a fully integrated solution for the production of aerospace RTM and SQRTM parts.
- We design and manufacture all the shop core equipment: Mold, Press, Injection Systems.
- We are the architect of all needed auxiliary equipment.





Fully integrated composite shop (picture from Albany Engineering)



INTEGRATION AFP/ATL – COEXPAIR DYNAMICS

For Automated Fiber Deposition services and equipment, you can contact Coexpair Dynamics.

Coexpair Dynamics works in collaboration with Partnership with TSS Albany (previously: Automated Dynamics). Their technology is available for thermoset prepregs, dry fibers and thermoplastic prepregs. With more than 100 machines in 17 countries, their solid experience ensures a continuous development of the AFP head over more than 25 years.



Assembled in Belgium, the automation relies on precise CNC control. Coexpair Dynamics is recognised as Solution Partner of Siemens. Both Robot or Gantry solutions have ergonomic interfaces, large HMI and are piloted through Sinumeric One.







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