The RJG *eDART* System™
A true breakthrough in the science of injection molding data acquisition

In the mid nineties, RJG, Inc. was a prosperous and growing data acquisition company which believed in molding from the *plastic's point of view*. Instrumentation was utilized to not only teach this concept but also apply it on the molding floor.

Several pioneering companies that worked with RJG, such as Lucent Technologies, Cascade Engineering, Prince Corporation (now JCI), Ford/Visteon, and ITW were polled as to what was necessary to make process monitoring and control technology simpler to implement. RJG completed extensive marketing analysis and determined that there were several issues to overcome prior to shop floor personnel easily accepting data acquisition and process control:

- **An intuitive understanding of the data was needed.** Graphical analysis, a wonderful tool for engineers and advanced technicians, is intimidating to many people because they struggle with how to interpret traditional "XY" graphical data.

- **The techniques of instrumentation have to be more user-friendly.** There was a great deal of aversion to the nuts and bolts of instrumentation, such as plugging things together into the proper channels, zeroing, and calibrating. It really seemed like people had to be instrumentation technicians in order to implement data acquisition and process control systems.

- **Sensors and data acquisition equipment have to be self-checking.** Transparent complexity has to be incorporated in order for the equipment to sort out its own problems.

- **The process of interfacing with machines needs to be easier.** Sequencing signals (or "triggers") to synchronize the data with the molding machine were often hard to get, especially signals such as fill time. Besides, machine manufacturers do not utilize a universal approach when determining these signals, so there were problems comparing fill time data derived from the signals of different machine makes.

Although all of these impediments could eventually be overcome by tenacious individuals, most molders would simply give up.

In addition, other areas needed to be addressed, such as:

- **Custom-tailored programs for special applications are necessary.** This must be done without large development costs.

- **Some people require only a few channels while others may require many.** These channels need to include not only sensors, but also outputs to the machine process and other devices such as remote pagers or reversing conveyors.

- **Use fail-safe alarms for three-way part containment.** This will allow the segregation of not only "good" and "bad" parts, but also parts that might be considered "abnormal" or "suspect".

- **Calibration is also an issue**. When does a sensor have to be recalibrated and how do we know?

- **Linearize signals when necessary to turn relatively poor data into high quality information.** A real hope and dream for users is to have the ability to take virtually any type of output, even a non-linear output, and create good usable information.

- **Have a system with enough intelligence to be able to guide the user into a *solution* rather than simply presenting *data.*** This is also a need expressed by many experienced users, because talented plant floor personnel, capable of interpreting the data are frequently not available.

- **Users also want a system that can be totally transparent to the user** in that it can even change the job and download the setup automatically on a machine-independent basis when a mold is put into a press.

Call to Development

We at RJG put our heads together and started the development of the *eDART* System™. We started from scratch. We did not simply develop the data engine and the software, but started with the sensor, knowing that in order to simplify the elements of the process, including setup, calibration, cabling and linearization, the sensor must be the starting point.

We developed the concept of the Lynx™ sensor, which is the first truly digital sensor for the industry. The Lynx sensor takes data, linearizes it, and provides it in a digital form to a local area network on the machine, developed expressly for both sensor inputs and signal outputs such as alarms, analog and digital signals to the machine and part diverters, etc. This allows both input and output devices to reside on a single cable network. For instance, even a mold employing 16 sensors, has only one cable going to the outside world. In addition, the sensors were given intelligence. They know what they are. They can also be set-up to know what mold or machine they are attached to and when they need to be calibrated to conform to ISO, QS or other required standards.

Digital sensors greatly reduce susceptibility to noise and eliminate signal loss problems associated with low-level signals and long cable lengths. Taking the long cables off of the analog sensor is a breakthrough in simplicity from the standpoint of industrial noise getting into signals. Virtually any signal or type of phenomena can be conditioned using a Lynx device. RJG also offers Lynx devices that take analog signals (such as 0-10 volts, 4-20mA, etc.) and convert them on the spot. Lynx devices include a digital stroke velocity encoder, cavity pressure sensors (both flush mount and ejector pin styles), hydraulic sensor, and Lynx devices to convert conventional strain gauge and piezioelectric sensor signals. There are also Lynx outputs such as programmable alarm light stack outputs as well as Lynx outputs to transfer machines, provide alarms, abort processes, and inhibit machine cycles. These output devices all allow the system to interface with the outside world for inputs and outputs to accomplish specific system needs. Remember, all of this is done with a digital local area network at the machine. All Lynx devices (both inputs and outputs) reside on a single-cable local area network at the machine. This is truly a revolutionary concept.

The *eDART*™ Production & Process Controller

With Lynx devices serving as the foundation, the next important consideration is to connect the data engine to the network. It is important that this data engine incorporate each of the following:

- It must be extremely powerful with an operating system that is truly fail-safe.
- It must be an operating system that is real-time.
- It must be rugged for the harsh industrial environment of the molding floor.
- It must have computing power to process at high speeds, taking data at rates as high as 1,000 points per second per channel. It must be able to process this data into useful information in microseconds, when critical process control is necessary.
- It must be totally configurable and must include automated configuration when applied to the network. This means that if a system component is replaced or installed on an existing network, there is virtually no setup required.
- It must be configured in such a way that it is flexible and will not become obsolete in the foreseeable future.
- It must be configurable as a stand-alone device, as well as have the ability to be interconnected to Windows-based host networks.
- It must have the flexibility to have data displays at any and all machines as necessary, but the system should also be capable of operating with a limited number of data access sites and not be hampered by the lack of display at every machine.
- In addition, as an important point of development, all network cabling approaches must be proven, standardized systems, both hardware (cabling) and protocol. This allows customers to utilize standard available hardware to configure the systems in the field. This will also minimize the need for continued interaction with RJG application support.

All of these parameters have been incorporated in the *eDART* System™

***eDART*™ Software**

Last but not least, the system has to be built on powerful, modular software configured in an intuitive fashion so that the user need not spend hours, days, or weeks just to understand the tools. Taking RJG's mission statement to the extreme, the *eDART* software was developed totally from the *Make Molding Simple*™ point of view. Working with displays that can be read at a glance for both process and production information, with animation and same-shot data display, the entire focus of the system is to *"Make Molding Simple"* on the shop floor.

Process control applications, such as sequencing valve gates, controlling cavity pressure, and injection unit retrofit control (to name a few), are possible quickly and easily with this approach. The key advantage of *eDART* software is error detection, especially from sensors, so that when problems arise, the appropriate output can be generated to either stop the process, abort injection, or alert personnel that a problem exists. Often, warning alarms go off well before problems occur in the molded parts themselves. This allows for a proactive response so personnel can head off bad parts before they occur.

One of the most powerful features of the *eDART* software is its ability to derive actual parametric data about the process from a combination of the sequences in the process data and put it into a standardized or normalized format that applies to all machines. This makes it unnecessary to have all of the signals (such as fill, pack, hold, cooling, etc.) come from the machine. The system takes what is easily available from the machine and derives the rest. This is important when implementing a network or installing on a portable basis because many times the signals are just not readily available.

Finally, the system is open-ended. While tremendous development has taken place up to now (in the words of John Paul Jones, we "…have not yet begun to fight"), the system is becoming more and more powerful and capable as time goes on. There have been *eDART*s running in production shops for more than three years now and they have met with excellent success, even in shops where other data acquisition systems failed because of their complex nature.

In future developments the *eDART* System will evolve to include application software for customer applications such as gas counter-pressure, gas assist, machine analysis, and hot runner balance controls (to name a few). More intelligence will be built in to the system to further simplify the use of the system and to improve performance on the shop floor. All of this is part of RJG's continuing strategy to convert process *data* into useful information.