A Guide to

# Extruder Upgrades

FOR

# EVERYONE

Sound Advice from Extruder Control Specialists!

## Building A Case for Capital Budgets!


INTEGRATED CONTROL TECHNOLOGIES

www.integratedcontroltech.com

Second Edition

# Introduction to the Guide

Integrated Control Technologies (ICT) has developed “A Guide to Upgrading Extruders for Everyone” in order to assist plastic manufacturers in creating a plan for how to have a successful extruder upgrade. Whether your role is corporate engineer, plant manager, plant engineer or plant maintenance, our hope is that you will find the information useful and that you would consider our company as a potential resource when planning an upgrade.

Integrated Control Technologies was established in 2008 with locations in Dallas and Houston and specializes in the after-market drive and control upgrades of plastic extrusion equipment. ICT is a member of the Plastics Industry Association and has been featured in articles within Plastic News, Plastic Technology and Plastic Machinery magazines. Our company is a regular participant in the National Plastics Expo (NPE), Extrusion Conference as well as many other conferences as they relate to the plastics industry. We have a large installed product base with satisfied customers throughout the United States within the plastics industry including some Fortune 500 companies.

ICT has developed many products specifically for the plastics industry including:

ACPAK® - Pre-Engineered AC Extruder Drive Package
RDI – Remote Drive Interface now also with the SMART-UP ASSISTANT option
TEMPCOM ® - Extruder Control System
GENESIS ® - Extruder Control System for PC Based and Single-loop upgrades

These products have been applied in various applications throughout the plastics industry including Pipe, Profile, Blown Film, Cast Film, Sheet, Foam, Wire and Cable. Our team of engineers can work with you to customize these products to meet the needs of your specific application. Our products are built in a UL508A Panel Shop and have a manufacturing process procedure which guarantees that our products are manufactured to the highest possible standards.

ICT strives to be the best choice for drive and control upgrades for extruders. This guide serves as a standard for the things that we believe to be essential in vendor and product selection.

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# Chapter 1

# Build a Case for a Business Upgrade

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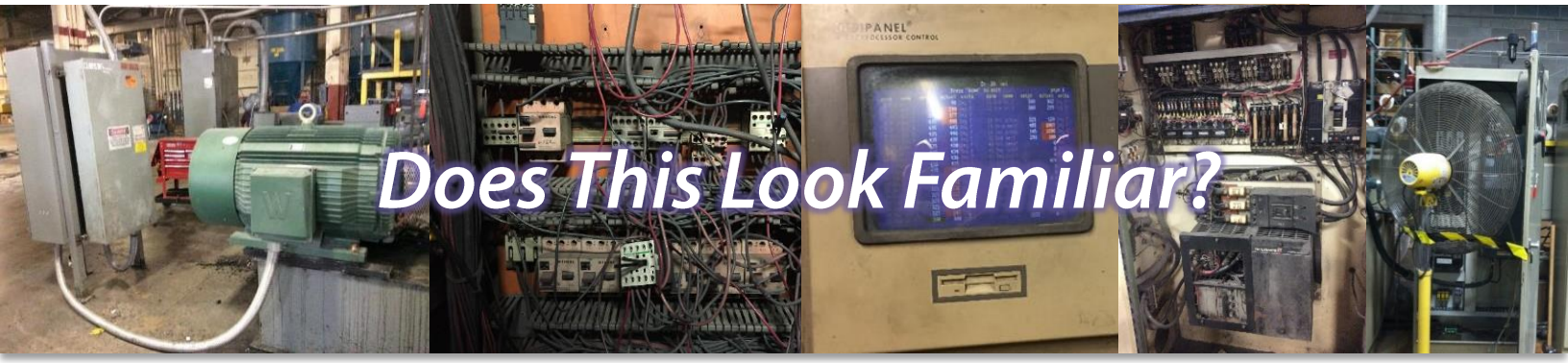
- Identification of Obsolete Controls
- How to Justify a Line Upgrade
- Funding Projects with AC Energy Savings
- FAQ: When Converting from DC to AC Drives
- Building the Business Case to Submit

Most people fail for one of two reasons: they fail to plan or fail to execute. The best choices are never made under duress, but without a plan, those decisions can be financially catastrophic to the bottom-line.

ICT has put together this guide to assist our customers in better planning for the inevitable, extruders will fail over time. The surprising part of that statement is, many times it can be predicted. This guide was prepared to assist you in building a business case that prioritizes the risk and helps you make logical recommendations to allow your company to make the best overall decisions. This chapter deals with the components that are needed in that plan to build such a case.

## What Is a Risk Assessment?




You may know exactly what is inside your electrical panels, or you may have only been told, but effectively communicating risk can be difficult, especially when the line is down. In business, it is essential that a plan is developed that consistently measures equipment on a scale that is logically derived to rank and predict the associated risk for downtime and its impact.

The Risk Assessment Form is provided, and may be modified, to gain a consistent baseline measurement of your extrusion line in order to rank the overall risk on a scale for comparison to other such lines.

DANGER

It should be noted, that in all cases, violations of the National Electric Code (NEC) or where there is a safety concern that has a potential for risk of life or limb, these should be corrected immediately to avoid injury or death. NEC violations should NOT ever be in operation and have significant implications for liability!

# Risk Assessment Form

**Although plastic machinery may be operating, it doesn't mean that there is not a significant risk to extended downtime. The following is a means of measuring risk and determining the urgency of your need for an upgrade:**

## Answer the following Questions

| | YES | NO |
|---|---|---|
| Is your system in violation of the National Electric Code or a safety concern? (Systems from China, Taiwan, and those done internally are suspect) | ☐ | ☐ |
| Is the extruder more than 20 years old? | ☐ | ☐ |
| Does the manufacturer of the extruder no longer exist or been purchased by another company? | ☐ | ☐ |
| Does the manufacturer of the control system consider it obsolete and no longer available? | ☐ | ☐ |
| Are any of the software or components used in the control system considered obsolete? | ☐ | ☐ |
| Are some portions of your extruder control non-operational? | ☐ | ☐ |
| Are you using eBay as one of your suppliers? | ☐ | ☐ |
| Has the door ever been left open with a fan blowing in the enclosure? | ☐ | ☐ |
| Has there been any undocumented changes to the extruder control system? | ☐ | ☐ |
| Is your control wiring outside wire ducts making troubleshooting difficult? | ☐ | ☐ |
| Does the extruder control system contain mercury relays? | ☐ | ☐ |
| Has the screw ever been damaged because an operator started into a cold zone? | ☐ | ☐ |
| Has there been a run-away heater condition that caused damage or downtime? | ☐ | ☐ |
| Are there DC Drives and Motors in use on the extruder? | ☐ | ☐ |
| Have you experienced more than 3 days of unscheduled downtime because of a maintenance issue? | ☐ | ☐ |
| Does someone come in early to pre-heat the extruder? | ☐ | ☐ |
| Is process data collected by hand? | ☐ | ☐ |

***Total Number of "Yes" Answers*** _____

| ***Low*** | | ***Medium*** | | ***High*** | | | | ***Very High*** | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ |

***Low Risk*** = Your need is not urgent
***Medium Risk*** = You have a need and should start the planning process
***High Risk*** = Your need is urgent and you should try to upgrade your line within the next few months
***Very High*** = Your need is critical and you should upgrade your line immediately

# Identification of Obsolete Controls

Identifying obsolete things are often easy when dealing with familiar objects such as cell phones or laptops, but it should be noted that many of the systems in operation today were installed during the infancy of such products. Operating an extrusion line on a DOS or Windows 95/NT/XP platform is not only a risk, but it may be next to impossible to support. Moreover, many manufacturers obsolescence's are due to the pace of technology that has left the potential for repair behind due to subcomponents no longer being manufactured. There are several quick methods to identify obsolescence, but you should know which electrical components are most critical in the operation of an extruder.

## Critical components

- ☑ Extruder Control System
- ☑ Programmable Logic Controller (PLC)
- ☑ AC Variable Frequency Drive
- ☑ DC Extruder Drive

TIPS

There are several ways to easily identify if an item is obsolete. If the manufacturer is no longer in business, if the webpage for the vendor identifies the product as obsolete, the only way you can obtain parts are through buying it on eBay, or if you are forced to repair the item through a third-party.

## Reference of obsolete controls

*Extruder Control Systems*[1]

| | |
|---|---|
| **DIGIPANEL** | Harrel Incorporated |
| **EPIC I & II** | Davis-Standard |
| **EM1 & EM2** | Eurotherm |
| **EXTROL 6000** | Battenfeld Gloucester |
| **MC2 & MC3** | Krauss Maffei |
| **ULTIMA II & III** | Welex |

*Programmable Logic Controllers (PLC)*

| | |
|---|---|
| **PLC 2, PLC 5** | A-B/Rockwell |
| **ALL-SYMAX** | SQD/Schneider |
| **ALL PLCs** | Texas Instruments |
| **Series 90-30** | GE |
| **M4** | Opto 22 |
| **Modicon** | Prior to Schneider |

*DC Drives*

| | |
|---|---|
| **All DC Drives** | Reliance, Saftronics |
| | FINCOR, Avtron, GE |
| | Warner SECO |
| **1370 & 1395** | A-B/Rockwell |
| **590** | Eurotherm |
| **Mentor/Quantum** | Control Techniques |

*AC Drives*[2]

| | |
|---|---|
| **1336 Plus** | A-B/Rockwell |
| **ACS600, ACS800** | ABB |
| **G3, G5, F7** | Yaskawa |
| **ALL AC Drives** | Saftronics, GE |

[1]Although the control system is no longer available, it may be still supported. Contact the manufacturer for more details.
[2]AC Drives over 10 years old should be taken out of service or have capacitors replaced and have thermal compound reapplied on the semi-conductors

# How to Justify a Line Upgrade

Although you understand that it may be a good idea to upgrade an extrusion line due to the risk and obsolesence, there may be people within your organization that would require preparing or composing a business case to justify the upgrade. To do this, it is important to understand machine efficiency and machine profitability. Machine efficiency is the percentage production time of the machine as compared to available production time. Low production time results in lower machine efficiency.

$$\textbf{Machine Efficiency Percentage} = \frac{\text{Production Time}}{\text{Available Time}} \text{ X } 100$$

Both external and internal forces can affect production time. For this purpose, we will focus on internal forces such as downtime, scrap, product change-overs and scheduled maintenance. If sales are good for that machine, these internal forces can drive costs up reducing machine profitability. Unfortunately, most companies do not have accounting information broken down for the operational cost of the machine, so this may be something that you will need to create.

There are several things that add up to the overall production cost of a machine, some are fixed costs and others are variable. Fixed costs are the building, utilities, labor, insurance, administrative overhead, etc. and variable costs are materials, scrap and downtime. The difference between costs and total revenue is profit or return on sales (ROS) which ranges between 5-10%. Although this is the average, machine performance will vary making some machinery more profitable to operate than others. You will probably need the assistance of someone within your accounting department or a production manager to help you breakdown the overall operating cost of the line you are proposing to upgrade. After you have established the operating cost, you can apply the revenue and determine the profitability of the line.

There are two areas that an upgrade can affect. It can affect a fixed cost in utilities and it can reduce the variable cost of downtime and maintenance. You can save between 10-15% on utilities if you convert your DC motors and drives to AC motors and drives on your extruders. This information can be obtained by an energy study, which can be conducted by Integrated Control Technologies, or it can be estimated based upon DC motor speed and load, as explained on page 5 of this guide. Fluctuating variable costs relating to downtime and repairs can be frustrating because of its impact on monthly or quarterly profits as they are unpredictable. Compounding the issue is that the revenue stream is interrupted and the fixed costs remain the same while some variables go up. This creates a loss which will continue long after the machine is running again.

One of the key reasons for an upgrade is to reduce downtime and increase production time which increases overall machine efficiency. Therefore, the overall cost of downtime must be calculated based upon both applied fixed and variable costs. If there is a 10% Return on Sales (ROS) on the line it will take 10 times the number of days down before the line becomes profitable again. For example, if the line is down 3 days, it will not be profitable for 30 days given a 24/7 work schedule.

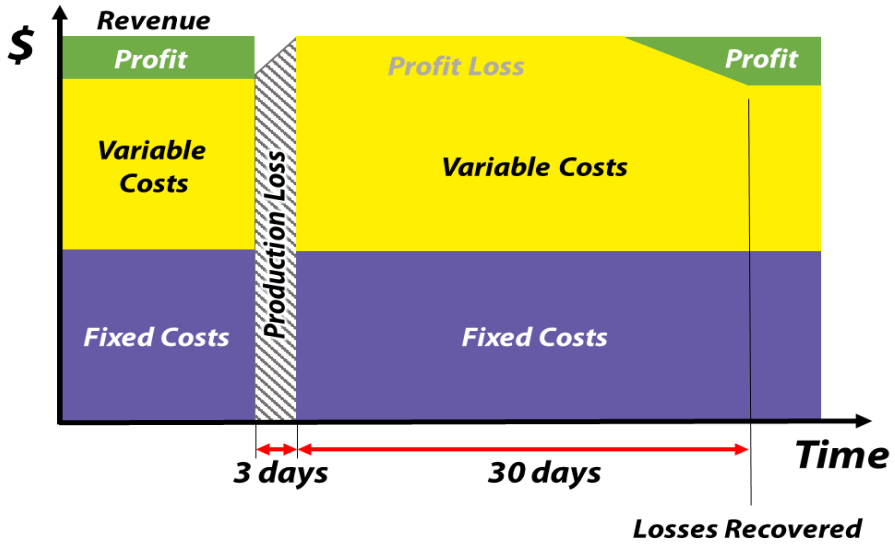
A justification should contain fixed and variable costs of each downtime occurrence as well as provide predictive downtime. This is accomplished with a risk assessment such as that provided in this guide. High Risk indicates the frequency of the downtime will increase with longer durations. This increase could be two to three times that of the previous year because of the risk factor. You have heard it said, “If it’s not broke, don’t fix it”, but the real question is “If it breaks, can you fix it?”. Identifying risks and quantifying the loss associated with that risk is key in justifying an upgrade.

# How to Justify a Line Upgrade (Cont'd)

There are other risks associated with the increased frequency and durations of downtimes such as the loss of customers. This is a real risk if the line in question is producing a dedicated product that is not replicated on another line. This is a non-tangible although it's important to mention when building a case.

The cost of downtime is the sum of all the fixed and variable costs plus the projected profit for the days not running. For example, if a line cost $5,000 a day to run and made $500 of profit a day, the cost of downtime would be $5,500 per day.

The following chart is an illustration of the cost of downtime and the delay in recovering loss:





GOOD IDEA

## A good business case should contain the following:

- ☑ Risk Assessment
- ☑ Improved Throughput on Machine Efficiency
- ☑ Return on Investment (ROI)

A good business case for a retrofit usually has a ROI of less than three years. To calculate the ROI, multiply the number of days the line was down for unscheduled maintenance by the cost of daily downtime. Then, divide the cost of the project by the total cost of the downtime. This would represent the ROI if it were done currently. Unfortunately, past performance is not a guarantee of future results, especially if the line is considered High Risk. Therefore, extending the length and duration of downtime is justified in helping to build a good business case.

$$\textbf{Current ROI (years)} = \frac{\text{Upgrade Cost}}{\text{Cost of Downtime/year}} \qquad \textbf{Projected ROI (years)} = \frac{\text{Upgrade Cost}}{\text{Projected Cost of Downtime/year}}$$

Although an upgrade may not increase the pounds per hour of plastic produced, it will increase throughput because of higher machine efficiency. To calculate improved throughput, multiply the number of downtime days by the number of hours the line runs during the day and multiply that by the pounds per hour the line typically produces. The result would be the additional number of pounds produced that year.

# Funding Projects with AC Energy Savings


SAVINGS

The rising cost of energy is one of the largest challenges facing domestic plastic manufacturers today. Energy costs continue to rise, squeezing plant profitability. Unfortunately, many plant managers feel their only option is to negotiate with energy providers and have not focused their attention on how they can improve energy efficiency in the extrusion process. Principles and strategies are presented here that show how to reduce electrical energy costs for the extrusion process.

For most plastic extrusion manufacturing facilities, approximately 1/3 of the energy consumed can be attributed to extruder motors. If the extrusion line is more than 20 years old, it is more than likely that a direct current (DC) motor is being used as the extruder motor. There is a desire by many plastic manufacturers to convert from their older DC motors and drives to AC because of the reduced maintenance; i.e., DC motor brushes require a high level of maintenance. Most manufacturers, however, are unaware of the additional benefits associated with energy savings for AC motors.

## Difference in efficiency

There are three things that affect energy differences between the two technologies, the first is efficiency. Efficiency is defined as the percentage ratio of Power Out over Power In as seen below:

$$\textbf{Percent Efficiency} = \frac{\text{Power Out}}{\text{Power In}} \text{ X } 100\%$$

There is more than a 5% efficiency difference between a new DC motor and a new AC motor. As the DC motor ages and it is rewound and reworked by motor shops, it declines in efficiency and the gap between the two technologies widens creating efficiency differences as much as 15% in some cases. The efficiency difference can be determined in an energy study although a good estimate is a 10% difference if the DC motor has been to a motor shop. Higher efficiency reduces the amount of kilowatts (kW) it takes to operate the motor. Efficiency savings can be estimated using the following calculations:

**Example 1** Comparing the efficiency of a 300 HP DC and AC Motor System

Knowns:

| | |
|---|---|
| 1 Horsepower = 0.746 kW | Operating Parameters = 80% Speed, 80% Load |
| DC Motor = 82% Efficient | Annual Hours of Operation = 24 hours x 7 days x 50 weeks = 8400 |
| AC Motor = 92% Efficient | Cost per kWh = $0.065 (As found on your utility bill) |

$$\textbf{300HP DC Motor} = \frac{\text{HP x 0.746 kW x \%Speed x \% Load}}{\text{\% Efficiency}} = \frac{300 \times 0.746 \times 0.8 \times 0.8}{0.82} = \textbf{174.7 kW}$$

$$\textbf{300HP AC Motor} = \frac{\text{HP x 0.746 kW x \%Speed x \% Load}}{\text{\% Efficiency}} = \frac{300 \times 0.746 \times 0.8 \times 0.8}{0.92} = \textbf{155.7 kW}$$

$$\textbf{Energy Savings} = \textbf{DC} \text{ Motor Energy} - \textbf{AC} \text{ Motor Energy} = 174.7 - 155.7 = \textbf{19 kW}$$

$$\textbf{Annual Savings} = 19\text{ kW} \times \text{Annual Hours of Operation} \times \text{Cost kWh} = 19\text{kW} \times 8400\text{ hours} \times \$\,0.065$$

$$= \textbf{\$10,374.00 per year}$$

# Funding Projects with AC Energy Savings (Cont'd)

## Difference in power

In addition to efficiency, another concern surrounding energy costs is the power factor. Power factor is defined as the ratio of true power (kilowatts) to apparent power (kilovolt amperes) as calculated in the following equation.

$$\textbf{True Power Factor} = \frac{\text{True Power (kW)}}{\text{Apparent Power (kVA)}}$$

Energy providers are very concerned about manufacturers operating with a good power factor and many penalize industrial manufacturers by adjusting their billing upward if it falls below 0.9 or 0.95. Hence, why many providers may encourage power factor correction capacitors. The reason they don't like poor power factor is that the current and power factor are inversely proportional. In other words, more current is required to do the same amount of work with a poor power factor, which requires power companies to have higher capacities in power production. Therefore, the energy provider usually bills for kilowatt-hours (kWH) and peak kilowatts (kW) with an adjusted charge to the peak kW for a poor power factor.

The power factor for a DC motor and drive system can be calculated as follows:

$$V_{dm} = \frac{3\sqrt{3}Vm}{2\Pi}$$

$$\textbf{Power Factor} = \frac{V_{dc}}{V_{dm}}$$

$V_m$ = Peak Phase Voltage = 1.414 ($V_{AC\text{-}rms}$)

$V_{dc}$ = Measured Armature Voltage

### Example 2

A DC motor with a 500 Vdc armature is operating at 75% speed and its measured armature volts is 375Vdc. The line voltage measured at the DC drive terminals is 480 VAC-rms. The power factor for this example is calculated using Equations (2) and (3) as follows:

$$V_{dm} = \frac{3\sqrt{3}\,(480)\,(1.414)}{2\Pi} = 562_{dm}$$

$$\textbf{Power Factor} = \frac{375_{dc}}{562_{dm}} = 0.67$$

The power factor of an AC Vector drive ranges between 0.90 and 0.98. If an AC drive and motor were operating under the same conditions as the previous example, there would be more than a 20% difference

# Funding Projects with AC Energy Savings (Cont'd)

in power factor between an AC and a DC drive and motor. A 20% difference in power factor translates into a 20% difference in current draw. The installation of an AC drive system will improve the overall power factor and reduces the need for power factor correction capacitors, thereby reducing utility penalty charges from the energy provider. The way you can tell if you are being charged for a poor power factor is to look on your utility bill. If you see your power factor listed anywhere on your bill you are probably being charged. This is the portion of the bill that is listed as "Peak kW Charge". Often utilities will increase the kW charge based upon a poor power factor. The method of how it is calculated varies with different utilities. At a minimum, a savings can be calculated based upon the kW difference between AC and DC drives and motors. In the previous example, there was a savings of 19kW of which the savings can be calculated as follows:

***Peak kW Charge*** = *$7.50 (As Found on Your Utility Bill)*

***Energy Savings*** = *19 kW*

***Annual Savings*** = *(Peak kW charge) x (Energy Savings) x (12 months) = $7.50 x 19 kW x 12 =* ***$1,710.00***

Different utilities use different methods in how they charge for a poor power factor. Contact your local utility to get details on how a poor power factor would affect your bill.

## Difference in $I^2R$ losses

Lower currents reduce the $I^2R$ heat losses that occur in transformers and wires from the point of power distribution to the DC drive. The biggest contributor to these losses is the isolation transformer. A DC drive requires an isolation transformer, while an AC drive only requires an input line reactor. The impedance of an isolation transformer is about 5% which converts to a resistance of 0.033 ohms. The $I^2R$ loss can be calculated using the following example:

Continuing with the 300 HP example

Known: AC Amps Measured at the input of the DC Drive = 397 A AC

***$I^2R$*** = *$(397 \text{ Amps})^2 \times 0.0330 \text{ ohms} = 5.2$ kW*

***Energy Savings*** = *5.2 kW*

***Annual Savings*** = *5.2 kW x (Total Hours operated in a year) x (Cost kWh) = 5.2 kW x 8400 x $0.065*
= ***$2,840.00 per year***

## Total energy savings

The total energy savings is the sum of the efficiency savings, power factor savings and the I2R savings. In this example it is calculated as follows:

***Total Savings*** = *$10,374.00 + $1,710.00 + $2,840.00 =* ***$14,924.00 annually***

The average Return on Investment (ROI) is approximately 2 years when energy is combined with DC motor maintenance costs. Contact Integrated Control Technologies for further questions or for an energy study.

$$\textbf{Total ROI} = \frac{\text{Cost of the Upgrade to AC}}{\text{Total Energy Savings} + \text{DC Motor Maintenance} + \text{Cost of Downtime}}$$

# FAQ: When Converting from DC to AC Drives

TIPS

There are some great benefits in converting from a DC motor and drive to an AC on an extruder. Converting to AC improves efficiency reducing utility costs as well as reduces downtime resulting from both scheduled and unscheduled maintenance. Making a mistake can be costly, therefore having a good understanding of what needs to be considered in an upgrade is important. The following is a list of common questions asked when considering an upgrade:

## Do I need to oversize my AC drive?

No. You do not need to oversize the drive and motor when converting to AC, as long as you are using the right drive and motor and you are not over-exciting the field of the DC motor to increase torque. AC Vector Motors have a wider (CTSR) constant torque speed range (1000:1) as compared to DC motors (10:1). This indicates that it can maintain torque at lower speeds without overheating. Also, AC Vector motors usually have a constant blower fan with filter similar to DC mounted opposite the shaft-end of the motor.

## Are AC drives rated the same as DC drives?

No. DC drives are all "Heavy Duty Rated" for applications such as extruders. AC Drives are both "Normal Duty" and "Heavy Duty" rated. Normal Duty is for pumps and fans and has a 110% overload capacity for one minute, while Heavy Duty is for applications such as extruders which has an overload capacity of 150% for one minute. Therefore, be sure to request AC drives with a Heavy Duty rating of the horsepower that you require.

## Do I need tach feedback?

No. The speed regulation of a DC drive is 0.5% with a DC tach, while the speed regulation of an AC drive in Open Loop Vector is 0.2%. Although, an encoder is required on applications associated with web and tension control such as primary and secondary nips or application requiring high precision such as medical tubing.

## Can I put the AC drive in the same enclosure as my DC drive?

Doubtful. Just because it fits, does not make it a good idea. AC drives have different heat ratings than DC and the drive may overheat in the same enclosure. This is especially true in applications that are greater than 100 horsepower. The watt loss of the drive can be obtained from the manufacturer to determine if there is appropriate cooling.

## What specifications are important when installing an AC drive in a new enclosure?

The enclosure should be a NEMA 12 free-standing flange disconnect enclosure with a circuit breaker. There should be ample room for an AC line reactor and blower motor starter. It is also a good idea to have the keypad operator mounted on the door. If the heatsink is not extended out the back of the enclosure, it will require air-conditioning. A good solution is a pre-engineered drive package such as the ACPAK from Integrated Control Technologies.

## Is there a limit of how far away I can mount the AC drive from the motor?

Yes. Distances greater than 150 feet require special provisions to ensure motor reliability which will increase the cost of installation. It is best to mount the drive close to the motor instead of in a control room that is too far away.

## Can I increase throughput?

Maybe, this is more dependent on your mechanics such as your gearbox and screw than the drive and motor. If the gearbox and screw can take the additional torque and speed, then it is possible to increase the horsepower proportional to the speed resulting in more throughput.

# FAQ: When Converting from DC to AC Drives (Cont'd)

## Can I use my existing meters for speed and load display?

Doubtful. Only if it is a newer DC drive that uses 0-10VDC as an output for speed and load. Older DC drives use shunt resistors and the meters would not be compatible. If the meters need to be changed, a good option would be the Remote Drive Interface (RDI) from Integrated Control Technologies.

## Is there a physical difference in the size of the AC motor and DC motor?

Yes. This is especially true when using a NEMA frame motor. The overall height of the motor as well as the shaft height will be greater resulting in the need to lower the base. A good solution would be the Reliance RPMAC motor which is built in a frame similar to that of a DC motor, reducing the amount of physical work required in a conversion..

## Does the motor require special bearings in a belted application?

Yes. Roller bearings are required for belted applications above 75 horsepower as opposed to the standard ball bearings.

## What are bearing currents and can they reduce the life of bearings?

Yes. Bearing currents can reduce the life of bearings in an AC motor. They are caused by stray magnetic flux that induces a voltage on the shaft which discharges through the bearing causing pitting. These currents can be mitigated by using such things as the AEGIS shaft-grounding rings, an extruder duty motor from ICT or the G7 drive from Yaskawa.

## Should I remove my isolation transformer?

Yes. DC drives require isolation transformers, while AC drives only require AC line reactors. Removing the isolation transformer will increase floor space and reduce kW.

## What problems will I run into if I wait until my DC motor fails before converting to AC?

An emergency conversion will always cost more than one that is planned. In addition, there may not be product availability, especially if it is a larger horsepower that requires an enclosure. In such situations, Integrated Control Technologies stocks extruder drive packages and motors through 500 horsepower available for shipment within 24 hours.

## What is the best AC drive to use in a conversion?

If the criteria is the best availability, highest quality, least failures with good pricing, we recommend the Yaskawa AC drive. It is manufactured outside of Chicago and used by many extruder manufacturers and is considered a standard by many within the plastics industry.

## Can I replace my 1150 RPM DC motor with a 1750 RPM AC motor?

No. While the HP of the drive remains the same, the torque necessary to turn the shaft is based upon the following formula:

$$\textbf{TORQUE} = \frac{HP \times 5250}{SPEED}$$

**Example** Comparing 200HP Drive paired with different motors


IMPORTANT

$$\textbf{TORQUE} = \frac{HP \times 5250}{SPEED} = \frac{200 \times 5250}{1150} = \textbf{913.04 ft-lbs}$$

$$\textbf{TORQUE} = \frac{HP \times 5250}{SPEED} = \frac{200 \times 5250}{1750} = \textbf{600 ft-lbs}$$

*Available from* ***Integrated Control Technologies***

# ICT AC Extruder Drive Package

ACPAK®

**UP TO 500HP**

**SHIPS IN 24HRS**

## EFFICIENT THERMAL DESIGN

- No Need for Air Conditioner
- Longer Component Life
- 70% Reduction in Heat

## YASKAWA GA800 DRIVE

- No Need to Upsize HP
- No Isolation Transformer
- PF Correction Not Needed

## COVERED LINE REACTOR

- Eliminates Iso-transformer
- Reduces Heat Losses
- Limits Energy Losses

## RELIANCE RPM-AC MOTOR*

- Better Speed Regulation
- Can Mount Under the Barrel
- Less Power Consumption
- Fits in Old DC Space
- Better Insulation
- Filter Kit Included


## DOOR MOUNTED DRIVE INTERFACE

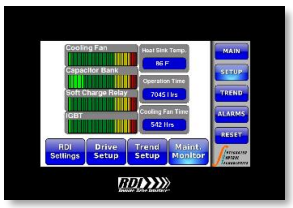
- Mounted on the Door
- No Need to Open Door
- Monitor Drive Status
- View Alarms

## COURTESY WIRING PANEL

- Pre-Wired Blower Starter
- Control Transformer
- Drive Control Connections

## ARC FLASH OPTION

- Remotely Mounted Breaker
- LED/Probe Verification
- No Power in Panel




## REMOTE DRIVE INTERFACE

- Control or Monitoring
- Drive Health Screen
- Trending
- Alarms and History
- Gearbox Calculator
- 7’ Touchscreen

★ ***PRE-ENGINEERED DESIGN***

★ ***HUNDREDS INSTALLED!***

★ ***100-500HP IN STOCK!***

★ ***NO AC REQUIRED***

* RMPAC Motor has a 2 year manufacturer warranty

# New Product Announcement

# SMART-UP ASSISTANT

COVID-19 RESPONSE

Creating break-through products that open the door to better manufacturing

When travel restrictions and visitor policies prevent a technician from starting up your drive, what you need is a smart-up assistant! The best way to start up a drive without a technician or manual!

## WHAT IS IT?

Integrated Control Technologies (ICT) is offering a product enhancement for the Remote Drive Interface that works with the ACPAK® that allows customers to start-up their AC drive package themselves with the expert assistance of ICT.

## WHAT DOES IT DO?

The SMART-UP ASSISTANT takes you step-by-step through the start-up of your ACPAK. In addition, ICT can connect to your drive and verify the settings. No one else is offering this!!!!

## WHAT IS INCLUDED?

- Ewon – For Remote Startup and Troubleshooting Support
- Software with Step-by-Step instructions with Pictures!
- Yaskawa Bluetooth Operator Interface Option
- 7” Color Touchscreen
- RDI Features
  - Speed and Load Monitoring
  - Fault Log
  - Trending
  - Drive Health Monitor



## Exclusively offered in the

# ACPAK®

AC EXTRUDER DRIVE PACKAGE

# Building the Business Case to Submit

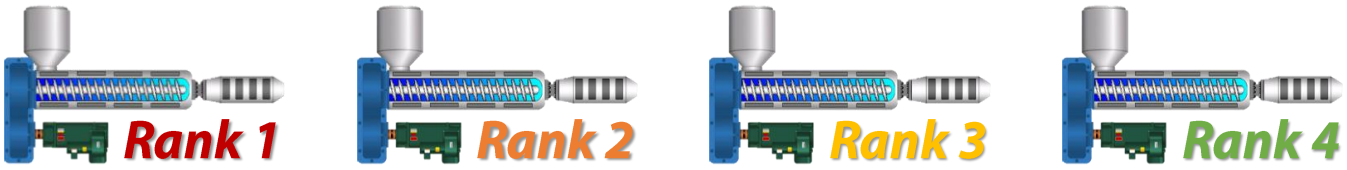
The final step in this process is to gather all the information into a single document that presents your findings. The results should allow for easy prioritization of needed work and identify a sense of urgency for those things that appear to jeopardize the net profitability of the company or compromises overall safety. Finally, you need to summarize the results and present your recommendations

## EACH extrusion line should have the following information and supporting documents:

- ☑ Completed Risk Assessment Form
- ☑ Identification of Critical Components that are Obsolete and Unsupported
- ☑ Machine Efficiency Calculation
  - ☑ Include Downtime Days and Reasons
- ☑ Machine Net Profitability
  - ☑ Include Losses Due to Downtime (Lost Production)

Business Objectives should never be made alone and should always include those items needed by management, operations, maintenance and operators. When there is complete "buy-in" for an upgrade, there is a better chance of a successful adoption and transition of the new control internally.

- ☑ Projected Return on Investment (ROI)
  - ☑ Include any AC Savings
  - ☑ Include Added Production Throughput Days




## Business Case Conclusion

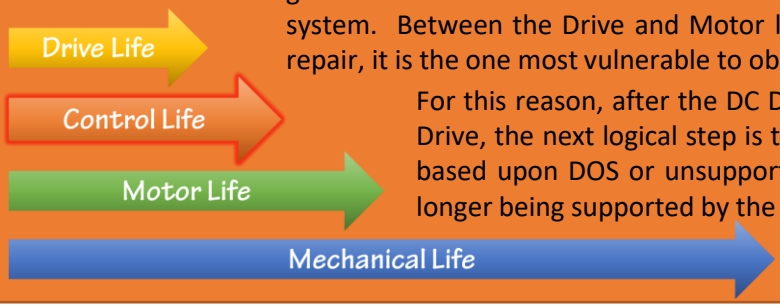
IMPORTANT

Lastly, as is with any business case that has been researched and evaluated, it is time to make your recommendations. *Items that are on the top of your list should have the most accurate number for the corrective upgrade cost as possible* as this YOUR recommendation for moving the company forward. To obtain this information, you must have a well defined Request for Quote (RFQ).

## Lifecycle of Extruder Components

TAKE NOTE

The lifecycle of the key components of the extruder vary. In general terms, outside of routine maintenance, the mechanics of the extruder itself has many years of life. The motor, although repaired, has the next longest life, albeit may not be energy efficient if DC. The AC Drive has a 10 year life on the electrical components as it produces the greatest amount of heat and is one of the hardest working components within the system. Between the Drive and Motor life rests the Control System. Often difficult to repair, it is the one most vulnerable to obsolescence due to the changes in technology.



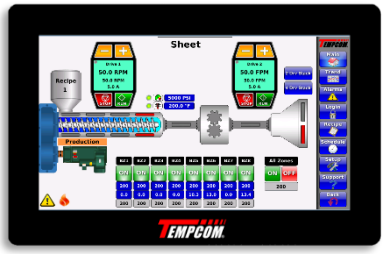

For this reason, after the DC Drive and Motor are replaced by an AC Extruder Drive, the next logical step is to replace the aging Control System as many are based upon DOS or unsupported Windows Platforms in addition to some no longer being supported by the original manufacturer of the equipment.

*Available from* ***Integrated Control Technologies***

# ICT Extruder Control System

TEMPCOM®

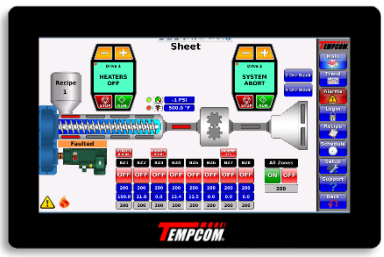
## INTUITIVE CONTROLS



- Accelerates Operator Adoption
- Animated Equipment
- Graphical Interface
- Easy-to-Operate
- Easy-to-Learn

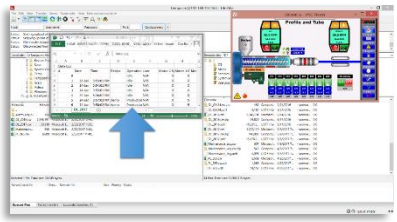
## CONNECTIVITY

- Remote Factory Support
- See What Your Operator Sees
  - At Your Desk
  - On Your Phone
  - From Your House!



## DATA COLLECTION & ACCESS

- Machine Operation Efficiency Data
- Process Data Collection
- Maintenance Log
- Alarm Log
- Time/Date
- Data Table
- CSV File

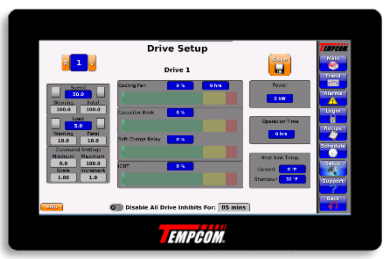


## COMPREHENSIVE DIAGNOSTICS

- Visual Indication of Faults with Descriptors
- Locates Where the Fault Occurred
- Minimizes Troubleshooting Time
- Shorted Solid State Relay Indication
- High Pressure Warning
- Open Heater Indication
- Audible and Visible Alarms
- Cabinet Temperature Warning
- Fatal Alarm Email or Text Option

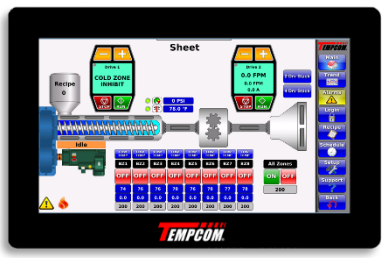
## ADVANCED FEATURES

- Drive Health Monitor with the Yaskawa Drive
- Preventative Maintenance Scheduling
- Recipe Storage and Scheduling
- Cascading Soak Feature
- User Defined Login
- Trending



## PROTECTIVE FEATURES

- Runaway Heat Protection Option
- High Pressure Shutoff
- Arc Flash Plus Option
- Cold Zone Inhibit
- All Zones Off Inhibit



# *ICT* Optional Features


## ARC FLASH PLUS

ARC Flash procedures are to protect maintenance personnel from potential injury when working inside of a live panel. Unfortunately, these suits are hot, cumbersome, and they make working in panels nearly impossible; for this reason we offer an ARC Flash PLUS design. The difference is we add a power supply to keep the low voltage electronics alive for troubleshooting! This means, no dangerous voltage when you open the panel…no suit is needed… but you are still able to work on the panel using all the system diagnostics, because they are still actively displayed!

## SHORTED SOLID STATE RELAY PROTECTION

Unlike mercury relays, solid state relays fail shorted. Improper design of circuit protection can lead to damage and even fires! This "runaway heat" condition not only needs to be detected, but stopped if ignored! Our systems at ICT detect this condition immediately, alarming the operator. In addition, we can remove power from the heats when critical temperatures are reached with a shunt-trip breaker or contactor. The advantage of the shunt-trip breaker is in preventing the operator from trying to restart the system after the alarm, and before maintenance has had time to address the problem. In all cases, we can tell you which zone had the failure.


## CONTROL STATION FLEXIBILITY

Our standard package places the operator screen on the enclosure door, but there are many available choices for mounting. It can be mounted on a swinging pivot arm, placed in a stand-alone control station located at your convenience, or in your existing operator station with a simple mounting bracket. Of course, this does not limit the ability to place the control on your existing intranet and viewing the screens anywhere on just about anything. No more guessing what the operator is trying to explain, you can see it remotely, even from another plant states away!

## REMOTE SUPPORT

We have between 3,000-4,000 hours of code development and our familiarity with the system is not based upon a single programmer, but a team of engineers. Our systems are capable of remote connectivity and support! The best part of our support, we talk through the cloud and never violate the IT firewall rules of engagement.


## OEM PLC PROGRAM ACCESS

Have you ever been concerned about product support five years later, ten years…even longer? Most OEMs will not allow access to their code and lock you into long-term support contracts with outrageous engineering rates. At ICT, we only require a simple non-disclosure agreement that your access is for support and not duplication and your inside with full access! We want to be a partner!

## CUSTOM PROGRAMMING / DOWNSTREAM / UPSTREAM

Extruder systems are like snowflakes, they look alike, but there are some differences. Whether it is controlling the drives in blown film, the Chill Rolls in sheet, or cooperative communication with other products, Integrated Control Technologies is the right choice to make it all work!

# Chapter 2

# Creating a Well Defined RFQ

## In This Chapter

- What is a Scope of Work?
- What is the Goal of an Request for Quote (RFQ)?
- What information is Critical?
- What Should a RFQ Look Like?
- Sample Scope of Work
- What Additional Information Would Help?

After building a business case for your recommendation and prioritizing the lines, it is important to obtain realistic quotations that will be used for your ROI calculations. The challenge here is, without a proper and well defined Request for Quote (RFQ), the project can significantly deviate from budgets which upends ROI calculations and can also reflect poorly on your evaluations. For this reason, the RFQ begins with a Scope of Work.

## What Is a Scope of Work?

A Scope of Work defines the items to be addressed within an upgrade, without this, quotations vary greatly because they are open to interpretation. It is important to note, it is highly likely that most companies will not perform all the necessary items within the Scope of Work because some jobs are cost prohibitive when crossing state lines and attempting to do so would greatly increase their overall bid price. It is much more common to anticipate and prefer companies operate within their strengths to guarantee that the quality of work does not suffer. The probability for success is also greater if you stay engaged in the project as the lead, to ensure that the items are all completed satisfactorily.

BAD PLAN

Sometimes it seems like the best solution is to have one provider for all services to reduce "finger-pointing" when issues arise. The reality is, when the project goes wrong, management always looks at those involved internally as responsibility cannot be transferred externally, it will always reflect on YOUR recommendation. The best plan is to always go with the experts for each item in the Scope of Work to avoid issues all together.

## What is the Goal of an Request for Quote (RFQ)?

The overall goal of the RFQ is to derive consistent quotations in order to evaluate and select the appropriate partners for each of the tasks required during the upgrade. Vendor quotations must be detailed enough so that they can be aligned with the request and all exceptions noted. It is important to note that an evaluation of the vendor and quotation must be performed in addition as there is as much associated risk in choosing a poor partner for the upgrade, as there is in selecting a system that is not fully developed and functional. The overall goal of the RFQ is to give you a specific response to your request. The more vague you are, the higher the bid prices typically become.

# What Information is Critical?

The most important item in any Scope of Work is the overall business objectives. The entire purpose of any system upgrade is not to repair the older system to operate as before, instead it is to IMPROVE the process and achieve better control, enhancing the system with new capabilities or features like that of newer systems for less expense.

## Business Objectives to Consider

- ☑ Improved Safety
- ☑ Improves Process
- ☑ Data Collection and storage
- ☑ Ease of Use / Intuitive Control
- ☑ Descriptive Self-Diagnostics

TIPS

Business Objectives should never be made alone and should always include those items needed by management, operations, maintenance and operators. When there is complete "buy-in" for an upgrade, there is a better chance of a successful adoption and transition of the new control internally.

# What Should an RFQ Look Like?

The RFQ should address each aspect of the upgrade in as much detail as possible to avoid ambiguity in the response. To allow for brevity, the example provided will only cover the extruder electrical portion of a typical Scope of Work.

## Important Sections Needed for Clarity

- ☑ System Overview
- ☑ Business Objectives
- ☑ PLC/HMI Preferences
- ☑ Heater Safety Requirements
- ☑ Heater Descriptions
- ☑ Solid State Relay Preferences
- ☑ Motor Control
  - ☑ Drives, Pumps, Starters, Etc…
- ☑ Wiring Methods
- ☑ Enclosure Requirements
- ☑ Preferred Electrical Equipment
- ☑ Current Documentation


GOOD IDEA

There is a difference between a "Preference" and a "Requirement". Requirements may limit those suppliers who may be best qualified. Most original equipment manufacturers (OEM) have established relationships for items that will not impact the actual performance of the system. Requirements should be reserved for those items that are necessary for system operation, and preferences a list of desires which changing would not likely impact performance. Think of it as "Wants and Needs".

# Scope of Work (Example)

**After building a business case for an upgrade, it is necessary to obtain an overall cost for the project. Therefore, you need to create a scope of work that establishes standards for vendors to quote. Below is a sample Scope of Work that can be downloaded from our website at**

***www.integratedcontroltech.com***

COMPANY NAME
CONTROL UPGRADE FOR EXTRUSION LINE 1
By (Project Manager's Name)
Company Address
City, State, ZIP
Email:

## *OVERVIEW*

| | |
|---|---|
| ***I*** | *The following is a scope of work for an extrusion line control upgrade. It is to be used as a means of creating a quotation for the project in accordance with the specifications put forth in this document.* |

To be considered as a vendor for this project, a company must be recognized within the extrusion industry as one that specializes in the after-market upgrades of extruders. The recognition comes from multiple user references within the industry, membership in Plastics Industry Association, published articles within industry magazines and participation in industry tradeshows and conferences. In addition, the company should be a UL508A panel shop with four or more electrical engineers on staff. A company resume' must be included with this quotation affirming all the requirements as listed.

## *THE OBJECTIVE*

| | |
|---|---|
| ***II*** | *Extrusion Line 1 is a line manufactured by (Davis-Standard, Welex, etc.,) that utilizes an obsolete control system or does not meet our company's current safety and automation goals. The proposed system will meet the following requirements:* |


IMPORTANT

1) Need #1: Improved diagnostics with the following specifications:
    a) Shorted solid-state relay indication
    b) High pressure warning
    c) Open heater Indication
    d) Cabinet temperature warning
    e) Audible and visible alarms
2) Need #2: Improved protection with the following specifications:
    a) Runaway heat protection (contactor or shunt-trip breaker)
    b) High pressure shutoff
    c) Cold-zone inhibit
    d) Arc-flash or arc-flash plus (low voltage power allowed for diagnostics)
3) Need #3: Improved system data collection with the following specifications:
    a) Process data collection
    b) Alarm log (date and time stamped with description)
    c) Maintenance log
    d) Machine operation efficiency

# Scope of Work Example (Cont'd)

4) Need #4: Improved features
    a) Recipe storage
    b) Recipe scheduling
    c) Soak feature
    d) Animated graphics for ease of use
    e) Trending
    f) Preventive maintenance scheduling
5) Need #5: System accessibility
    a) User defined log-ins and security
    b) Remote factory support
    c) Remote screen access
6) Need #6: Improved documentation
    a) System user manual
    b) Authorized program access with non-disclosure agreement
    c) Wiring diagram with wire numbers to identify specific location on drawings

### *PROGRAMMABLE LOGIC CONTROLLER (PLC) & HUMAN MACHINE INTERFACE (HMI)*

| | |
|---|---|
| ***III*** | *A PLC and an HMI will be used for extruder control with software that uses ladder logic as a means of control. A computer will not be used as a means of control and would be accepted as part of the system if it were used for data collection and storage only. The PLC and HMI will have the following preferences:* |

1) The HMI will be a color touch-screen with a screen diagonal of 15 inches or more
2) The PLC will have Modbus TCP/IP communication and Ethernet IP
3) The PLC will either be a PLC/PC combination such as the:
    a) Unitronics UniStream OPLC
    b) Siemens open controller
    c) Rockwell CompactLogix controller
4) The PLC and HMI are to be industrial rated able to withstand temperatures of 55°C or 131°F
5) The PLC will consist of at least 1 MB of ladder memory capable of supporting over 2000 I/O

### *HEATER SAFETY*

| | |
|---|---|
| ***IV*** | *The heater safety system shall detect and control the following requirements:* |

1) Heater thermocouple signal loss
2) Low and high temperature warnings
3) Shorted solid-state relay detection
4) Open heater detection
5) Run-away heater detection and power disconnect with contactor or shunt-trip breaker

# Scope of Work Example (Cont'd)

IMPORTANT

## HEATER PANEL DESCRIPTION

**V** *(Give a brief description of the heat function such as) The (Davis-Standard, Welex, etc.) has a total of 12 heat zones. The barrel zones are Heat-Cool Controls and the remainder are Heat Only. The extruder is air-cooled using single phase, 120VAC fans.*

| Zone | Description | Volts/Phase | Watts | Amps | Control Type |
|---|---|---|---|---|---|
| 1 | Barrel Zone 1 | 480VAC/3Ø | 20 kW | 24 A | Heat & Cool/Air |
| 2 | Barrel Zone 2 | 480VAC/3Ø | 20 kW | 24 A | Heat & Cool/Air |
| 3 | Barrel Zone 3 | 480VAC/3Ø | 20 kW | 24 A | Heat & Cool/Air |
| 4 | Barrel Zone 4 | 480VAC/3Ø | 20 kW | 24 A | Heat & Cool/Air |
| 5 | Barrel Zone 5 | 480VAC/3Ø | 20 kW | 24 A | Heat & Cool/Air |
| 6 | Screen Changer | 240VAC/1Ø | 7.5 kW | 31 A | Heat Only |
| 7 | Adapter | 240VAC/1Ø | 7.5 kW | 31 A | Heat Only |
| 8 | Die Zone 1 | 240VAC/1Ø | 5 kW | 21 A | Heat Only |
| 9 | Die Zone 2 | 240VAC/1Ø | 5 kW | 21 A | Heat Only |
| 10 | Die Zone 3 | 240VAC/1Ø | 5 kW | 21 A | Heat Only |
| 11 | Die Zone 4 | 240VAC/1Ø | 5 kW | 21 A | Heat Only |
| 12 | Die Zone 5 | 240VAC/1Ø | 5 kW | 21 A | Heat Only |

## SOLID STATE RELAY SELECTION

**VI** *There are three methods of heater control using solid-state relays that are preferred are in this proposal and are as follows:*

1) Intelligent Solid-State Relay (SSR) such as the Carlo Gavazzi RGC1S or Crydom Nova 22 SSRs. When using this method, the PID for temperature control is performed within the PLC and all diagnostics, such as shorted solid-state relay and open heater indication, are performed by the Intelligent SSR. There is a fault output that can be connected to the PLC for fault notification and fault determination is given by visual light indication on the SSR. More components are required to provide specific fault indication to the PLC.
2) Intelligent Temperature Control Module such as the Gefran GFX4. This module contains up to 4 single phase heater zones or 2 three phase zones. Modules are individually fused with the PID resident on the module. The PLC must use Modbus communications to control and monitor module functions.
3) Solid-State Relay with individual Current Transformers (CT). In this method, the PLC performs all PID and Diagnostics. This is the least desirable method because of program complexity especially in systems with more than 20 zones per PLC.

# Scope of Work Example (Cont'd)

IMPORTANT

## MOTOR CONTROL

**VII** *The following is a listing of all motor control required for this project*

| Motor | Description | Volts | HP | RPM | Conduit Box/Coupled | Control Type |
|---|---|---|---|---|---|---|
| 1 | Extruder | 480VAC | 150 | 1750 | F2/ Belt Coupled | AC Vector/Open Loop |
| 2 | Primary Nip | 480VAC | 3 | 1750 | F1/Direct Coupled | AC Vector/Closed Loop |
| 3 | Air Ring Blower | 480VAC | 10 | 1750 | F1/Direct Coupled | AC Drive -V/Hz |
| 4 | Pump | 480VAC | 2 | N/A | N/A | Motor Starter |
| 5 | Vacuum | 480VAC | 2 | N/A | N/A | Motor Starter |

Motors are to be quoted on items 1-3. Motors existing on items 4-5.

## WIRING METHODOLOGY

**VIII** *The electrical panel will be UL or cUL rated with the following:*

1) All solid-state relays are individually fused with semiconductor fuses in finger-safe fuse blocks
2) Wire color shall be as follows:
    a) Black – 3 phase or single phase wiring over 120VAC
    b) Red – 120 VAC Control Wiring
    c) White – current-carrying grounded conductor
    d) Blue – DC wiring
    e) Green – equipment grounding
3) All wires will have (ferrule) connectors up to 14 gauge wire.
4) All wiring will be in recognized raceway such as Thomas & Betts or Panduit. DC and AC wiring are to be in separate raceways.
5) All ethernet communication cable will be certified Cat6e shielded
6) All new AC drives will use Modbus TCP/IP for control communication and monitoring. Discrete control can be used for older drives that are retained in the upgrade.

## ENCLOSURE DESIGN SPECIFICATIONS

**IX** *Free-Standing NEMA 12 enclosure painted RAL 7035 Grey River Texture High Gloss with the following design specifications:*

1) Flange-mounted main circuit breaker
2) Door-mounted program access port with 120 VAC socket
3) Human Machine Interface (HIM) to be mounted in one or more of the following configurations
    a) Door-mounted
    b) Swing-arm mounted to the enclosure
    c) Remote operator station

# Scope of Work Example (Cont'd)

4) Door-mounted keypad operators for all AC drives
5) Enclosure cooling will be one of the following based upon the heat calculations
    a) Top-mounted fans with filters mounted on the lower portion of the enclosure door
    b) Side-mounted air conditioner
    c) Side-mounted water-to-air heat exchanger
6) A thermal sensor will be mounted inside the enclosure and alert the PLC if the temperature exceeds 40°C.
7) Die plugs are to be the Meltric DS series switch-rated die plugs
8) A three-color tower light will be mounted to the top of the enclosure to alert operators of an alarm condition
    a) Green - all systems operating as normal
    b) Yellow – a warning condition has occurred in one of the settings
    c) Red – fatal alarm that will shut down the line
9) An audible alarm similar to Federal Signal # 350WB120 or as a component of the tower light
10) The enclosure will be shipped in a wooden crate (fully enclosed) and securely fastened so that it does not become loose during shipping.

### *PREFERRED MANUFACTURERS OF ELECTRICAL EQUIPMENT*

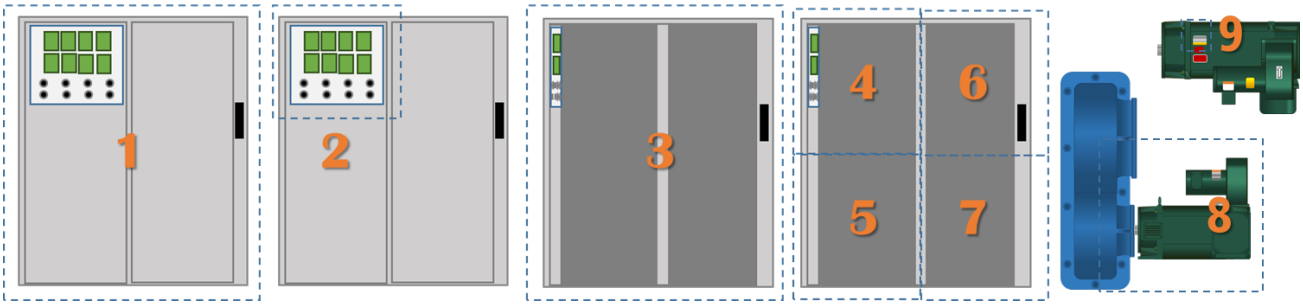
| | |
|---|---|
| **X** | *The following is a list of preferred manufacturers for this project; substitutions must be noted* |

1) AC Drives
    a) Yaskawa
    b) ABB
    c) LS
2) AC Motors
    a) Reliance RPMAC
    b) Reliance VS-Master
    c) Marathon BlackMax
    d) Marathon BlueMax
3) Motor Starters and Contactors
    a) Square D
    b) LS
    c) Rockwell
4) Solid State Relays
    a) Gefran GFX4
    b) Carlo Gavazzi
    c) Crydom
5) Programmable Logic Controller (PLC)
    a) Unitronics UniStream OPLC
    b) Siemens Open Controller
    c) Rockwell CompactLogix
6) Human Machine Interface
    a) Unitronics USP-156-B10 (15" Screen)
    b) Siemens Touchscreen (19" Screen)
    c) Rockwell Panelview

# What Additional Information Would Help?

BEST PRACTICE

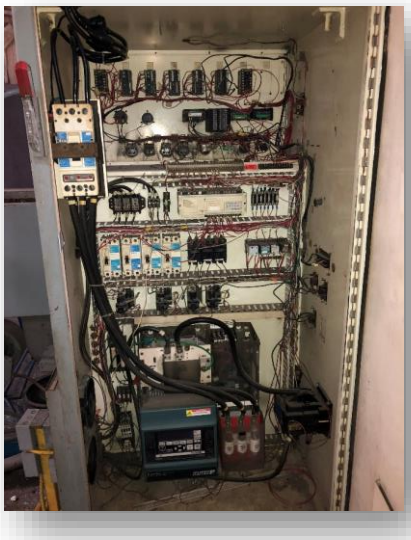
Attaching schematics of the current system with pictures of the installed panels and motors showing the configuration to the load and nameplate data. (Best Practices include a consistent pattern of picture taking and naming if covering multiple panels. All pictures should allow for complete clarity and consistency)



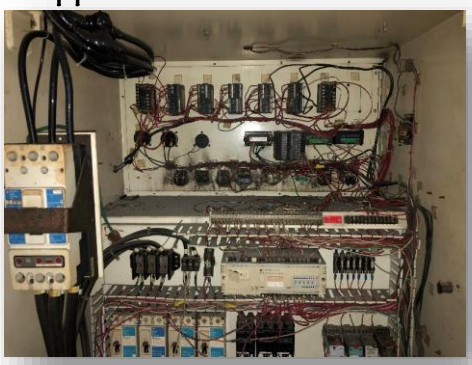

## Single-Door Enclosure Picture Example (keep pictures grouped by enclosure for clarity)

1.Main Enclosure

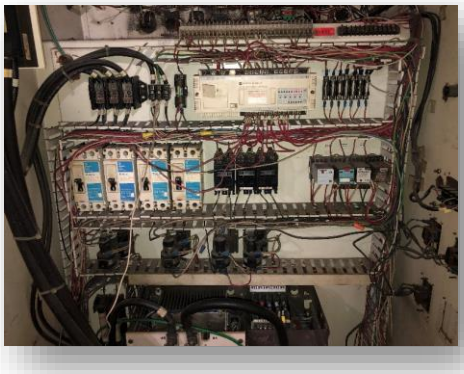
3.Panel



4.Upper Panel



5.Lower Panel



2.Controls

8. DC Motor

9. Motor Nameplate

# Chapter 3

# Evaluating the Proposals

## In This Chapter

- Evaluating the Vendors
- Vendor Evaluation Form
- Evaluating the Control Systems
- Control System Evaluation Form
- Weighing System Proposals
- Selection Guide
- Making Your Recommendation

Trusting the wrong people can be devastating to a projects overall success and result in significant downtime and possibly the system never achieving the business objectives that were stated and agreed upon by your team. Since meeting these objectives lead to a successful adoption of the system, careful consideration must go into picking a trusted advisor and vendor. The challenge for trust is complicated, because this influence can both be considered internally as well as externally. Beware of those individuals who have little experience in extruder control upgrades and claim how easily it can be programmed.

BAD PLAN

A true control system is more than simple temperature control. Newer systems have teams of programmers modifying and improving base structure code that has been developed over years. These systems have intricate and sophisticated diagnostics and safety built into them to shut off the system when problems occur. Unless you have a "dedicated" team of programmers and a solid base code, it is never advisable to pursue internal development. Having the success of your extrusion line depend upon the talent of a single individual is a significant long-term risk that will likely result in a lack of proper documentation, violation of UL and possibly NEC rules. It is always best to go with those who specialize in control solutions.

## Evaluating the Vendors

Any upgrade should exclude the potential vendor if it is dependent upon a single individual in order to limit risk. Aside from this, it is also important to recognize that not all companies have the same capabilities or expertise. Some organizations such as system integrators may have the ability to provide a solution, but it is likely that they are not working from an established base code for the development and the system will lack some important features unless specifically spelled out within the scope of work. If this is the case, the start-up time will likely be extended for debug in the field. The original manufacturer of the equipment, if still in business, are experts on their equipment and likely have all the historical schematics assuming the system has not had field modifications. They offer a very low risk, but because they primarily sell new lines, so there may be extended delays in addressing such a request and probable they are the higher priced solution. There are companies placed between these two choices that specialize in extrusion lines, having a team of dedicated programmers, a base design that has been field tested, and system architecture that rivals the newer systems. These type companies also offer the ability to integrate the equipment with other controls making them more flexible.

The Vendor Evaluation Form, which follows, is a tool to allow you to evaluate these organizations systematically and is an important function of your overall assessment of project risk.

# Vendor Evaluation Form

**It is possible to get pricing for an upgrade from many sources that claim to have the expertise necessary for a successful project. Unfortunately, selecting the wrong vendor to perform an upgrade can be costly and you may not get what you were expecting. It's important to understand that not all vendors are the same and that you need to qualify them based upon specific criteria. The following is a means of ranking vendors and eliminating those that are not qualified.**

## *Answer the following Questions*

| | YES | NO |
|---|---|---|
| Do they have literature or a website that identifies them as being a specialist in the plastics industry? | ☐ | ☐ |
| Is their proposed software fully developed? | ☐ | ☐ |
| Can they demonstrate their software (live) with its features and functions? | ☐ | ☐ |
| Do they have multiple user references within the plastics industry? | ☐ | ☐ |
| Are they recognized in any plastics industry publications? | ☐ | ☐ |
| Do they participate in industry trade shows? (NPE, Extrusion Conference, etc.) | ☐ | ☐ |
| Are they a member of the Plastics Industry Association? | ☐ | ☐ |
| Are they a UL508A panel shop? | ☐ | ☐ |
| Is the vendor's company more than ten years old? | ☐ | ☐ |
| Do they have four or more engineers on staff? | ☐ | ☐ |
| Do they have a standardized process flow for upgrades? | ☐ | ☐ |
| Do they have a means of remotely supporting their product? | ☐ | ☐ |
| Do they have a product manual? | ☐ | ☐ |
| Do they have customer references for extrusion? | ☐ | ☐ |

***Total Number of "Yes" Answers*** ____

| ***Run Away*** | | | ***Poor Value*** | | ***Good Value*** | | | ***Very Qualified*** | |
|---|---|---|---|---|---|---|---|---|---|
| 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |

***Run Away*** = This product should not be considered in the evaluation
***Poor Value*** = Although it can be considered, it should not be considered an equal to other products
***Good Value*** = This product should be considered as a possible solution
***Very Qualified*** = This product would be the best choice for your solution

# Evaluating the Control System

Although cost plays a large role in many capex expenditures, it should never play the primary role in making the decision to move forward with a solution. In addition to evaluating the vendor, the control system must be compared to the Scope of Work to validate its proximity to the objectives and system requirements. The greater weight in any decision should be on achieving the overall goals and meeting the requirements necessary for operation; preferences may have some weight, but typically only if trying to narrow down the choice between two qualified vendors and like systems. When choosing a solution, the vendor should always have references of other working systems and be able to demonstrate their proposed system.

TAKE NOTE

Manufacturers have spent thousands of hours developing code for their systems. This information is part of their intellectual property (IP) and purchase of a system does not include the acquisition of their development. In addition, the code is often complex and would take many months to comprehend, and edits could result in unexpected operation. It is for this reason the access to the code is often restricted.

The Control System Evaluation Form is provided as a tool to allow for you to quantify the system proposed so it may be compared to other such quotations. Like the Vender Evaluation Form, this can be edited.


Integrated Control Technologies designed and built a 5-Layer Cast Film Control System using the TEMPCOM® Extruder Control System. Our customer and ICT got this system start-up completed in 2 WEEKS TIME!

**Can your Vendor do this?**

# Control System Evaluation Form

**Selecting an established solution that is used within the plastics industry, is a better investment than getting something custom developed. A proven solution minimizes risk as well as provides you with a richer feature set. Significantly more engineering hours from several engineers are required in developing a pre-engineered solution versus the hours required for a single engineer to develop a custom solution. A product evaluation could be done by reviewing a specification sheet or a product demonstration, although a demonstration may give you more insight into the product.**

## *Answer the following Questions*

| | *YES* | *NO* |
|---|---|---|
| Does the product appear to be easy to use and is it intuitive? | ☐ | ☐ |
| Does the operator or main page have a graphical representation of the system? | ☐ | ☐ |
| Does the product sense a shorted solid-state relay and alert the operator? | ☐ | ☐ |
| Does the product have cold zone inhibit? | ☐ | ☐ |
| Does the product have recipes and recipe scheduling? | ☐ | ☐ |
| Does the product have an I/O status page? | ☐ | ☐ |
| Does the product have trending and data collection? | ☐ | ☐ |
| Does the product have an alarm log? | ☐ | ☐ |
| Does the product have a maintenance log? | ☐ | ☐ |
| Does the product have preventative maintenance scheduling? | ☐ | ☐ |
| Does the system have configurable security levels? | ☐ | ☐ |
| Can the screens be viewed remotely? | ☐ | ☐ |
| Is the vendor willing to give you a copy of the program? | ☐ | ☐ |
| Is the lead time less than 16 weeks? | ☐ | ☐ |
| Has the system been applied to various extruder manufacturer's products allowing for standardization? | ☐ | ☐ |

***Total Number of "Yes" Answers*** ____

| *Run Away* | | *Poor Value* | | *Good Value* | | | *Very Qualified* | | |
|---|---|---|---|---|---|---|---|---|---|
| 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |

***Run Away*** = This product should not be considered in the evaluation
***Poor Value*** = Although it can be considered, it should not be considered an equal to other products
***Good Value*** = This product should be considered as a possible solution
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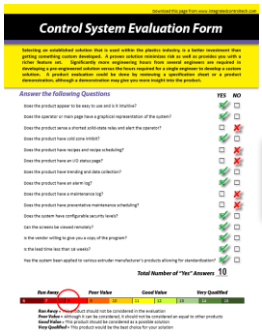
# Weighing System Proposals

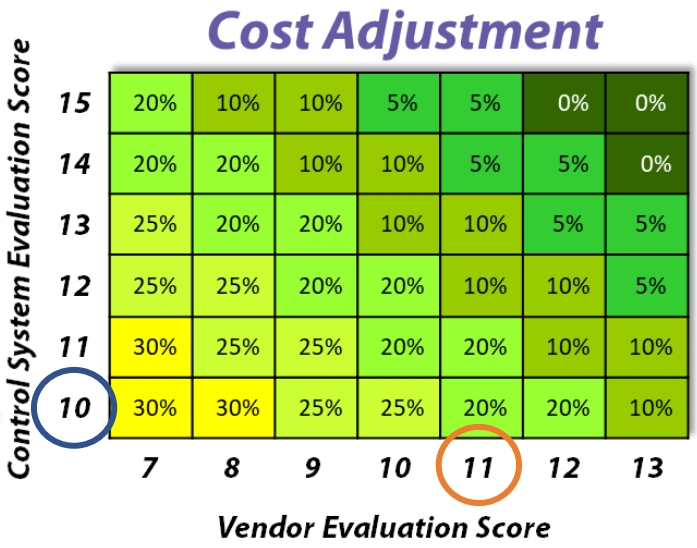
Once you have received all the proposals, evaluated the vendors and the control systems using the appropriate forms, it is time to weigh the information. In order to do this, you take the score for both forms and cross reference it to a table that adds an adjusted cost to the proposal. The combination of these weighed values allows you to view the proposals beyond simply comparing the acquisition cost of the system; instead it helps you understanding the hidden cost of the system by allocating risk through adjusting the numbers to reflect the potential consequences for a given choice.

In order to weigh each item, the Selection Guide is provided as a reference. Of course, the ratios may be edited for your purposes, this is simply provided as a resource and potential solution in weighing proposals. The way this works is as follows:

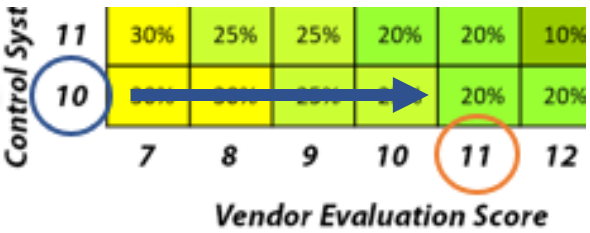
## Example 1

To use the chart, locate the score on your Control System Evaluation Form and select the number on the Y Axis. Then place the score for the Vendor Evaluation Form on the X axis. The intersection is the percentage you will add to the total proposal cost.




The overall score for the Control System Evaluation score was 10.




The intersection of the two values becomes the amount added to the overall cost to indicate the level of risk. In this case, 20% would be added to the overall proposal price to account for the poor ratings for the Control System Design and Vendor experience.


The overall score for the Vendor Evaluation score was 8.

# Selection Guide

**All vendors and control solutions are not equal, even with a defined Scope of Work. The Selection Guide is a means of quantifying the value associated by the Vendor and Control Solution Evaluations and applying it to the quotation provided by each vendor to develop an overall value proposition. Proper selection is determining value and not just pricing. Both Vendor and Control Solution will have a minimum requirement and ratings below the minimum should be eliminated from consideration. Low ratings on either evaluation decreases value of the quotation and it cannot be considered equal to a quotation with high ratings. The following chart is a means of using the evaluations to establish an overall adjusted cost. Lower ratings will include a percentage adder that is applied to the quotation to establish an overall cost for comparison**

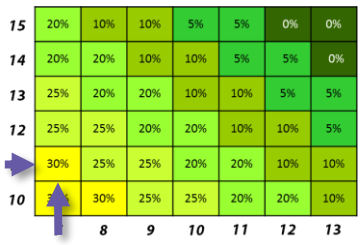
## Cost Adjustment

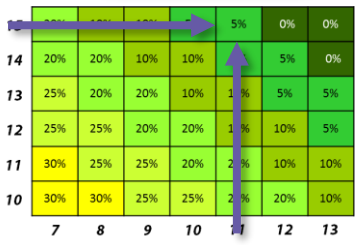
| Control System Evaluation Score | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|
| 15 | 20% | 10% | 10% | 5% | 5% | 0% | 0% |
| 14 | 20% | 20% | 10% | 10% | 5% | 5% | 0% |
| 13 | 25% | 20% | 20% | 10% | 10% | 5% | 5% |
| 12 | 25% | 25% | 20% | 20% | 10% | 10% | 5% |
| 11 | 30% | 25% | 25% | 20% | 20% | 10% | 10% |
| 10 | 30% | 30% | 25% | 25% | 20% | 20% | 10% |

**Vendor Evaluation Score**

THE BETTER VALUE

| Example 2 | Vendor A | Vendor B |
|---|---|---|
| System Quotation Price | $100,000 | $115,000 |
| Vendor Evaluation Score | 7 | 11 |
| Control System Evaluation Score | 11 | 15 |
| Cost Adjustment % Multiplier | +30% | +5% |
| Amount to Add | 100,000 x .3 = $30,000 | 115,000 x .05 = $5,750 |
| *Adjusted Cost* | $130,000 | $120,750 |



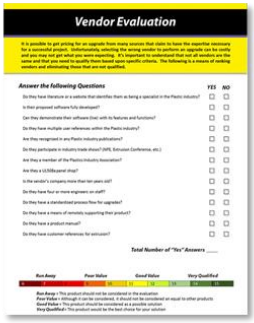


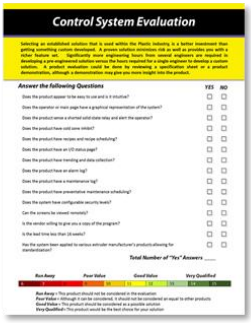
Although the quoted price for Vendor A was lower, when the Vendor and Control System were evaluated, the quotation by Vendor B offered the better overall value and is recommended.

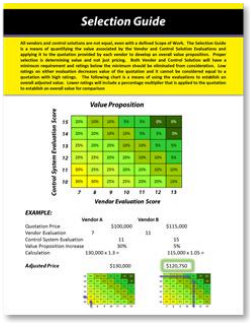
# Making Your Recommendation

IMPORTANT

Taking the time to make an informed recommendation to management carries much greater credibility and it removes the emotion from the business decision. It is more likely that management will understand and approve Cap-Ex funding for a solution that was well thought out and shows a clear ROI; furthermore, it provides a path for future upgrades and groundwork for a process that will ultimately lead to a better operation. Over time, the effort will become easier to manage once the right information is being collected for each line.








## Recommendation should include:

- ☑ Business Case (See Chapter 1)
- ☑ Scope of Work (See Chapter 2)
- ☑ Submitted RFQ's (See Chapter 2)
- ☑ Vendor and Control System Evaluations for Each
- ☑ Adjusted (Weighed) Proposal Costs to Reflect Risk
- ☑ Final Recommendation
- ☑ Validated Return on Investment Calculation

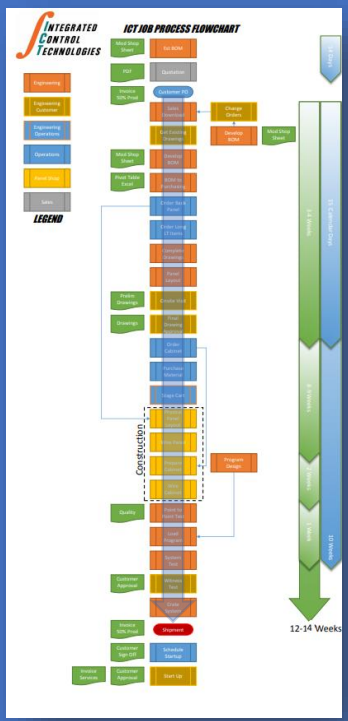
# Integrated Control Technologies Order Process

Once ICT receives a PO from our customer, the work begins on the development of the baseline schematics. Upon completion, engineering arranges a site-visit where the current equipment is reviewed and the drawings red-lined for final build approval.

Once our customer approves the final drawings, the work begins. The final BOM is created, the equipment is planned and scheduled for assembly and any long lead-time items identified and expedited. We pay attention to every detail. On the scheduled date for assembly, we make final checks for the inventory as planned. As an UL 508a shop, the work we put into our assembly is of the best quality. We pride ourselves on delivering you the best possible design and workmanship with each system we provide.

When the system is completed, engineering begins their final checks, validating all the connections as built to the drawing specifications. The core program is modified and upon completion of the edits, the customer is invited for a Witness Test. Upon completion, we crate and ship the system to you and it is ready for installation.

After you have the system installed, ICT engineering starts up your system! From the PO to delivery, we average about 12-16 weeks depending on the line complexity.



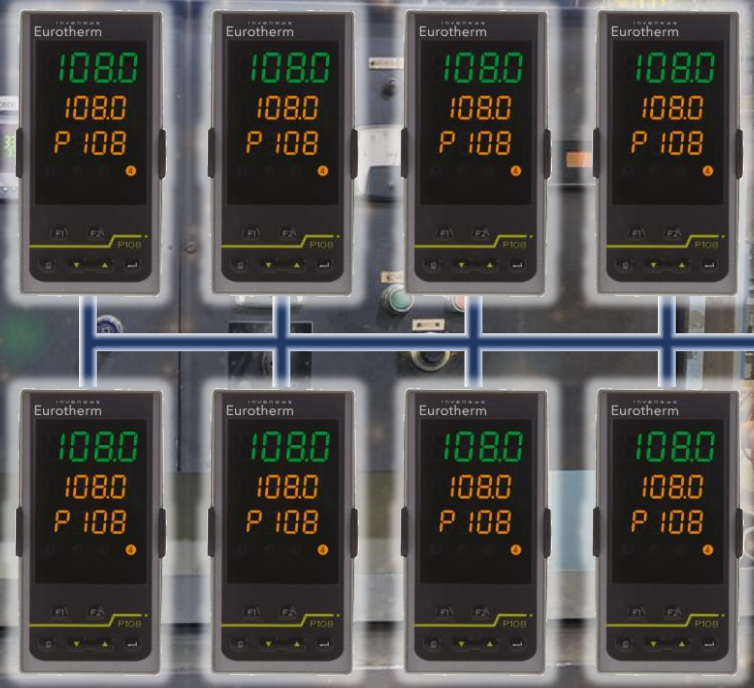
Giving new life to your older extrusion line

# GENESIS®

## GIVE YOUR OLD EXTRUDER SOMETHING NEW








**TRENDING**

**DIAGNOSTICS**

**DATA COLLECTION**

**GLOBAL ZONE CONTROL**

**RECIPES AND SCHEDULING**

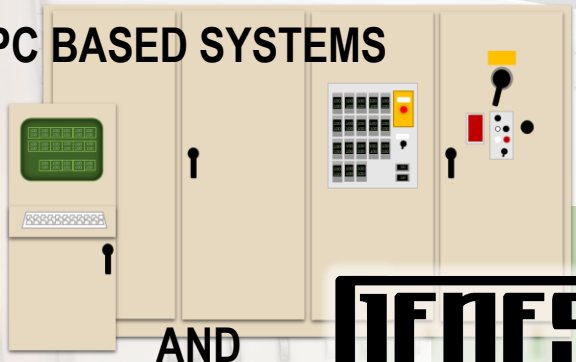
BLOWN FILM - CAST FILM - FILM - SHEET - PROFILE - PIPE - TUBING

# GENESIS® TECHNICAL DATA

*Creating break-through products that open the door to better manufacturing*

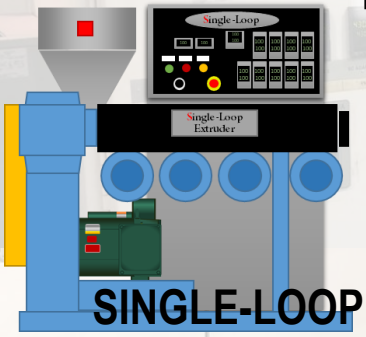
The GENESIS system is designed to directly replace the failing PC based systems, like those from Welex, Milacron and NRM systems, in addition to giving new functionality to other single-loop extruders. The design is flexible enough to address the complexity of a three-layer Cast Film line yet its easy enough to operate that a user of a basic mono extruder line can be successful. The timing for the release of this product is crucial as many of these systems are already long obsolete in their product availability and sometimes support, but this is now intensified with the obsolescence of component level sourcing for Eurotherm. Users of the 2216e, 2208e, 2204e, 2416, 2408, 2404 loop controls will soon find these devices unavailable and requiring upgrades. Coordinated systems with PC's will be more problematic in this transition as communications are crucial to operation. It is for this reason that ICT has created the GENESIS system, giving new life to your older extrusion line!

## PC BASED SYSTEMS



AND

GENESIS®




## SINGLE-LOOP SYSTEMS

## STANDARD CONTROL FEATURES

- Color Graphics
  - Heating/Cooling
  - Over/Under Temp
- Self-Diagnostic
- Production Monitoring Status
  - Idle
  - Production
  - Scrap
  - Maintenance
  - Faulted
- Protective Features
  - Cold Zone Start Inhibit
  - Open Heater
  - Broken Probe
  - Run-away Heat
- Recipe Storage
  - Custom Names
  - Soak Routine
- Scheduling Feature
  - Schedule Pre-Heat
  - Schedule Shutdown
  - Schedule Recipes or Soak
- Data Collection to .csv


## SYSTEM CAPABILITIES

- Controls PC Based or Single-Loop Systems
- Easy-to-Use Color Graphic Interface
- Control/Monitor Temperatures (Type J Thermocouples)
- Monitor Pressures (mV)
- Control Drives (Run/Start/Stop/Speed)
- Motor Control for Blowers and Starters
- Coordinates the Eurotherm P108 Loop Controller
  - Eliminate Overshoot
  - High visibility three color LED display

INTEGRATED CONTROL TECHNOLOGIES

https://www.integratedcontroltech.com/genesis.html

# Specializing in Extruder Drive and Control Upgrades

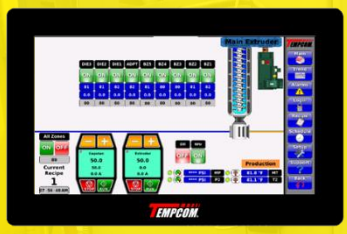
**Integrated Control Technologies**

## Call us at (972) 906-7445



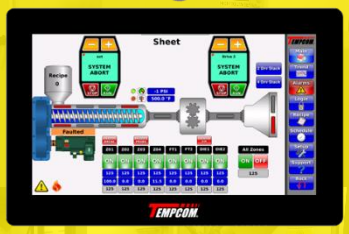
### Remote Access

### Intuitive Controls

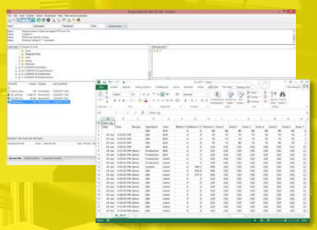


### Recipe Storage

### Self Diagnostic



### Data Collection



### Online User Manual And Drawings

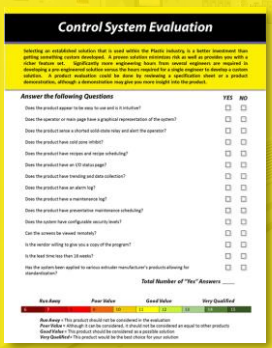
### User Defined Security

### Create Your Own PM Alarms

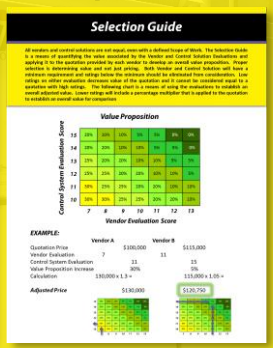
TEMPCOM®

DENESIS®

## *Go online to download the Forms and Scope of Work Example*







# www.integratedcontroltech.com