

AUDITING YOUR EXTRUSION COATING OR CAST FILM LINE

Jan Ivey
Consultant
Black Clawson Converting Machinery, Inc.
46 North First Street
Fulton, NY 13069
Phone: 315-598-7121
Fax: 315-593-0396

ABSTRACT

Equipment audits, like IRS audits, are designed to be negative; however, much more rewarding as you gain the monetary savings or profits, not give them away. As in IRS audits, plant or equipment audits should be kept confidential and discussed only with those affected.

The purpose of conducting these audits is to improve the areas that the audit is directed toward, not to embarrass individuals or point out shortcomings to higher authorities. These audit results should go only to the lowest person with the authority to correct the problem areas identified. In most audits I have been involved in, the results are shared after problems are corrected.

This paper outlines a methodology to conduct an audit of an extrusion coating/laminating line to identify "what is and what could be."

DISCUSSION

Webster defines audit as "a formal examination and verification of accounts." If we take this definition and expand it to only Extrusion Coating and Cast Film, it may look something like "a formal examination review and recommendation for improvement of a plant or specific piece of equipment." For this paper, we will concentrate on extrusion coating and cast film and how an audit may be done and what results could be expected. This paper will suggest how, by whom, and what should be audited.

First, we need to outline the objectives we expect to achieve and the areas to be investigated. The overall objective should be to identify to the plant any change to procedure or pieces of equipment that offer the possibility of improving safety, quality, productivity, or personnel.

The Audit Team will look for areas of weakness in procedures or equipment that could result in:

1. Excessive variation in product properties
2. Excess operating waste
3. Excess start-up time or waste
4. Poor reliability or excessive downtime
5. Always looking for safety opportunities

The first step in putting together an audit effort is to select the audit team. The make-up of the team will often depend on the specific areas to be audited and may be specific to one definite objective. For our purpose, we will put together a team of peers to look at waste reduction and productivity, as these are the two areas of major cost in an extrusion coating or cast film plant. We must stress that all audit personnel must always keep in mind that they should always be aware of safety opportunities. Generally speaking, it is best to have audit team members from other plants or areas. This will eliminate the "not invested here" problem that can occur when we audit ourselves.

The most difficult part of putting together an audit team is to get the right people. Team members **must** be the best in their respective field and these are the people other plants do not want to let go for a week. However, if we want the best results possible, then the best people must do the audit. There would be no advantages to have young or inexperienced people do the audit simply because they are available.

What type of people should comprise the audit team? A recommended team would look something like this:

1. Accounting Manager
2. Department Supervisors
3. Engineers – 1 Process; 1 Maintenance
4. Facilitator (Group Engineer or Outside Facilitator)

All of these team members should be from similar plants and understand the Company Policies and Procedures.

It is important that team members be from similar plants and understand Company Policy as one of the objectives will be to recommend opportunities for improvements. Knowledge of corporate procedures for capital improvements are beneficial.

The selection of the accounting type team member is very important as he/she must know accounting procedures as well as have a good idea of how the accounting data should be collected on the plant floor. This is extremely important as accounting information identifies the areas of opportunity and their relative magnitude. These accounting numbers are also generally used to justify capital expenditures and payout times. This team member should first identify area of opportunity and then verify that data reported from the plant floor is correct. Some of the areas the Accountant should look at are:

- Incoming Raw Material Weight Verification
- Waste Weight Verification
- Rework or Hold Procedure
- Good Product Weight Verification

As simple as this may seem, it is the foundation for grading a manufacturing plant audit.

In the ideal situation, the Accounting Team Member would do his/her audit prior to the rest of the team and provide a chart of plant waste or product cost. This will allow the main audit team to concentrate on the areas which have a faster or more profitable return.

Other members of the Audit Team should have expertise in the areas to be audited. The Process Engineers should understand the process as well as the equipment. The Department Heads should understand the products produced and the process variables. These are the key members who will make recommendations as to equipment, process, and procedural changes, if any, that should be considered.

The facilitator makes sure that audit procedures are followed, that target areas are addressed, and that proper reporting is accomplished. The role of the facilitator is one that can be done by a Professional Audit Facilitator or by a Senior Manager within the organization. Any audit team member may be from outside the company; however, audits are generally negative and should be kept inside the company if possible. Some companies must use outside auditors as they cannot provide help from other locations and often consultants are used to do the audits.

As noted, those audits are designed to look for opportunities of improvement and, therefore, negative by definition. Most plants that conduct audits **do not** distribute the audit results outside the plant or the department being audited. In our follow-up, audit items of importance have not been corrected, some other action may be justified. The fact that audit results will not be distributed makes the audited plant or department more willing to share items and not try to hide information.

Now that we have selected an Audit Team of our most knowledgeable peers, we need to determine **how** and what should be audited. Based on the results of the earlier accounting findings, we should focus on the areas which offer the greatest opportunity for affecting plant or department performance in a positive manner. For purpose of discussion in this paper, we will assume that our Accounting Audit finds the biggest opportunities for saving money are in **waste reduction** and **quality** improvement. We must keep in mind that **safety** is a major concern and as we audit the equipment, we should look for proper guarding, signs, and worker awareness.

As we consider the controlling variables that effect the extrusion and web handling process, whether it is extrusion coating or cast film, the main controllable variables are Pressure, Temperature, and Tension (P.T.T.). As we audit the various sections of the line or lines, we will continuously look at areas that can effect P.T.T.

To start the audit and to make sure we understand the requirements of the various customers, we will start reviewing specification sheets and quality requirements. Areas to investigate are:

- Do clear specification sheets exist for every product?
- Do specification sheets outline the major customer requirements and their acceptable ranges?
- Are raw material specification and definition clearly outlined?
- Do specification ranges consider the capabilities of the equipment?

After we have looked at the requirement for the major product, we will move to the extruder resin feed system. This part of the extruder system is often overlooked as not important, **but** can and does have major impact on cost of product as well as quality. With many converters going to coextrusions, which often utilizes several resin components as blends in each extruder, the accuracy of the blend system can effect performance of the film or lamination.

Many older lines or mono lines have volumetric feed systems while newer, more sophisticated lines may have gravametric feed systems. Regardless of the type we have, the important things we must check are:

- Are resin hoppers properly and clearly labeled so Operator can easily check levels, etc.?
- Are resin system controls clearly specified and understood by Operator?
- Audit Team should run weight check to determine if actual weight agrees with reported weights (Gravametric System).
- If system is Volumetric, is there justification for installing a Gravametric System?
- Is the system delivering a consistent feed to the extruder or extruders? Extrusion hopper variation can lead to extruder feed problem.
- Is the system, especially the load cells, clean and free of excess dust and resin?

The main component of an extrusion system is the extruder and an area of major effort for a system audit. The purpose of the extruder is to melt, mix, and deliver a molten homogeneous polymer at a constant pressure and temperature. The Audit Team must determine if the Operators and Supervisors have a good solid working knowledge of the extrusion process and the variables involved. They must know how the various variables effect the process and what their window of flexibility in changing those parameters are.

One of the major areas for the Audit Team to look at is the thermocouple. Often the forgotten item of the entire system, this is the feedback link that controls the various systems.

Thermocouples, because of their sturdy construction, are often never looked at until they short, break off, or give some electronic sign of a problem. Many thermocouple related problems do not show up on the control panel, yet cause major operating problems. Special effort should be made to make sure each thermocouple in the entire system is checked for:

- Proper Seating
- Seals are clean for good T/C contact
- Electrical terminals are clean and tight
- Thermocouples are properly labeled and connected to the proper zone

Major areas for auditing on the extruder are:

- Feed Cylinder Cooling System
- Screw Cooling System (Do operators understand the need and function)
- Screw Design. If more than one resin is run, the design is a compromise, but it is the best.
- If the extruder is vented, is the vent in proper working order?
- Are barrel heaters clean and cooling system in proper working order?
- Audit Team should check maintenance records to determine if screw and barrel measurements are being maintained and recorded.
- Are pressure gauges and transducers in the proper location and tested for accuracy on a scheduled basis?
- Are rupture disc or blow out tubes installed and of the proper range?
- Are screen changes clean and screens changed on some predetermined schedule or at a specified pressure?
- Is the extruder valve clean and operational?

The die and adapter are the next areas for audit as we move down the line components. Much as the extruder, the thermocouples are the communication system and should be looked at thoroughly:

- Are the thermocouples seated, clean, and in the correct zone?
- Most dies have plug-in power cables to the different zones. Are the cables properly and clearly labeled?
- If the die is equipped with deckles, are the deckles being used properly to reduce edge trim?
- Are the deckles cleaned properly, lubricated, and in good working order?
- Do the Operators know how to use the deckles and are they?
- If the line is a cast line and using a vacuum box, are the seals properly installed and the vacuum box clean?
- Is the vacuum meter or manometer installed and in good working order?
- If the line is coextrusion, is the coextrusion combining adapter properly labeled and marked as to the layer distribution and position?
- If line is equipped with an automatic die, is die kept within its control range and is it understood by the Operator?
- Is the die and chill roll properly aligned?

As every line is different, it is difficult to draw a universal check sheet that will fill every need. However, it is recommended that a check sheet be developed to keep records that can be reviewed on the following audits. The Audit Team should develop check sheets based on the piece of equipment or plant they will be auditing.

The Audit Team now will need some basic tools as we move to the line section of the equipment. The following tools should be available:

1. Dial Indicator with magnetic base
2. Machinist Level
3. Tape Measure (metal)
4. 10 Pound Weight
5. 20 Pound Weight
6. Rope and Pull Scale

The machine line should be checked for the following at a minimum:

- Rotary Unions should be clamped to prevent rotation and should not leak under pressure.
- The Chill Roll needs to be checked for runout and measured against original manufacturer's specification. Total runout should not exceed .003 of an inch. Runout should be checked in several places along the length of the drum. The measurements should be maintained for future reference.
- If the line is an Extrusion Coating Line, the nip roll cylinders should be free moving and clear of scrap film trash.
- Nip pressure should be checked for uniformity across the roll face (nip a dollar bill).
- Nip roll should be free, concentric, and free of cuts, flat spots, etc.

- Chill roll, back-up roll, and all temperature controlled rolls should be checked for temperature accuracy and gauges properly located.
- The chill roll should be checked for surface finish.
- Spare chill rolls should be properly stored.

Prior to auditing the winder and unwinds, we should look at the line element. When we talk about web handling, two things are critical. The rolls must be **level** and **aligned**. The machinery level and tape can be used to check these items:

- Check each roll to make sure they are level.
 - Check alignment with tape going around the rolls in at least three places.
- * **Note:** Use the same lead roll as long as possible to prevent small distances from accumulating.
- If there are any nip rolls in the web path line, the nip pressure should be checked for consistency across the roll face.
 - A side view of the audited line with the measurements recorded will provide a permanent record of the finished results.
 - All idlers should be checked to make sure they are free turning and free of trim, excessive dust build-up, etc.

The level and alignment are extremely important as off-set roll will cause uneven tension forcing the web to shift sideways or wrinkle.

The unwinds on an Extrusion Coating/Lamination Line should be reviewed very closely by the Audit Team, as this can be a major cause of waste and quality problems. As there are many types of unwinds with various types of auxiliary equipment, we will discuss general areas to check for. Each Audit Team will need to address specifics depending on the unwind type:

- The brake system should be checked by the Audit Team and measure the actual tension vs. indicated tension using the known 10 and/or 20 pound weight. Often indicated tension level is not the actual resulting in problems downstream.
- The automatic roll splicing (if equipped) equipment should be checked for alignment and proper working order.
- Unwind should be checked for alignment and level (both shafts) in the "run" position.
- All downstream rolls should be checked (just like the line rolls) and measurements recorded.
- Actual tension as indicated should be checked with rope and scale.

The winder, because of the many different types and varying complexity, makes it difficult to outline a general audit guideline. However, the same basic rules apply:

- All nip rolls should be checked for constant pressure across the roll face.
- All idlers should be level and aligned.
- All rolls should turn freely and be free of trim, excess dirt, etc.
- Force transducer or dancer rolls should be checked for tension accuracy with the known weight to verify tension levels.
- Rider roll or lay-on roll should be checked for alignment and pressure in at least three (3) positions of its stroke. Pressure, both up and down, should be checked for accuracy. Rider roll pivots should be clean and rolls should move freely.
- Footage counters or measuring devices (if used) should be checked for accuracy.

This paper has attempted to give you a brief outline for auditing an Extrusion Line. Each Audit Team will develop their own target areas. These target areas can be directed by the cost analysis review at the start of each audit. We have only addressed the main parts of a line, but complete audits should include all auxiliary equipment, such as:

Measuring Gauges
Auto Die Function (If Used)
Trim Handling Equipment
Refrigeration Equipment
Treaters
PM Program
Waste Reduction Program
Skill of Personnel

Hopefully, improvements will come from auditing the complete system – remember:

Audits = Opportunity For Improvement

4/2/98