SAFETY SUMMARY

INTRODUCTION

Safety is everyone’s business. Whether you are an equipment operator, a maintenance person, a supervisor, or business owner, you are directly responsible for the day-to-day safe operation of your Engel equipment. It is your responsibility to maintain and operate this equipment in strict compliance with all applicable laws, safety regulations, and the manufacturer’s recommended procedures.

PROMOTING SAFETY

Institute a company safety program. The formation of an organized safety program is strongly recommended. This safety program should include the formation of a safety committee to review and update company safety policies on a regular basis. Establish a firm policy on safety regulations in the work place. Publish these objectives, spelling out each employee's responsibilities. Make certain that each employee knows what is expected of them.

SAFETY PROGRAM

The following steps are suggestions that a company developing, or expanding, a comprehensive safety program should consider:

1. Engel Industries carefully design safeguards into their products in order to minimize hazards. However, the manner in which equipment is incorporated into a manufacturing process may inadvertently create a hazard or otherwise defeat built-in safeguards. Closely examine the operation of your company’s processing equipment. Take notice of potential hazards. Install guards or take other appropriate action to eliminate hazard risks.

2. Make certain equipment operators and maintenance personnel are properly trained.

3. Setup a program of daily, weekly, and monthly machinery inspection. Make a check list. Keep a historical record of all maintenance work, repairs, and adjustments.

4. Frequently evaluate safety guards and devices during actual production runs. Correct any unsafe practice or situation immediately.

5. Establish safe, convenient material handling systems. If conveyor equipment is installed in your facility, it should conform to recommendations published in the ‘American National Standard, Conveyors and Related Equipment, Safety Standards for ANSI/ASME B20.1’ which are available from the American National Standards Institute (ANSI).

6. Provide personal protective equipment, such as safety glasses with side shields, safety helmets, tongs, gloves, hand pads, spats, and protective sleeves, as required to suit the operation.

7. Organize a company safety committee. Schedule periodic meetings on a regular basis to review and update all safety policies.

8. Establish a firm policy on safety regulations in the work place. Publish these objectives, spelling out each employees responsibilities. Make certain that each employee knows what is expected of them.

9. Investigate all accidents and close calls. Take immediate action to prevent a recurrence of the incident. Keep records of the investigation and the corrective measures taken.
10. Post a list of names, addresses, and phone numbers of physicians and others who are to be called in emergency situations.

CUSTOMER'S RESPONSIBILITIES

There are certain hazards associated with the operation of any equipment or system of machinery that are impractical, if not impossible, for equipment suppliers to safeguard. The user must address these hazards and be responsible for providing guards or barriers for establishing appropriate work procedures and for training personnel in the safe operation of that equipment.

With respect to coil and strip processing equipment, the following hazards should be noted:

- Open pits and depressions or raised areas in the floor.
- Space between machines, where strip edges and ends are exposed during feed-up, run, and tail-out conditions. This includes carry-over tables and both roller and belt conveyors.
- Nip and pinch points of machinery, coils, and strip which may be exposed in feed-up, run, and tail-out.
- Areas surrounding coil handling devices where coils are in motion.
- Areas surrounding payoff reels and recoilers, where clock-springing strip ends present a hazard during banding, un-banding, feed-up and tail-out conditions.
- Sheet and pack handling devices (including conveyors) where the motion, as well as shifting of sheets or packs, may present a hazard.
- The area surrounding sheet stacking devices, which must be approached for setup, but which should be clear of personnel during operation because of moving machinery or material.
- Areas associated with high temperatures, high pressure fluids (hydraulic, air, or water) and electrical devices and connections.
- The vicinity of machinery which moves into or out of the line.

REFERENCE SOURCES

Questions concerning specific hazards or safeguarding of equipment may be addressed to the equipment manufacturer. For additional information, refer to the sources listed here:

*American National Standards Institute (ANSI)*

ANSI B11.18, "Machinery and Machine Systems for the Processing of Coiled Strip, Sheet and Plate - Safety Requirements for Construction, Care and Use.”

ANSI B11.4, “Shears: Safety Requirements for Construction, Care and Use.”

ANSI B11.14, "Coil-Slitting Machines/Systems Safety Requirements for Construction, Care and Use.”

ANSI B11.18, "Machinery and Machine Systems for the Processing of Coiled Strip, Sheet and Plate - Safety Requirements for Construction, Care and Use.”

*National Fire Protection Association (NFPA)*

NFPA 79, “Electrical Standards for Industrial Machinery.”

*European Union*

“Directives on Safety of Machinery” and “CE Marking”
WARNING LABELS

Warning and safety related informational labels are placed on the Engel Industries Industries' equipment at strategic points. It is important that these labels not be removed, covered, hidden, or defaced. The purpose of these labels is to alert personnel to potential personal injury hazards or other direct or indirect safety concerns.

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING indicates a potentially hazardous situation which, if not avoided, could result in minor or serious injury.

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTICE indicates a company policy that relates directly or indirectly to the safety of personnel or protection of property.

It is important that the meaning of a safety sign be clearly understood b contact with the hazard. To increase the understanding of a safety sign Z535 committee encourages safety sign manufacturers and owners of facilities to publish and exhibit the following (above) information on safety posters, safety bulletins or the like. Doing so will assist in the objective of achieving a national uniform system for the recognition of potential personal injury hazards and accident prevention." - ANSI Z535.2, Annex A1

WARNING MESSAGES IN THIS MANUAL

Throughout this manual various DANGER, WARNING, CAUTION, and safety related NOTICE appear. The intent is to alert operator and maintenance personnel to potential hazards. In addition, important operation and maintenance details are emphasized with the NOTE heading.

SAFETY FIRST
The equipment in this line was designed and manufactured for a specific task. **DO NOT** use the equipment for any other function or to process material that is beyond the equipment’s design specifications. Modifications or additions to this equipment line should not be made without first consulting Engel Industries Industries. Replacement and maintenance parts should be equal to original equipment. Use of other parts may result in unsafe operating conditions. If there is a question as to the suitability of a part, Engel Industries should be consulted.

In general, every piece of equipment must be treated as dangerous. While operating or maintaining this equipment, each person must be aware of their own safety as well as the safety of all others around the line.

**Material Coils**

- Coils present numerous hazards. They may shift, roll or fall without warning. Some coils may spring open without warning. Sharp edges of the strip in the coil are hazardous. Stay clear of coils as they are being moved. Use extreme caution any time a coil is approached or handled.

**Metal Strips**

- The metal strip may have sharp or ragged edges. The strip is under tension and is subject to abrupt tension changes. This can result in strip breakage with the ends flying without warning. Stay clear of the strip whenever possible. When it is necessary to approach or handle the strip, use extreme caution. Use protective devices such as tongs, gloves, eye protection, and wrist guards as required for safety. The strip presents many pinch hazards with the machinery. Stay clear of these. Never step on or over strip in the line.

**Machinery**

- Never reach into any piece of machinery which is operating or which is capable of operation. Loose clothing or jewelry should be kept clear of machinery at all times. When working on one piece of equipment, be aware of hazards of surrounding equipment. Any item inserted into a machine may be thrown or may cause a dangerous malfunction or breakage.

**Safe Guards**

- No equipment should be operated unless the safe guards or devices supplied with the product are securely in place and properly adjusted.
ENGEL has conducted hazard evaluation and risk analysis studies for their products. **Safe guards installed on the equipment are there for a reason. BEFORE EQUIPMENT IS PLACED INTO SERVICE, ALL SAFE GUARDS OR DEVICES MUST BE IN PLACE AND PROPERLY ADJUSTED.**

**Maintenance**

Before performing any maintenance on a piece of equipment, insure that all power is locked off in accordance with your company’s lockout/tagout policy. Be sure that all movable members (*such as rolls, arms, tables, etc.*) are securely blocked from inadvertent motion which might be hazardous. Treat all electrical lines as being live and all piping as being under high pressure. Insure that all items are properly reassembled before placing them into operation. *Before equipment is returned to service, ALL safe guards or devices MUST BE in place and properly adjusted.*

**NOTICE**

Before doing any WELDING ON EQUIPMENT, the following precautions must be taken to insure against damage:

1) All power is removed from system.
2) The weld ground is connected to the closest possible location on the unit where the welding is being performed.
3) All encoders, sense eyes, and controls should be electronically disconnected if at all possible to avoid possible damage.

**Operation**

This equipment is capable of speeds, tensions, and adjustments which may be hazardous for some of the materials within the line specification. For example, thin, narrow strip may be subjected to tensions sufficient to cause breakage. Never attempt to process any material unless the safe adjustments for that particular are known and can be implemented.

**Traffic Around Equipment**

Care should be taken at all times in moving around the equipment, whether on foot or in a vehicle. Changes in floor elevation, machine bases and debris around the equipment are trip hazards. Take care that personnel are not trapped between vehicles and equipment.

**DANGER**

Do not attempt to walk or climb on any machine while in operation. Failure to observe this warning may result in death or serious injury.

**HAZARD REMINDER**

Use the following HAZARD REMINDER sheet to reinforce awareness of the hazards associated with coil processing lines. This reminder can be a useful supplement to your company’s safety program. **ENGEL suggests the following steps:**

1. SHOW each individual the HAZARD REMINDER sheet and explain each category of hazard.
2. POINT OUT EXAMPLES of each type of hazard on the actual equipment the individual operates or works around.

3. EXPLAIN HOW TO AVOID HAZARDS in the individuals work environment.

4. GIVE a copy of the HAZARD REMINDER sheet to each individual.

   Safety is everyone’s business!
THINK SAFETY FIRST

NIP POINT
When one object rotates near another, it can pull you in and crush you.

PINCH POINT
When one object moves closer to another, it can cut or pinch you.

MOVING EQUIPMENT and COILS
Can knock you off balance or crush you.

STRIP EDGES and ENDS
Can cut or strike you.

ELECTRICAL and FLUID SYSTEMS
Can shock and burn you and can explode.

CLIMBING ON MACHINES
Can make you fall - maybe into one of the hazards above.
1. LOCKOUT GUIDE

A. INTRODUCTION

An essential element of a comprehensive safety program includes the development and use of a written hazardous energy lockout procedure. The lockout procedure establishes the minimum requirements for the lockout of hazardous energy sources using an energy-isolating device whenever maintenance or service is performed on the processing line. The goal of this section is to outline a sample procedure that can be used as a guide when developing your own written procedures for complying with the requirements of O.S.H.A. 29 CFR 1910.147.

B. SCOPE

This procedure applies to all work on the processing line other than normal operational tasks. “Normal operational tasks” are tasks that:

- Do not require the employee to place any part of his body in a danger zone or point of operation.
- Do not require safety guards or safety devices to be removed or defeated.
- Do not expose the employee to hazards associated with the unexpected energization, start-up, or release of stored energy.

This procedure shall be used to ensure that the machine is stopped and isolated from all potentially hazardous energy sources and that these energy sources are locked out before employees perform any servicing or maintenance when the unexpected energization, start-up of the machine, or the release of stored energy could cause injury.

This procedure does not apply to minor tool changes and adjustments and other minor servicing activities that take place during normal production operations.

C. DEFINITIONS

1. Affected Employee
   Any employee who is performing service or maintenance on equipment or whose job requires the individual to work in an area in which servicing or maintenance is being performed.

2. Authorized Employee
   A person who locks or tags out machines or equipment in order to perform service or maintenance on that machine or equipment. An affected employee becomes an authorized employee when that employee’s duties include performing service or maintenance covered under this section.

3. Energy-Isolating Device
   An apparatus that isolates hazardous energy. The apparatus must be capable of accepting a lock and tag when equipment is being repaired or maintained.
(4) **Lockout**  
The placement of a lockout device on an energy-isolating device, in accordance with an established procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

(5) **Tagout**  
The placement of a tagout device on an energy isolating device, in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

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**CAUTION**  
Use of a tag in place of a lock does not adequately guard against accidental operation.

(6) **Servicing and/or maintenance**  
Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying and maintaining and/or servicing machines or equipment. These activities include lubrication, cleaning or unjamming of machines or equipment and making adjustments or tool changes where the employee may be exposed to the unexpected energization or start-up of the equipment or the release of hazardous energy.

D. **RESPONSIBILITIES**  
Department managers shall ensure compliance with the lockout/tagout procedure, provide training, and provide required materials as needed for compliance.

(1) **Department Supervisors shall:**  
- Develop lockout procedures for all equipment and keep documentation of the methods on file.
- Provide specific lockout method training to employees before allowing authorized employees to perform service or maintenance work.
- Assure that lockout procedures are audited on a regular basis and corrective actions taken and documented when necessary.

(2) **Maintenance Manager shall:**  
- Maintain a supply of locks, multiple lockout devices, plug locks, breaker locks, and any other devices needed to lock out machines or equipment.
- Maintain a supply of informational lockout warning tags.
- Notify the appropriate manager or department when energy isolation instructions or instructional signs need to be made or changed.
- Audit maintenance employee use of lockout procedures periodically, take corrective actions as required, and document all corrective actions taken.

(3) **Manufacturing Engineers shall:**  
- Assure that new equipment, rebuilt equipment, and equipment being renovated or upgraded has energy-isolating devices that are capable of being locked out before being installed or put back into service.
- Maintain a list of all plant equipment.
• Contact Safety Manager for review of new equipment prior to releasing the equipment to production.

(4) **Affected employees shall:**

• Notify one of the following departments for an authorized employee lockout whenever servicing or maintenance is needed:
  
  - Maintenance
  - Die Setters
  - Press Operators
  - Engineers and Technicians

• Never interfere with equipment that is locked out, remove a lock, or attempt to operate locked out equipment.

(5) **Safety Manager shall:**

• Develop and upgrade this policy as needed.
• Audit the lockout program at least annually.
• Assist in training.

E. **PROCEDURES**

(1) **Lock System**

• Locks to be used for lockout will be red, key operated padlocks and will be supplied to authorized employees using the current tool policy.

• One lock and one key will be issued to each authorized employee, unless an individual requires more than one lock on a regular basis.

• Each lock will be identified by the employee name and clock number engraved on the lock. Locks may not be loaned to other employees.

• Department locks used for group lockout or when extra locks are needed for a specific situation will be numbered by department and kept in the department office or an area lock bank. When locks from the bank are in use, tags will be left in the bank indicating date, where used, authorized employee name and id number.

• Locks may be used for lockout only. Red locks may not be used on lockers or tool boxes at any time.

• Only one key will be issued per lock. All duplicates will be destroyed, and no master keys will be kept.

(2) **Sequence of Lockout**

• Notify all affected employees that servicing or maintenance is required and that the machine or equipment must be shut down and locked out.

• Refer to the written lockout procedure for the equipment to determine the types and magnitude of the energy sources involved, understand the hazards of that energy, and the methods of control.
• Shut the machine down using normal operating means (stop button). Operate (shut
off, close, block, etc.) all of the energy-isolating devices. Lock out the energy-isolating
devices with the assigned red padlock(s). Mechanical power presses will have the
lockout procedures posted in a binder in each department supervisor’s office, listed by
asset number. Other equipment having multiple energy sources will have the lockout
procedure posted on the equipment.

⚠️ NOTICE
If more than one person is working on a machine, each individual must attach his own lock to the
energy-isolating device.

• Verify, by operating the normal starting means or using test equipment, that the
lockout has accomplished zero mechanical state. Return controls to off.

(3) Restoring Equipment to Normal Operation
• Remove tools, install guards, and notify affected employees, ensuring that they
understand and are in the clear.
• Verify that the operating controls are in the off or neutral position.
• Remove lockout devices and reenergize the machine.
• Notify affected employees that the machine is ready for use.

(4) Special Situations
Group Lockout is used when more than one employee must work on a machine at the same
time. One of the following must be used:
• Each employee shall place his lock on the energy isolating device(s).
• A multiple lock device (hasp) may be used if the energy-isolating device cannot
accept multiple locks.
• When multiple locks cannot be used, lockout can be accomplished by:
  ✓ An authorized employee may lockout (including all necessary steps) energy-
    isolating device(s) using identified departmental locks.
  ✓ The key to the identified departmental locks will then be placed into an identified
    lock box.
  ✓ All personnel associated with the lockout will then secure the identified lock box
    with their personal locks.
  ✓ As each individual completes his task, he will remove his lock from the lock
  ✓ When all locks have been removed from the lock box, the authorized employee
    who made the original lockout may remove the locks from the energy isolating
    devices, following all steps in restoring a machine to service.

Shift Changes must maintain continuity of lockout and the safety of incoming employees using
the following procedure.
• The lock(s) of the authorized employee(s) of the first crew will be replaced with
  identified departmental locks.
• The departmental lock keys will then be given to the supervisor, who will supply them
to the incoming crew.
• The incoming crew will then verify lockout using all procedures before replacing the
departmental locks with their own or using lock box procedures.

Contractors working in the company plant must have lockout procedures that meet or exceed
the standard.

• Prior to beginning work, each contractor must supply the company with the written
lockout procedures to be used.

• The contractor’s procedure will be reviewed by the Safety Manager and the
contractor will be approved or rejected.

• If approved, the contractor’s procedure and the company procedure will be reviewed
in a joint meeting so that each party is aware of the other’s procedure.

• Under no circumstances will the company provide a contractor with locks or
advice on lockout procedures, other than assistance with identifying energy sources
and energy isolating devices.

Lock removal by other than the owner of the lock may only be done if all of the following
conditions are met.

• The supervisor must verify that the authorized employee who placed the lock is not in
the facility.

• The supervisor must make a reasonable effort to contact the employee to verify the
condition/situation with the equipment and to inform the employee that his lock is
going to be removed.

• The supervisor must insure that the person knows his lock has been removed prior to
resuming work in the facility.

• The supervisor completes the Safety Lock Removal Incident form. This form must be
reviewed with the appropriate department manager and the Safety Manager.

F. TRAINING

The following sample outline may be used as a guide when developing a lockout/tagout
training program for your company’s employees.

(1) Authorized Employees must be trained in the following:

• Recognition of applicable hazardous energy sources.

• The type and magnitude of the energy available in the workplace.

• The methods and means necessary for energy isolation and control.

(2) Affected Employees must be trained in the following:

• The purpose and use of the energy control procedure.

• The prohibition and dangers of related to attempts to start or reenergize machines
that are locked out.

(3) Retraining

Retraining will be provided for authorized and affected employees whenever one of the
following occurs. The retraining should reestablish employee proficiency or introduce new
methods and procedures as needed.
- There is a change in their job assignments.
- There is a change in equipment, machines, or processes that present a new hazard.
- There is a change in energy control procedures.
- Periodic inspection reveals or there is reason to believe that there are deviations from this policy caused by inadequate knowledge of the procedure.

⚠️ NOTICE
Deviations from this policy due to negligence on the part of the employee must be dealt with by the established corrective action policy.

4) Training
- Training must be certified, including the date and time of training and each Records will be filed by the Safety Manager.
- Training will follow the Lockout Program Training Outline.

G. TRAINING OUTLINE

1) Why lockout?
   1. To prevent injury from the accidental start-up or release of energy while performing maintenance or testing.
   2. To comply with O.S.H.A. 1910.147.
   3. It is the RIGHT thing to do.

2) What are sources of energy?
   - Thermal
   - Pneumatic (air)
   - Gravity
   - Hydraulic
   - Electrical
   - Mechanical

3) Sequence for lockout:
   1. Notify all affected employees.
   2. Shut down equipment by normal methods.
   3. Operate controls/dissipate energy (return controls!)
   4. Lockout energy isolation devices
   5. Verify lockout.

4) Lock system:
   1. Locks are RED key operated locks.
   2. ONE lock, ONE key issued to authorized employees (additional locks, individually keyed may be required for some authorized employees).
   3. EACH lock (with one key) will be identified by employee name and clock number.
4. Department locks will be numbered and identified by department and kept in:
   - The department office in a lock bank.
   - In the area on a lock bank.
   - In a cabinet.
5. Locks will be purchased by departments (by Managers ONLY).
6. Lock replacement policy - use existing tool policy.
7. Locks must be in the care of the personnel to whom they are assigned whenever on duty.
8. Identification tags will be placed in the lock bank when locks are in use indicating:
   - Date.
   - Equipment where used.
   - Authorized employee name.
   - Authorized employee ID number.

(5) The lock:
1. Must be readily identifiable as a lockout lock.
2. Can be used for lockout ONLY.
3. Can have only ONE key for each lock.
4. Can NOT have a “master key”.
5. Must be individually identified.
6. Personal lockout locks CANNOT be lent or borrowed.
7. MUST be used.

(6) When is lockout not required?
Lockout is not required for minor tool changes and adjustments and other minor servicing activities which take place during normal production operations.
This is ONLY applicable if they are ROUTINE, REPETITIVE and INTEGRAL to the use of the equipment for production, provided that the work is performed using alternative measures which provide effective protection.

(7) When do we lockout?
1. A machine or line which is OPERABLE FOR PRODUCTION can be SERVICED, ADJUSTED, and/or TESTED without lockout if:
   - The person is NOT required to place any part of his/her body in jeopardy
     and
   - The person is NOT working where a safety guard is removed or a safety device is defeated.
     and
• The person is not exposed to unexpected energization, start-up or release of stored energy.

2. When servicing, testing, and maintaining equipment in which:
   • The unexpected energization of machines or equipment COULD CAUSE INJURY OR DEATH.
     or
   • The unexpected start-up of machines or equipment COULD CAUSE INJURY OR DEATH.
     or
   • The release of stored energy COULD CAUSE INJURY OR DEATH.

(8) What about contractors?
Each contractor working on projects in the plant must have lockout procedures that meet or exceed the standard.

Prior to beginning work, the responsible representative of the contractor and will meet with the company contact to review the lockout procedures of the contractor and the company.

The company contact or project coordinator shall review the contractor’s lockout procedure with any company personnel who will be involved with the project.

(9) Unfamiliar with lockout?
When a service or technical group must inspect or perform work on an unfamiliar operational unit, an operations or maintenance supervisor familiar with the unit shall be on site and will actively participate in the lockout. The operations or maintenance supervisor duties include the verification of zero mechanical state and active participation in the lockout removal procedure.

(10) How do I know where to put my lock(s) for lockout?
   1. Refer to the Equipment Lockout Survey (developed by the Safety Committee or Safety Manager) which identifies lockout points for each machine.
   2. If not sure, contact knowledgeable operations or maintenance supervisor who will actively participate in the lockout, including verification of zero mechanical state and active participation in lockout removal procedure.
   3. VERIFY LOCKOUT BEFORE BEGINNING WORK.

(11) Verify lockout - how?
• Testers
• Operate Controls

(12) Group lockout
   1. Each person shall place their lock(s) on the appropriate energy isolating device(s).
   2. A multiple lock device (hasp) may be used, if the energy isolating device cannot accept multiple locks.
   3. When multiple locks are not used, lockout can be accomplished by:
      • An authorized person may lockout (including all necessary steps) energy isolation device(s) using an identified departmental lock(s).
• The key to that identified departmental lock(s) will then be placed into an identified lock box.

• All personnel associated with the lockout will then secure the identified lock box with their personal locks.

(13) Department lock banks
All departments will maintain a “lock bank”. A lock bank is a storage area for identified departmental locks. Authorized personnel may “borrow” identified lockout lock(s) by recording the following information:
1. The identification number of the “borrowed” lockout lock(s).
2. The name of the authorized person who is “borrowing” the lockout lock.
3. The date the lockout lock(s) were “borrowed”.
4. Where the “borrowed” lockout lock(s) are being used.

(14) Restoring machines/equipment to normal operation.
1. Check area around machine/equipment.
2. Remove tools, install guards, notify affected employees, verify affected employees understand change of status, and verify they are clear of equipment.
3. Verify that Operating controls are in the de-energized (OFF) position.
4. Start-up of machine/equipment may then be accomplished.

(15) What about shift changes?
To ensure the continuity of lockout during shift changes:
1. The lock(s) of the authorized employee(s) of the first crew shall be replaced with identified departmental lock(s) from the “Lock Bank”.
2. The identified departmental lock key(s) will then be supplied by the Supervisor to the authorized employee(s) of the second crew.
3. The authorized employee(s) of the second crew will then replace the identified departmental lock(s) on the controlling device(s) or will use lock box procedures.

(16) Removing locks
1. Can ONLY be done by the person who place their personal lock(s) on the device.

2. When the person cannot remove the lock, the lock can be removed under the following circumstances:
   • Supervisor or leader verifies that the authorized person who applied the lock to the device(s) is not at the facility.
   • Supervisor or leader must take all reasonable efforts to contact the authorized person (informing them that the lock is going to be removed).
   • Supervisor or leader ensures that the authorized person has this knowledge BEFORE they resume work at the facility.
   • A REMOVAL FORM must be filled out. The Supervisor and Manager must review the form with the Safety Manager and Plant Manager.
(17) Retraining

1. When there is a change in job assignment, machines, equipment, or processes that present a new hazard or there is a change in the energy control procedure.

2. Shall re-establish employee proficiency and introduce new or revised control methods and procedures as necessary.

3. The company shall certify that employee training has been accomplished and is kept up-to-date.

4. Certification.
1. MATERIAL PROCESSING

A. INTRODUCTION

Unfortunately, most material that you will process through your Engel processing line will not arrive at your receiving dock in perfect condition. Suppliers of coil stock have tolerances, for the quality of their product, just like all manufactures.

With this in mind, we have added this section to the operator’s manual. If you have processed coil stock prior to installing your processing line, you will be very familiar with the conditions described. If not, this section should help you recognize the problems that can be found in coil stock and provide possible solutions.

B. COIL QUALITY

Commercial quality coils are produced to decimal thickness and are subject to thickness, width and camber tolerances only. It should also be noted that there are no tolerances for flatness, guaranteed for commercial quality coils.

Specified thickness:

<table>
<thead>
<tr>
<th>Coil:</th>
<th>0.1419</th>
<th>0.0971</th>
<th>0.0709</th>
<th>0.0567</th>
<th>0.0388</th>
<th>0.0194</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width:</td>
<td>0.0972</td>
<td>0.0710</td>
<td>0.0568</td>
<td>0.0389</td>
<td>0.0195</td>
<td>0.0142</td>
</tr>
<tr>
<td>12-15&quot;</td>
<td>± 0.005</td>
<td>± 0.005</td>
<td>± 0.005</td>
<td>± 0.004</td>
<td>± 0.003</td>
<td>± 0.002</td>
</tr>
<tr>
<td>15-72&quot;</td>
<td>± 0.006</td>
<td>± 0.005</td>
<td>± 0.005</td>
<td>± 0.004</td>
<td>± 0.003</td>
<td>± 0.002</td>
</tr>
</tbody>
</table>

Thickness to be measured at any point across the coil but not less than 3/8" from side edge.

Width tolerance:

<table>
<thead>
<tr>
<th>Coil Width:</th>
<th>Tolerance:</th>
</tr>
</thead>
<tbody>
<tr>
<td>12&quot; to 30&quot; inc.</td>
<td>Plus 1/8&quot; Minus 0&quot;</td>
</tr>
<tr>
<td>over 30&quot; to 48&quot; inc.</td>
<td>Plus 3/16&quot; Minus 0&quot;</td>
</tr>
<tr>
<td>over 48&quot; to 60&quot; inc.</td>
<td>Plus 1/4&quot; Minus 0&quot;</td>
</tr>
<tr>
<td>over 60&quot; to 80&quot; inc.</td>
<td>Plus 5/16&quot; Minus 0&quot;</td>
</tr>
</tbody>
</table>

Camber tolerance:

Camber tolerance, for coils is 1 inch in any 20 feet of material.

All of the tolerances listed are commercial tolerances and are what you can expect from your supplier if you do not specify higher quality coils. It is very important that you work closely with your steel supplier so that he knows what quality you require. If your product or customer requires higher quality parts you must purchase higher quality coil stock or have the ability to improve the coil yourself.
C. EQUIPMENT USED TO IMPROVE COIL QUALITY

(1) Straightener

This is a multiple roll machine with the upper rolls offset from the lower rolls. This arrangement allows the upper rolls to be adjusted below metal line and between the lower rolls. As the material moves through this machine it is forced up and down through these rolls and as a result will remove the “coil set” from the coil. This process will also remove “cross bow” (curvature across coil) that is a product of coil set. A straightener will not remove any other type of coil defect. If other defects are to be removed different correction equipment must be used such as a leveler. The alternate to other expensive equipment is to purchase higher quality coil where it is required.

(2) Leveler

A leveler can be placed in line with most coil lines to condition and improve the quality of the coil before it is slit and cut to length. The leveler is like a straightener except for one important difference, there are adjustments to allow the operator to bend the rolls across the width of the coil. If the lower rolls are bent up in the center of the machine it will create a longer path for the metal in the center when it travels through it. This will stretch the metal on the centerline. The machine can also be set to stretch the edges.

A leveler provides the ability to selectively stretch different portions across the width of the coil. By stretching the center you can remove edge wave. By stretching the edges you can remove center buckle. Conditions that a leveler will remove or improve are: cross bow, coil set, minor coil breaks, twist, quarter buckle, center buckle and edge wave. Camber is a condition that a leveler can not remove or reduce.

(3) Stretcher leveler

This machine is used for all of the above, but is a very expensive unit that is usually only found in mills and steel warehouses, It is best to order higher quality coil from a supplier who has this equipment, and specify stretcher leveled coil.

D. IMPROVING QUALITY

The shear line is not a “magic machine”. It will only cut perfect blanks from perfect material.

- A straightener will only remove coil set and cross bow that is a result of coil set.
- A leveler will only remove or improve the conditions listed above.
- Nothing will remove camber in this line or any shear line we know of.

With these things in mind, let’s take a look at a few adverse conditions that you may run into and how we can make the best of them.

(1) Coil Set & Crossbow

Coil set is a curvature of the material in the length direction and can be viewed by rolling out a length of material. It is caused by tightly rewinding the material at the mill. This is a normal condition with any coil regardless of quality.

Normal crossbow is a curvature across the width of the coil, curving in the same direction as coil set. If crossbow is in the opposite direction from coil set it is an additional defect that will not be relieved by a straightener.
Coil set can be easily removed by proper application of the straightener. When coil set is removed normal crossbow will automatically disappear.

Until you are familiar with the operation of the machine you will need to experiment with the settings on the straightener.

- The entrance rolls should be engaged the deepest, with the depth trailing off on the remaining rolls.
- Coil set in a coil becomes greater closer to the center of the coil. The operator needs to monitor the material at the shear to determine if further adjustment needs to be made. This adjustment can be made while the machine is running.
- If you are having problems getting the straightener to operate on what you believe is good material, check to be sure that the upper rolls are parallel to the lower rolls. Most Engel straighteners have an adjustment to correct this or to purposely set them out of parallel.
- Some parts, because of stress or other defects in the coil, will have some coil set remaining only in one side of the part. If this happens the upper rolls can be purposely set out of parallel, but remember to return them back to parallel when the coil is changed.

(2) Edge Wave

Edge wave is usually caused by too much pressure on the ends of the rolls and center deflection during the reduction process at the rolling mill. This condition can not be corrected with a straightener. It must be removed with a stretcher or roller leveler.
To remove edge wave, the center of the rolls in a roller leveler must be bent upwards to create a longer path through the leveler in the center than the edges. This will stretch the center of the coil and remove the edge wave.

(a) **Self Induced Edge Wave**

Your processing line has the capability to induce edge wave into the coil if it is not setup correctly. If you see edge waved parts coming out of the shear, but not going in, check all of the pinch roll setting. If pinch rolls are set with too much spring tension or not set for the correct clearance, the condition will induce edge wave into the part. These adjustments are especially critical on thin materials and softer materials such as aluminum or brass.

(3) **Center Buckle**

Center buckle is the opposite of edge wave, the rolling mill used too much pressure in the center of the reduction rolls and stretched the center of the coil. No straightener will remove center buckle.

![Image of loose centers or center buckle]

To remove center buckle on a leveler, leave the center of the lower rolls level and raise the ends of the rolls upward. This will produce a longer path through the machine for the sides of the coil than the center, thereby stretching the sides of the coil to match the center. Using this logic, buckles at any location, across the coil, can usually be removed by stretching the smooth portion.

(a) **Self Induced Center Buckle**

If your machine has back up rollers on any of the pinch rolls, incorrect settings may cause the processing line to induce center buckle. If center buckle appears after the material runs through the processing line, the backup tension probably is too tight.

(4) **Camber**

Camber is one of the most difficult coil conditions that you will run into. It is very important that you understand camber, and how it will effect your parts being cut. Camber is caused in one of two ways, by the steel processor (*using too much pressure on one side of the rolls*) or during improper slitting to width.
Camber is a curvature of the side edges and is measured on the concave side to a straight line. The easiest way to see camber is to cut two parts 20 foot long and lay them flat on the floor. Lay the two parts side to side and turn one part end to end. If you have camber in the coil, there will be a gap in the center between the two parts or a gap at the ends of the parts. This gap will be twice the actual camber of the coil in 20 foot.

**NOTICE**

NO STRAIGHTENER OR LEVELER WILL REMOVE CAMBER! Commercial camber tolerance is very large. Commercial camber tolerance is 1” in any 20 feet of coil length.

If you need parts for your production or customer with no or little camber, you must work with your coil supplier and purchase higher quality coil. It is the only way around this problem.

The next few pages show how camber will affect your parts and how to set the machine to minimize the effect.

The drawing below along with the following table shows a cut length with the maximum amount of camber allowed in commercial quality coil, and how it will effect the length measurement of various parts 60" wide.

You will notice that side A will be 0.830" longer than side B for a 100" part length.

If you use narrower coils the difference will be proportionally less and if you use wider coils it will be greater, and as the part gets shorter the difference is less.

There is nothing that you can do to improve this situation, except to purchase higher quality coils. Cambered coils can be used for shorter parts if the difference will not affect the final part.
As you can see from the illustration above, it is impossible to cut a rectangle from cambered coil, the best you can hope for is a trapezoid, with cross corner, matching dimensions. To do this, adjust the squaring mechanism on the shear head until the diagonal measurements are equal.

You may also need to adjust your part length, as most Engel shear lines measure the center line of the material, making cambered material short on one side and long on the other.

Another way to detect camber without cutting two 20 foot parts is to cut five or six parts that can accurately be measured for length, possibly around 20" long. Measure and record the length of the right side of all parts and do the same for the left side of the parts. If the parts are consistently longer on one side than the other, the coil is cambered.

Camber is usually found in all coils to one degree or another, and is usually the same direction and to the same degree throughout the entire coil, but beware of the coil where it changes direction.

A change in camber direction will show up in your cut blanks losing the equal diagonal measurement. If this happens, the shear head will need to be re-squared. While reversal of camber within a coil is uncommon, it will sometimes happen.

### Table 1. Typical Camber

<table>
<thead>
<tr>
<th>X CAMBER (x=Amount of Camber in 20 ft)</th>
<th>C PART LENGTH</th>
<th>A DIM.</th>
<th>B DIM.</th>
</tr>
</thead>
<tbody>
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</table>
### Table 1. Typical Camber

<table>
<thead>
<tr>
<th>X CAMBER (x=Amount of Camber in 20 ft)</th>
<th>C PART LENGTH</th>
<th>A DIM.</th>
<th>B DIM.</th>
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(5) Slitting

If you have an Engel slitting line, you have the capability to slit to width and cut to length in the same operation. It is important that you fully understand how the topics we have discussed previously will effect the slitting operation.

(a) **Coil set and crossbow**

If these are not fully removed, they will seldom effect the slitting operation.

(b) **Edge wave and center buckle**

These conditions can affect the slit parts to a great degree, especially if the slit passes through them. These buckles mean that there is excess material in these areas. The slitting process will release stress, in these areas, and the slit strands can move to the right or left and leave you with cambered strips at the cut off shear.
The slit strips can spread apart or even overlap by the time they get to the shear. You can see that if the strips go in opposite directions, there is no way to square the shear head to them.

(c) Camber

Camber will give all of the same problems as described before, plus you can put camber into the strips, if you do not set up the slitter properly.

When setting up the slitter, be very sure that all inside blades are forcing the material in the same direction.

If the slitter is set up improperly, it will have a tendency to stretch one edge of the material, thus inducing camber.

*Camber can not be reduced or eliminated by edge trimming.* Some people incorrectly believe that it is possible to remove camber by edge trimming, but it cannot be done, all you do is reduce the width of the coil.

E. MACHINE CAPACITY

The model number of all ENGEL cutting and bending machines will give the maximum width of material, and the gauge capacity of the machine.

(1) Mild Steel

The maximum gauge capacity of all ENGEL machinery is specified in terms of mild steel.

We define mild steel, for purposes of this specification, as being carbon steel, that contains less than 0.25% carbon, and have an ultimate tensile strength of less than 67,000 psi and ultimate yield strength of less than 50,000 psi.

(2) Shear Strength

This characteristic is the most important mechanical specification you will need to know in determining the capacity of your machine.

It is used to determine if the material is within the range of your machine for slitting and shearing.

If you do not know the shear strength of the steel you are processing, but know the tensile strength, multiply by .75 to obtain the shear strength.

*Example:*

\[
\text{Tensile strength} \times .75 = \text{Shear strength}
\]

\[
67,000 \text{ psi} \times .75 = 50,250 \text{ psi}
\]

For other materials, this formula is fairly accurate for estimating the shear strength, but if you use the following formulas for determining your machine capacity, for materials other than steel, and you are close to the maximum, please consult your supplier for accurate shear strengths.

(3) Yield Strength

This characteristic is important when it comes to the straightening or leveling process, to insure that you keep within the capacity of your machine. It has nothing to do with the shearing and slitting process. Yield strength has no practical relationship to tensile
strength for our purposes, but it is a very easy number to get from a steel book or from your supplier of material.

(4) Material Limitations

There are really no limitations, to the type of materials that your ENGEL line will process, as long as you stay within the Shear Strength and Yield Strength limitations, and maximum and minimum thickness limitations.

(5) Materials other than Mild Steel

Many other materials such as aluminum, stainless steel, brass etc. can be processed on your machine, if within the overall limits of the machine.

The following is not a guarantee by Engel that you can run materials that the following formulas suggest, but only a guideline to the possibilities.

For instance you will not be able to process thin, high tensile spring steel, although the formulas suggest this. You will not be able to straighten material such as this, although you can cut it.

It is always best to make a trial run, of the suspect material, before committing yourself to running it in production, especially when attempting, high tensile steel or materials that are close to the limits when using the following formulas.

As stated before, there are two considerations to be made when determining if a particular material and/or thickness can be processed in your machine. These are the Shear Strength, for cutting and the Yield Strength for straightening.

To determine if the Shear Strength falls within your range, use the following formula.

50,000 psi x the maximum gauge of your machine. = index number.

Example:

50,000 psi x .062" (16 GA.) = 3100 index number for cutting.

To determine the maximum thickness, you can cut with a higher or lower Shear Strength, divide this number by the Shear Strength of the material in question.

Example:

3100 divided by 63,000 psi = .049"

This means, you can cut .049" material with a Shear Strength of 63,000 psi with your shear. But will you overload your straightener?

To determine the index number of your straightener use the same logic, but substitute the Yield Strength of mild steel.

Example:

50,000 psi x .062" (16 GA.) = 3100 index number for straightening.

Again, divide this index number by the Yield Strength, of the material in question, to give the maximum material that can be straightened without overloading your machine.

Example:

3100 divided by 32,000 psi = .096"
This means that you can straighten a maximum of .096” of material but you could not cut it if it has a higher Shear Strength.

From the two examples given, you can see how to determine the capacity of your machine for different materials, other than mild steel, and why it is important to check both the Shear Strength and Yield Strength.

**Table 2. Common Non-Steel Shear and Yield Strength**

<table>
<thead>
<tr>
<th>ALUMINUM</th>
<th>SHEAR (psi)</th>
<th>YIELD (psi)</th>
<th>SHEAR (psi)</th>
<th>YIELD (psi)</th>
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### Table 2. Common Non-Steel Shear and Yield Strength

#### ALUMINUM

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<th>Material</th>
<th>Shear</th>
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#### STAINLESS STEEL (full annealed only)

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