

Chapter B

SPARE PARTS

Spare Parts Inventory

Spare parts for an extrusion plant usually represent a major investment, typically about 5% of initial equipment cost. Most plants experience some downtime waiting for parts, and spend considerable time and effort having parts specially made or flown in on a rush basis. Maintenance workers usually complain that the stockroom doesn't have what they need, but instead is filled with items they don't use, and many obsolete or useless items. Go through the parts inventory a couple of times every year to clean out obsolete items and note anything important that may be missing. A carefully thought-out spare parts policy may well save you from disaster some day. It is best if prepared in written form. It should include:

- **a plan for every major component** – whether to stock it, wait until needed to buy it, or have it made (the decision is based on delivery and how critical the parts are).
- **a system for keeping an inventory of components** such as containers and stems, which are repaired and returned to inventory (in some plants, used parts are not included in the inventory records system). Keep these on a PC for instant reference, and record if the parts have been sent out for repair.
- regularly screening for and **removal of obsolete parts**.
- **proper storage conditions** and occasional **inspection** of spares.



Figure B-1: Inspecting die carrier (Photo courtesy of RL Best)

The following recommendations are offered for maintaining spare tools such as the container, liner, ram stem, dummy blocks, cylinders, etc.:

- **Maintain accurate drawings** for all tools, for purchase and inspection of repairs or replacements.
- **Inspect spare tools when received** (new or repaired) for condition and conformance to dimensions.

Recommended spare parts

The list of recommended spare parts for any particular extrusion plant depends on several considerations:

- the design and age of the press and other equipment
- the delivery time for different types of parts (plant location with respect to suppliers)
- the history of parts failures for the particular press system
- how critical or costly down-time will be if waiting for parts
- each company's policy regarding spare parts inventory – many companies set a maximum inventory value.

For these reasons it is impossible to generate a single spare parts list which is correct for every plant. Still, a few suggestions are offered here which may be useful as a general reference guide for maintenance managers.

When considering whether to stock a particular part as spare, the cost of not stocking it should be evaluated according to the formula:

Total Risk = Severity of Failure X Probability of Failure

For example, in the case of a part which has a probability of failure of 10%, and the cost of a failure (in terms of lost production, overtime, etc.) would be \$10,000, then the risk could be considered as $0.10 \times \$10,000 = \1000 . If the part costs less than \$1000, consider stocking it.

To minimize total parts inventory, standardize on as many common component parts as possible, so that one part in inventory will fit in many places. For example:

- limit and proximity switches and photocells
- control instruments, relays, and PLC system components
- electrical fuses, connectors, and pushbuttons
- fittings for pipe and hydraulic tubing and hoses
- hydraulic pumps, filters, valves, and other components
- combustion safety switches and valves, etc.

Where these types of parts are listed below, a (+) indicates that the part will probably also serve as a spare for other equipment.

Another important factor in the decision whether to stock a particular part is the availability locally of replacement parts or rebuild services, for example a local shop which can rewind electric motors and return them to service in a few hours. Whether your plant is located in an industrial region with good parts supply, or located far from the nearest suppliers, will be the deciding factor on many parts, and these are indicated below as (±).

As always, consult your equipment suppliers for their spare parts recommendations. When buying new equipment, always insist that the supplier use the same component parts that you have in stock, as far as possible. For custom-fabricated parts, always request detailed drawings from the supplier to allow quick local fabrication in an emergency.

If maintenance can be scheduled in advance, it will improve the chance of having necessary parts on hand. If maintenance can be scheduled on week days instead of the weekend, it will be possible to get parts that were not planned for.

Extrusion Press --- Recommended Spare Parts List

Mechanical

- Complete set of packing, “O” rings, and gaskets for main ram, crosshead cylinders, container cylinders, butt shear, and die change cylinders
- Container cylinder (one) (very important: it is not unusual to bend or break a container cylinder rod)
- Crosshead cylinder (one)

Hydraulic

- Main pumps (complete set); or rebuild kits for all pumps if plant is equipped and trained for in-house rebuilds. (A complete set is recommended because failure of one pump often releases particles which then damage the other pumps.)
- Coupling for main pump
- Auxiliary pump(s) (one spare for each pump)
- Complete servo-valve (one)
- Filters --- complete set
- Spools for valves --- complete set
- Solenoid coils

Electrical

- Container heating elements --- complete set
- Motor for main pump
- Temperature controller ‡

Tooling

- Container with liner (one)
- Stem (one)
- Fixed dummy blocks (3 to 5)
- Die carrier (for Unistation or Rotostation die changers)

Press feed Line --- Recommended Spare Parts

Billet/Log Feed Conveyor

- Carrier chain (3 to 6 feet/1 or 2 meters) (for chain-bottom furnaces)
- Drive motor ‡
- Cylinder packing, O-rings, gaskets for push-type cylinder (if installed)
- Hydraulic system pump, filters, valves, fittings and hoses †

Billet/Log Heater - Gas Fired

- Complete temperature probe assembly (one or two)
- Rebuild parts for temperature probe assemblies, including: air cylinder rebuild kits, probe rods, insulators, springs, fiber block holder, coils for air solenoid valves, microswitches
- Billet support rollers and bushings (or carrier castings for chain-bottom type oven) - (12)
- Crown refractory blocks (2)
- Side refractory blocks (4)
- Mortar or fiber seals for refractory
- Burner tiles (6)
- Pilot burner tiles (2)
- Pilot tips (4) †
- Spark plugs (4) †
- Flame rod assemblies (2) (or flame detector UV sensors) †

- Flame rods (4) †
- Air damper control (Modutrol) motor †
- Flame detector protection relay †
- Pilot gas regulator †
- Pilot gas solenoid valve †
- Diaphragm kit for main gas regulator (or a spare regulator) †
- Safety shut-off valve †
- Temperature controller ‡

Billet/Log Heater - Induction

- Complete thermocouple assembly
- Coil
- Coil liner
- Coil liner insulation
- Capacitor fuses

Log Shear

- Spare shear tools or cutters
- Cylinder packing, O-rings, gaskets for main and auxiliary cylinders
- Spare auxiliary cylinders (rods may be sheared or broken in case of control failure)
- Hydraulic system pumps, filters, valves, fittings and hoses †
- Limit and/or proximity switches †

Billet Conveyor

- Drive chains
- Gearbox
- Drive clutch

Billet Lubrication

- Spark plug (for flame type billet lubricator)

Profile Handling Systems --- Recommended Spare Parts

Water Quench

- Water pump
- Spray nozzles
- Solenoid valves

Slat Conveyor

- Carrier chain --- 30 to 40 feet (10 meters)
- Slats (30)
- Slat covers and sides --- graphite or Kevlar (30)
- Hydraulic drive motor and drive chain
- Hydraulic system pump, filter, valves, fittings and hoses † or,
- DC drive motor, gearbox, drive chain
- Limit and proximity switches and/or photocells †

Roller Conveyor

- Rollers
- Roller covers
- Drive motor ‡, gearbox, drive chain (if powered)
- Cylinder packing, O-rings, gaskets for hydraulic lift cylinder(s) (if installed)
- Hydraulic system pump, filter, valves, etc. (if installed)
- Limit and proximity switches and/or photocells †

Hot Profile Saw

- Blades
- Saw motor ‡
- Hydraulic motor for positioning drive
- Hydraulic system pump, filter, valves, fittings and hoses †
- Limit and proximity switches and/or photocells †
- Carriage wheels

Hot Profile Shear

- Blades (2)
- Hydraulic cylinder
- Cylinder packing, O-rings, gaskets
- Hydraulic system pump, filter, valves, fittings and hoses †

Puller

- Drive cable or chain
- Position encoder
- Carriage wheels and/or bearings
- Drive motor (usually a special motor)
- DC drive controller
- Drive brake
- Gripper fingers and springs
- Limit and proximity switches and/or photocells †

For Linear Motor-Type Pullers:

- Linear motor (1 complete motor)
- Electric jaw actuator (Tully-type)
- Sliding contact rails and follower shoes for electric feed (complete set)
- Position encoder

Lift-Overs (if installed)

- Graphite (or Kevlar) covers (10)
- Eccentrics (6)
- Drive motor(s) ‡, gearbox, drive chain (if installed)
- Cylinder packing, O-rings, gaskets for hydraulic or air drive or lift cylinders (if installed)
- Hydraulic system pump, filter, valves, fittings and hoses †
- Drive shaft (2)
- Drive shaft bearings (4)
- Drive shaft couplings (4)
- Limit and proximity switches and/or photocells †

Walking Beams (if installed)

- Graphite (or Kevlar) slat covers (10)
- Eccentrics (6)
- Drive motor(s) ‡, gearbox, drive chain (if installed)
- Cylinder packing, O-rings, gaskets for hydraulic or air drive or lift cylinders (if installed)
- Hydraulic system pump, filter, valves, fittings and hoses †
- Drive shaft (2)
- Drive shaft bearings (4)
- Drive shaft couplings (4)
- Limit and proximity switches and/or photocells †

(Many parts should be common for lift-overs and walking beams, also transfer beams to saw feed conveyor.)

Belt Systems

- Spare belts (about 20% of one complete set, but 40% of one set for the hottest service area, depending on actual experience)
- Spare pulleys (head, tail, and take-up --- about 5 sets)
- Complete belt conveyor units, including frames, for quick change-out (3 or 4 units)
- Actuator air cylinders for retracting belts at the stretcher (4 cylinders); also rebuild kits
- Drive gearmotor(s)
- Drive shafts (2), bearings (6) and couplings (6)
- Limit and proximity switches and/or photocells †

Stretcher

- Jaw inserts --- 1 set
- Cylinder packing, O-rings, gaskets for all cylinders
- Hydraulic pump (or rebuild kit), filter, valves, fittings and hoses †

Saw Feed Conveyor

- Rollers (20)
- Roller covers (20)

- Drive belt
- Drive motor ‡, gearbox, drive chain

Finish Saw

- Blades (2 minimum)
- Clamp pads
- Blade lubricant applicator system
- Cylinder packing, O-rings, gaskets for hydraulic and/or air cylinders
- Hydraulic system pump, filter, valves, fittings and hoses †
- Limit and proximity switches and/or photocells †
- Foot-operated switch

Length Gauge

- Rollers
- Roller covers

Profile Stacker

Gantry-type:

- Chain for positioning spacer bars
- Limit and proximity switches and/or photocells †
- Linear bearing and guide rod
- Gantry carriage wheels

Support-roller type:

- Chain
- Rollers
- Cylinder packing, O-rings, gaskets for hydraulic lift cylinder
- Hydraulic system pump, filter, valves, fittings and hoses †
- Limit and proximity switches and/or photocells †

Age Oven

- Fan blade for circulation blower

- Drive belts for circulation blower (1 set)
- Door seals (1 set)
- Air damper control (Modutrol) motor †
- Flame detection UV sensor †
- Flame detection protection relay †
- Spark plug †
- Pilot gas regulator †
- Pilot gas solenoid valve †
- Diaphragm kit for main gas regulator (or a spare regulator)
- Safety shut-off valve †
- Temperature controller ‡

Die Oven

- Heating elements
- Temperature controller ‡
- Fuses †
- Limit switches †
- Contactor coil
- Door seals (1 set)

For reference, the following list of recommended spare parts was offered by **Clark Automation** for their typical handling system, circa 1970:

Recommended Spare Parts for an Extrusion Handling System

Run-Out Table

Fuses for disconnect

Fuses for rectifier circuit

Brushes for motor

Carrier chain

Drive chain

Run-out slat

Graphite bar

Index limit switch

Oiler solenoid

Oiler strainer

Motor brake coil

Motor brake discs

Lift-Over

Graphite

Limit switch

Control relay

Air cylinder packing

Air cylinder supply hose

Drive chain

Gear rack

Motor brake coil

Motor brake discs

Sweep-Off

Graphite

Fence crank arm pins

Fence crank arm bushing

Fence crank arm

Pivot arm

Drive arm

Drive arm pins

Drive arm bushing

Air cylinder packing

Air cylinder hose

Limit switch

Control relay

Cooling Table and Storage Table

Graphite

Eccentric

Bearing

Drive chain

Limit switch

Motor brake coil

Motor brake discs

Saw Feed Loader

Limit switch

Control relay

Air cylinder packing

Air cylinder hose

Saw Feed Conveyor

Rollers

Roll covers

Saw

Saw blades

Limit switch

Lubricant control valve

Saw Gauge Table

Rollers

Roller covers

Barcode Tracking for Tools and Spare Parts

Many plant computer systems only keep track of new spare parts; they do not account, for example, for spare press containers, which are routinely repaired and returned to storage. It is left to the memory of someone in the plant whether the spare container is ready for use when needed; and the same is true for other major press parts. We have previously recommended that the computerized parts tracking system include these parts as well. Now there is an excellent tool for keeping such records with a minimum of cost and without relying on personal memory.

Barcode tracking systems (**Figure B-2**) have been greatly improved and may be easily applied for a small investment. Coding software, printers, and scanners are commonly available for ordinary PC's and smart phones. For larger parts, portable scanners may be used with laptop PC's. The system is also useful for keeping a record of company owned tools such as drills, special wrenches, hydraulic jacks, etc.



Figure B-2: Barcode identification and tracking of tools

One consideration to keep in mind when developing such a system: the next generation of technology, already under development, will replace the barcodes with inexpensive microchips that can be read from a distance with electronic scanners. This technology is already being deployed for retail stores and supermarket checkouts in the USA.

Storage of Spare Parts

Proper storage of spare parts begins with maintaining correct records and identification of the parts. Records must indicate when parts are passed in or out of inventory. If parts are returned to storage after use, make a record of the condition when returned and insure that any necessary repairs are made. In addition:

- **Store in a clean, dry area, free from extreme temperatures**
- **Rotate shaft monthly**
- **Check with megohmmeter every 6 months**



Figure B-3: Recommendations for Electric Motor Storage (Courtesy of Inman Electric Co., www.inmanelectric.com)

- The storage area must be clean, dry, and free from extreme temperatures.
- Stored parts should not be subjected to vibration.
- Motors with sleeve bearings should be rotated by hand and the oil reservoirs refilled monthly.
- Motors with ball bearings should be rotated by hand monthly and re-filled with grease every 6 months.
- Check the motor windings with a Megohmmeter when received in storage and again when used, or every 6 months at a minimum.
- Store cylinders in an upright position with the rod up, to avoid any load on the packing.
- Partially fill cylinders with oil, coat the inside of cylinders with oil, and oil the threads, trunnions, or other machined surfaces.
- Plug all cylinder ports.
- Pumps and valves should be filled with oil and the ports plugged.
- Pumps and valves should be inspected for oil protection every 6 months.

Store spare press tools in a warm place, to minimize preheat time and avoid thermal shock.



Figure B-4: Side or crosshead cylinders. After inspection, store in a vertical position to avoid any load on packing, and coat the inside and machined surfaces with oil. (Photo courtesy of Lake Park Tool)

