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Process Parameters for Mechanical Plating and Mechanical Galvanizing

The variables or parameters affecting the quality of a mechanically deposited metal coating include:

- *Barrel Load*
- *Media Mixture*
- *Media Quantity*
- *Temperature*
- *Barrel Speed*
- *Barrel Angle*
- *Water Level*
- *Chemical and Metal Additions*

For optimum reproducibility in performance of the mechanical plating process, the 'run card' or 'work instruction(s)' or process control standard should include specific, quantified instructions about each of these parameters. For ISO 9000 or QS 9000 such documentation is mandatory.

Barrel Load

*Mechanical plating barrels are normally given a nominal size such as 6, 10, 20, or 27 cubic feet. These ratings are indicators of the quantity of "live load" of parts. For parts that do not tangle or jackstraw - such as, for example, washers - the "live load" or dynamic (in other words, the load size when the barrel is moving) load is the same as the static or stationary load (when the parts are **not** moving, as, for example, when they are in a tub). For parts that tangle or jackstraw, such as, for example, nails, the quantity of parts that can be plated is dependent on the "live load", which is always less than the static load. In general, when the parts and media are charged to the barrel with the appropriate amount of water and the barrel is operated at the correct speed, the parts should not contact each other above the media. If you hear part-to-part contact, the barrel is overloaded with respect to the media-to-parts ratio. For plating, the usual rule of thumb is that the barrel should be charged with the nominal quantity of media and an equal quantity of parts to be plated. The actual barrel loading usually has to be determined by experience and experiment. A few examples of live bulk densities of parts often mechanically plated follow with guidelines for barrel loading:*

Part Type	***Barrel Loading Factor***
6d nails	80*Ib/cu. ft.*
8d nails	50*Ib/cu. ft.*
16d nails	*45Ib/cu. ft.*
1/4 x 1 machine screws	*150Ib/cu. ft.*
½ x 2 machine screws	*110Ib/cu. ft.*
1/4 – 1/2 machine screw nuts	*150Ib/cu. ft.*
314 - 1 nuts	*110Ib/cu. ft.*
Plain or Belleville washers - 1/4"	*150Ib/cu. ft.*
Plain or Belleville washers 51B" and over	*125Ib/ cu. ft.*

Media Mixture

Mechanical plating and mechanical galvanizing utilize the energy in glass beads to "cold-weld" the plating metal to the surface of the part to be plated. The selection of the impact media has an important effect on the quality of the plating achieved

The media mix most commonly recommended is as follows: 4 parts 4 - 5 mesh beads; 2 parts 10 - 13 mesh beads; 1 part 16 - 25 mesh beads; 1 part 50 mesh beads. If there are no other factors (such as lodging considerations), this mixture should be utilized.

On some machines, this preferred media mix cannot be used. The most common example is the old 3M "Metal Plating Centers" which (usually) have 3/16" perforated holes in the separator unit which would trap the media with the parts. For these machines, we recommend: 6 parts 1 0 - 13 mesh beads; 2 parts 16 25 mesh beads; and 1 part 50 mesh beads

On some part types, such as cross-recess screws, one media size will lodge in the cross recess. Generally, this is media in the 10 to 25 mesh range. If any media size is capable of lodging, it will lodge. Therefore, the plater must select a media mix that contains no sizes that will lodge.

It is impossible to completely separate media such that 1 00% of the lodging size is eliminated; media in the sump, in cracks or crevices in the barrel, in the piping - all these contribute to the lodging problem.

For some part types, the only alternative is to use straight "mush" media, which is 50 mesh - 100 mesh with no larger media. This media mix has poor flow characteristics and typically plates at a lower efficiency than other media mixes. However, if the parts themselves act similarly to the media, this will work acceptably.

Another media mix that is worth evaluation is a mixture of only large beads (over 5 mesh) and fine media. A typical formula is: Large Beads - 7 parts; Fine Media - 3 parts.

The large beads can be 3, 4, 5, 6, 7, or 8mm beads; in the United States the common sizes are 3 to 5 mm. The larger beads are typically made by a molding process, and are typically both durable and expensive. A media mix like this will offer both the impact energy associated with the use of large beads and the "throw" associated with fine media.

For some part types, platers have developed their own media formulations. A great deal of flexibility is possible in mechanical plating. The only plating formula that we do not recommend is the use of formulations that do not include a fine mesh impact media. Without the fine media, the deposit is rough, the efficiency is low, and the throw into recesses suffers.

During the plating process (including, in particular, the separation and media return) the fine media is typically lost from the system due to dragout. This must then be periodically replaced. Alert operators can tell when their plating system is low in fine media by seeing how the process cleans in recessed areas such as thread roots and how well the process plates in these areas.

Media Quantity

In general, the barrel should receive a full charge of media for all loads. Dry media weighs about 115 pounds per cubic foot.

For mechanical plating, the usual "rule of thumb" is that for each volume of live load of parts, the plater uses the same volume of media. Thus a cubic foot of parts uses a cubic foot of media. For plating cross recess screws, the ratio of media to parts is often reduced, and the water level raised. For mechanical galvanizing (thicknesses over 0.001") the general rule is to use 2 parts of media to one part of parts to provide additional cushioning to prevent chipping during the plating process. If the part type is difficult, the ratio of impact media to parts may be increased even more.

Temperature

The plating cycle should begin at a temperature of 70 0 to 750 F. Lower temperatures produce slower
plating; higher temperatures produce more rapid plating. Excessive temperatures (over about 1000 F.) produce a poorly consolidated, "spongy" deposit that is more easily scratched. It is normal for the temperature to rise 100 to 250 F. during the cycle; if the temperature rises excessively, ice may be used to reduce the temperature. (Most mechanical plating and galvanizing operations south of the Mason Dixon line use ice.)

Barrel Speed

The barrel speed is measured in RPM (revolutions per minute). This can be determined by counting the revolutions in a fixed time period and calculating the RPM or by counting the time to do a fixed number of revolutions and calculating the RPM.

In general, the following starting barrel speeds apply:

Nominal Barrel Size	***RPM***
6 cubic foot	*16 rpm*
10 cubic foot	*14 rpm*
20 cubic foot	*12 rpm*
27 cubic foot	*10 rpm*

- *If the parts are heavier than average, then the barrel speeds should be reduced, because the parts themselves provide more energy.*
- *If the parts are exceptionally light, the barrel speed should be increased.*
- *If the media mixture used consists of primarily fine beads, then the barrel speed should be increased.*
- *If the parts have sharp edges, the barrel speed should be decreased to eliminate scraping or burnishing.*

Barrel Angle

The angle the barrel makes with the ground is an important process parameter. If the barrel is too upright, the mixing will be poor and the amount of energy transmitted to the parts will be insufficient to produce a high quality coating.

If the barrel angle is too low, the barrel will not be able to be loaded with the nominal charge of parts. Typically the barrel should be at 30 0 from horizontal with 25 0 being a low angle and 35 0 being a high angle.

Water Level

The preferred starting point for the water level is that there should be about 1" or 2" of water ahead of the media/parts/water mixture when the barrel is operating at the desired speed. A preferred way of quantifying the amount of water is that the puddle of water should appear to the operator to be about halfway across the barrel when the barrel is charged with parts, media, and water and operating at the desired speed.

If the parts have internal recesses - particularly if there are "through holes" such as nuts or other internally threaded fasteners - then the water level should be raised. Usually the water level is not reduced, as this will create a rougher deposit and increased part-to-part variability.

Chemical and Metal Additions

Before each load of parts is plated a "run card" or "work instruction" with exact quantities of parts and the proper quantities of each of the required chemicals and metal powders should be prepared. (Note that before this can be done, one needs to know the exact weight of parts to be plated and the surface area in square feet per hundred pounds.)

The run card may be prepared manually or the PS& T Electronic Run Card may be utilized to prepare the instructions. Such instructions should include:

- *Products to be added*
- *Quantities*
- *Times*

Failure to prepare these instructions in advance results in varying quality of deposit and varying thicknesses.

Automatic chemical addition systems such as PS& T's Hypermatic TM System link the Electronic Run Card with a PC-based industrial control system and provide unmatched consistency in production.

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