

# Maximizing Operational Efficiencies Through Proper Machinery Rebuilding Procedures



Graham rotary wheel spools before (foreground) and after (background) a major rebuild. Minor rebuilds are used to maintain your machine in peak running condition, while major rebuilds are used to obtain “like new” performance.

## Rotary Wheel Requirements

Like any mechanical machine, rotary wheel machines from Graham Engineering require routine maintenance, as well as periodic rebuilds. To ensure the prolonged life of your machine, it is important to establish a schedule for both routine maintenance and the replacement of worn parts.

In this guide, we will help you fully understand the rebuilding options available to you – and show you how to optimize your production and extend the life of your Graham rotary wheel blow molding machines.



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## The Keys to Understanding

Assuming you already have the basics down for routine maintenance, such as lubrication, we will focus here on machine “rebuilt” and “component replacements”. For the sake of concise language, we use the term “rebuild” to describe everything from “preventative maintenance component replacements” to full machinery teardowns and rebuilds. To help you understand the timing on when rebuilds might be required, we will discuss the stages of machine rebuilds, and we will also cover some of the symptoms that may indicate when a rebuild is required.

### Category One – Pin & Bushing Replacement

Generally, the first “rebuild” required on a rotary wheel machine is the simple replacement of linkage pins and bushings.

These can be replaced as needed, but generally when a few stations show excessive “play” in the linkages, it is beneficial to replace the pins and bushings on all the stations at the same time.



### Category Two – Linkage Replacement



A Category Two “rebuild” contains the following parts:

- Pins and Bushings (Category One)
- Linkages (as needed)
- Spring Stacks

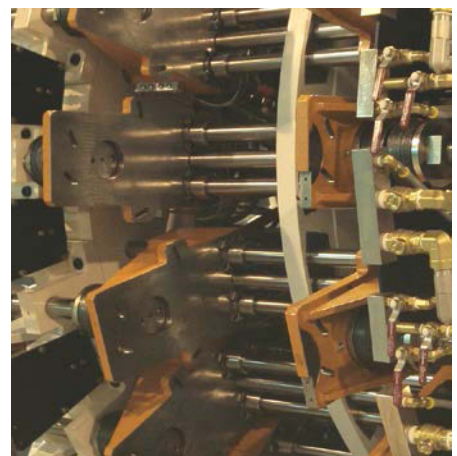
Linkages require replacement when they have become worn from grinding against other linkages, or when they become wobbly as the bearing holes may “wallow out” due to loose fitting of the pins and bearings over time.

When the linkages need replaced, it is our experience that the spring stacks are also due for replacement. Most customers replace all of these units at one time when undergoing a category two rebuild.

### Category Three – Complete Station Rebuild

A Category Three rebuild contains the following parts:

- Everything listed under categories One and Two above
- Guide rods and guide rod bearings
- Pivot Blocks
- Actuating rods and actuating rod bearings
- Bases and gibs (slides) on the cam follower slide blocks
- Cam followers





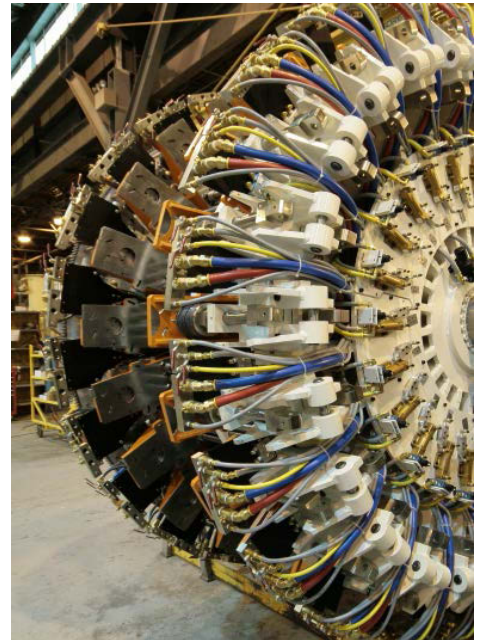
## Category Four – Complete Spool Rebuild

This replaces the following parts:

- Everything listed under categories One, Two and Three above
- Main Shaft
- Mold Opening Cam
- All rotating parts
- Valves, hosing
- Rotary unions and shaft insert tubes

An easier way to describe this is “everything but the bull gear and the center support.”

This rebuild is a major undertaking. In fact, many customers will decide to simply replace the spool instead of conducting a category four rebuild, because of the cost of tearing down the old spool and the time required to rebuild the spool.



If rebuilding the spool, we suggest that the spool be shipped to Graham’s York facility. The rebuilt spool can then be replaced in the original frame, or “swapped out” into another blow molding machine of like series.

## Category Five – Spool and Cam Replacement

For equipment that has worked for many years and show symptoms of wear at the rotary shaft union, bull gear, shaft keyways and cams, we offer complete spool replacement. All rotating parts are replaced. This will also reduce the time needed for repair, compared to Category 4, when the line has to be back in production with minimum downtime. Typical change over time is 6-10 days.



We are often asked about the required frequency of wheel rebuilds. This is a difficult question to answer, because it can vary based on operating conditions (such as speed and clamp force setting) and the quality of your routine maintenance.

Category One: Generally, you may expect a set of pins and bushings to last about 4 years, but the lifespan will vary, depending on the clamp force, operational speed of the wheel, and the quality and frequency of your routine lubrication maintenance.

Category Two: A general guideline here is to expect a Category Two component replacement in 6-8 years. Thus, when you are ready for the second Category One rebuild, you are likely due for a Category Two rebuild and should evaluate whether a Category Three rebuild would be beneficial.

Category Three: Our experience shows that a Category Three rebuild will typically be required after about 8-12 years of operation, depending on the frequency of Category One and Two rebuilds.

Category Four: The timing for a category four rebuild is more difficult to define, because it depends heavily on whether Category One, Two and Three rebuilds have been undertaken. As a rule of thumb, when the speed of the wheel (in RPM's) times the number of years of operation reaches the range of 60-70, you should evaluate the need for a Category Four rebuild. Some customers go much longer, by following good lubrication practices and performing minor rebuilds as required. We have some customers who have been running rotary wheel machines for over 30 years who have never required a Category Four rebuild. This is accomplished only through the proper use of Category One - Three rebuilds as needed.

## Understanding The Symptoms

The following symptoms may indicate the need for a rebuild:

- Bottle quality deterioration
  - Parting Line Mismatch - indicates play in the clamp stations or leader pin wear caused by station play, which may result in mold half misalignment
  - Bottle drop inconsistencies, or bottles staying in the molds
  - Issues from mold pinches becoming worn, such as bad trimming. This may be due to mold misalignment of overcompensating for station wear by increasing clamp forces
- General tightening up of the processing window.
- Molds blowing open or loss of clamp pressure.
- Frequent issues causing stopping and restarting of the process.
- Damage to molds - pinches and leader pins.
- Noticeable "play" in the linkages.
- Evidence of fretting or metal particles around the bearings.
- Excessive wear in the cam - such as a rolled out "lip" noticeable to the touch, or "dishing out" of the cam track.
- Breaking of guide rod or tie bar bolts. (This is often evidence of major wear or even cracked parts due to not performing rebuilds).

## The Proper Approach

There are things that are sometimes done to "mask" or overcome the symptoms that a rebuild is needed - for example, tightening the slide gibs on the cam followers when the molds pop open, or increasing the clamp pressure when some loose play develops in the linkages. Unfortunately, many of these "fixes" are not fixes at all - they only accelerate the wear of the system and make the problem worse in the long run. These short-term fixes will cause even more money to be spent in the future.



It may be tempting to do a Category One service, when a Category Two or Category Three rebuild should be performed. Again, this can gain some short-term improvements - but unless the root causes are addressed, these will lose effectiveness in a short period of time.

GEC wheel machines can last a lifetime. We estimate that well over 90% of all GEC wheel machines produced (we started in 1968) are still in production today. The first GEC wheel, serial number 00001, is still in production in Mexico. We did a major rebuild on this line in 2005.

But when the machines are not properly maintained, there is a risk of *catastrophic failure*. This usually happens when Category Three or Category Four rebuilds should be performed, but are delayed. The primary risk is that the play in the linkages will add stress to the machine, causing fatigue failures of the shaft or guide rod supports. When this occurs, the cracks may not be readily visible, but you will notice molds popping open, loss of clamp pressure and perhaps bolts breaking on the ends of the guide rods. In some cases the machine can be repaired by welding supports in place, then running at a reduced rate or under reduced clamp pressure. At other times, repairs are not practical, and a new spool must be ordered. This can cause months of downtime, as GEC has to build the new spool for the machine - and the lead time for a new spool is typically 4-5 months.

The proper approach is to conduct rebuilds when they are needed. We suggest that a GEC technician inspect each wheel machine every few years to give you an assessment of the condition - or that we train your personnel how to properly conduct these inspections.

**\$ Financial Justification**

The following charts give an indication of the typical durations and costs to perform category one, two, three and four rebuilds on 12-station and 24-station rotary wheel machines.

		Category	Items Replaced	Typical Frequency
<b>"Major Spool Rebuild or Replacement"</b>	<b>"Complete Stations"</b>	1	Pins Bushings	~ 4 years
		2	Items in Category 1 + Linkages Spring Stacks Pivot Blocks	~ 6-8 years
		3	Items in Category 1 & 2 + Guide Rods & Bearings Actuating Rods & Bearings Slide Block Bases & Gibs Cam Followers	~ 8-12 years
	4	All Items Above + Main Shaft, Cam, All Rotating Parts, Valves, Hosing, Rotary Unions + Insert Tubes, "Everything but the Bull-Gear & Center Support"	Varies **	
	5	Entire Spool Replaced (Labor hours for on site replacement)	Varies **	

\*\* Varies widely based on frequency of Category 1-3 rebuilds and maintenance practices

Category	Typical Part Costs - 12 Stations	Typical Part Costs - 24 Stations	Typical Labor Costs - 12 Stations	Typical Labor Costs - 24 Stations	Notes
1 – Pins & Bushings	\$7,150	\$14,300	\$20,000	\$35,000	Labor Rates Include On-Site Expenses
2 – Linkage Rebuild	\$46,725	\$107,500	\$35,000	\$60,000	
3 – Complete Station Rebuild	\$113,975	\$348,800	\$60,000	\$110,000	
4 – Complete Spool Rebuild	\$259,625	\$474,800	\$40,000	\$70,000	Labor performed at GEC
5 – New Spool & Cam	\$600,000	\$900,000	Includes labor to build spool. On-Site installation extra.		

- Rebuild costs for Category One-Three include typical travel and expenses. Rates vary by geographic region.
- GEC reserves the right to quote rebuild hours based upon condition and location of specific machines. Estimates will vary.
- Labor costs based on standard 2012 GEC assembly and Service rates. Rebuild labor costs do not include removing and re-integration of spool into frame.
- Prices for parts and labor are estimates only and will vary based on size (model) of wheel, number of stations, condition of the machine, and other factors. We will be glad to provide a detailed quotation based upon a thorough inspection by a GEC technician.

## Other Considerations

We are often asked how to justify the cost of doing rebuilds. While the factors vary for each customer, the following should be considered when weighing when to do a rebuild:

- “Pay Now or Pay Later” – delaying a rebuild will ultimately raise overall maintenance costs as wear will accelerate, requiring even more extensive parts replacements in the future.
- Lost production – due to poor bottle quality.
- Lost production – due to frequent machine stoppages to deal with issues such as popping molds, mold damage, or breaking of components.
- Down time for machine repairs will be minimized by following proper rebuilding and maintenance procedures.



We will be glad to provide an assessment of your machine and a quotation for bringing your machine back into top running condition. Please give us a call!



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