



# Belvac Production Machinery Technical Bulletin

Information for Customers Operating & Maintaining Belvac Machines

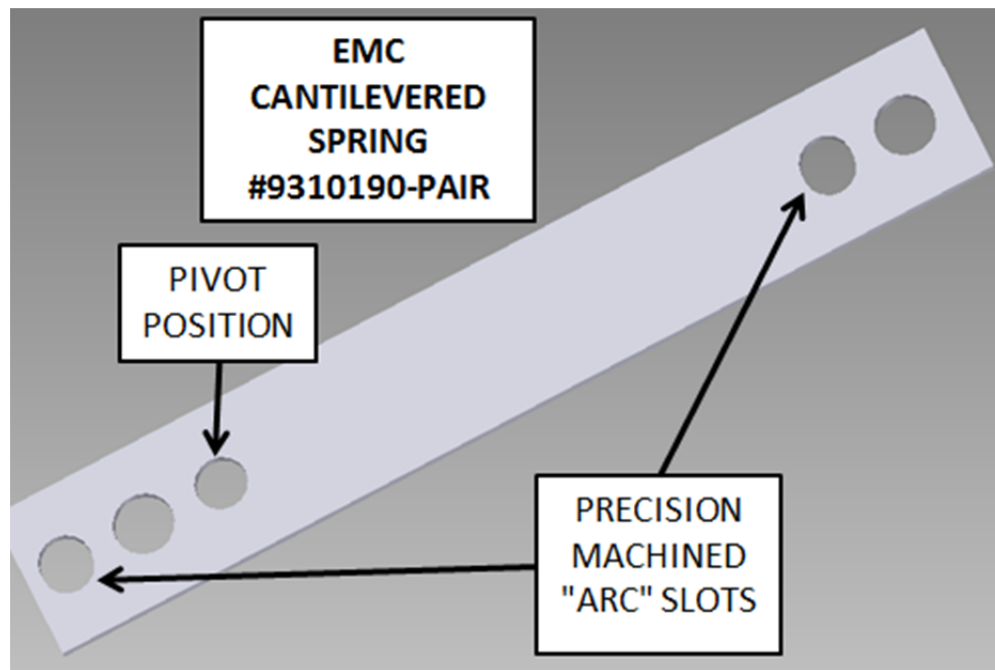
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## EMC CARTRIDGE ENHANCEMENT DESIGN

Belvac has enhanced the EMC Inside Burr (IB) and Outside Burr (OB) cartridge design for ease of setup, by creating the means to micro-tune the alignment of the lower knife shaft knife to the center knife shaft. At the same time, setup procedures have been expanded taking full advantage of this enhancement.

This feature is accomplished thru the introduction of a precision slotted cantilevered spring as shown below:



In addition to the above, Belvac is supplying new lower shaft labyrinth seals #C22579 (Item 2041) to mitigate preload variances in the commercial supplied part. The replacement seal will remain C22579, but will be recognized by a "Black Oxide" finish.

**NOTE:** Please dispose of all stockroom labyrinth seals (C22579) received prior to March 01, 2015: any/all less black oxide finish. Contact Belvac Service Department for replacements.



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## Kit #9310192 for all Existing EMC's

The design enhancement kit #9310192 consists of the following parts:

Item #	Part Number	Description	Quantity
185	C20650	O-RING 212 – 45 DURO	1 EACH
2033	9310190-PAIR	SPRING, SLOTTED LOWER ARM	1 PAIR
2041	C22579	SEAL, LABYRINTH PER DRAWING	2 EACH
2076	C101439	SEAL, V RING, .750 SHAFT 1.00 BORE	1 EACH

Items #185 and #2076 consist of standard EMC parts, and are issued only to account for age of units, relative to minor design enhancements made since Q4/2013.

Item #2033 consists of a matched pair of new lower shaft spring arms. These new spring arms have slots added to allow for easier adjustment of the height differential between the lower shaft's East and West quadrants (see Figure 1).

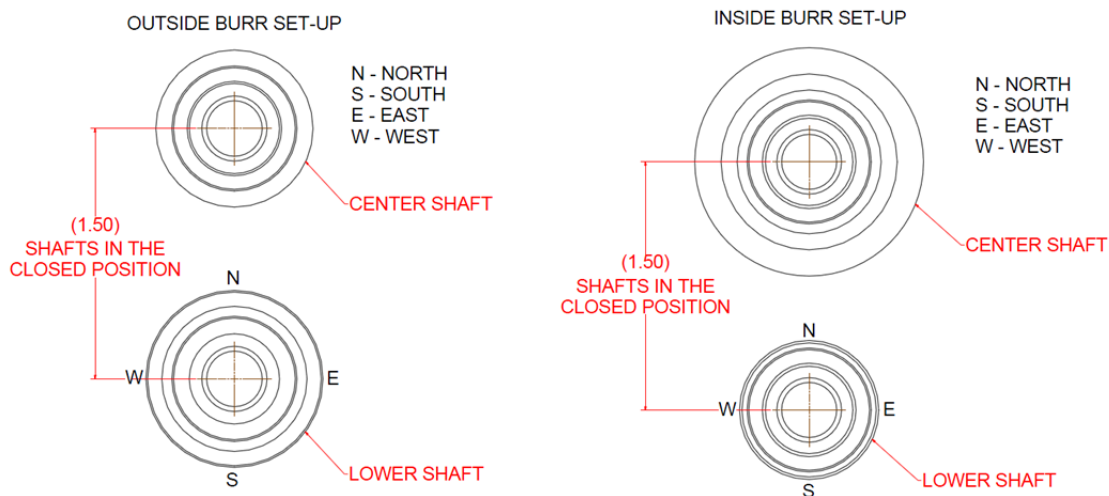


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**FIGURE #1**

The additional clearance added with the slots will allow users to control and moderate the shaft's East-West tilt, thereby mitigating its effects on the knife height gap setting: instructions on the adjustment procedure are detailed in the below section "Revised EMC Knife Gap Set-up Procedure".

## EMC Grease Applications – Mobilith SHC PM 460

In order to ensure optimal performance of EMC components, Belvac strongly recommends using Mobilith SHC PM 460 grease (or equivalent) where applicable during cartridge rebuilds. For example, this synthetic grease should be used for lubricating center shaft bearings #2052, lower shaft bearings #2038, the main rocker assembly needle bearings #2024, and to lubricate the cam track faces of depth of cut feet #2035. Experience has shown increased cartridge longevity with the use of Mobilith SHC PM 460 grease given its excellent wear protection and oxidation resistance.



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## Revised EMC Knife Gap Set-up Procedure

### Effects of Lower Shaft North-South Tilt on Knife Gap

The relation between shaft height differential and knife gap is highly dependent on the height differential between the extreme North and South quadrants of the lower shaft (Reference Figure-1 for definition of lower shaft quadrants). Due to the extremes in geometric tolerancing and runnout of the knife shafts, there exists a height differential between the shaft's North and South quadrants. This "tilt" on the shaft is amplified on the knife, considering the shaft seating diameter is a percentage of the knife diameter. This differential will either increase or consume the expected knife gap, based on the positive or negative differential.

### Effects of Lower Shaft East-West Tilt on Knife Gap

Similarly, there is a direct relation between the parallelism differential of the knives and consumption of knife gap: this condition being defined as the height differential between the lower shaft's East and West quadrants (Reference Figure-1 for definition of lower shaft quadrants). As with the North-South tilt, a height differential between the East and West quadrants of the lower shaft is amplified on the lower knife considering the shaft seating diameter is a percentage of the knife diameter. This "tilt" between the East and West quadrants of the lower knife results in a non-perfect parallelism with resultant consumption of knife gap to varying degrees.

The information listed below details a revised set-up procedure for all EMC cartridges: including both Outside Burr and Inside Burr configurations, taking into account the above mentioned new design slotted spring arms for easier adjustment of the lower shaft's E-W tilt, and the effects of the lower shaft's N-S tilt on the knife height gap. NOTE: EMC Manual Appendix B (reference CC93-95-B00 REV 11 or later) has been updated to detail the below procedure accordingly.

### Setting Knife Height Gap: Outside or Inside Burr

*(Refer to drawing number 9310000 & 9310090 for Outside Burr or Inside Burr, respectively)*

*NOTE: Cartridge must be fully assembled, with exception of lower & center shaft knife components, prior to following procedure below.*

- 1) Remove the following items from the lower shaft #2034 and center shaft #2050 assemblies:
  - a. For Outside Burr: Items #131, #149, #154, #155, #156, #157, #159, #185, and #225.
  - b. For Inside Burr: Items #131, #149, #150, #154, #155, #156, #157, #159, #180, and #185.
- 2) Ensure spacers #2031 are installed: these are accessed by removing screws #2025 and #2045 from the lower housing:
  - a. As an initial starting point use original spacers #2031 installed in the assembly, noting their thickness.
  - b. Typically 0.072" to 0.074" thick spacers are ideal for depth of cut set-up.



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- 3) Install fixture #9310120 shown below onto backplate #2060.



- 4) Screw in center screw of fixture #9310120 all the way as shown. This will close the center and lower shafts together, leaving them spring loaded. NOTE: The fixture will make an audible “click” sound when the screw has been inserted all the way.



- 5) Ensure both the lower shaft #2034 and center shaft #2050 run-out is within 0.0002” specification.
  - a. Lower shaft: measure run-out on shaft face mating to #155.
  - b. Center shaft: measure run-out on shaft face mating to #131.
- 6) Ensure the screws #2023 are loose for adjustment: screws should be finger tight.
- 7) Measure the total height differential between the North and South extreme lower shaft quadrants,  $D_{N-S}$  (reference below for definition of lower shaft quadrants):

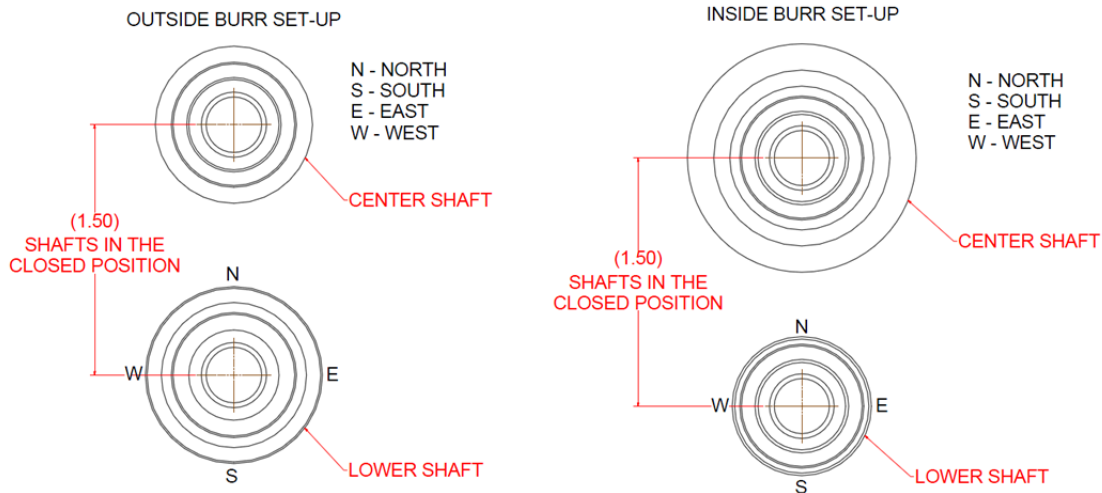


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- NOTE: If "S" is higher (+) or lower (-) than the "N" quadrant, the differential  $D_{N-S}$  may be positive or negative, respectively.
- NOTE: The required shaft height gap, measured between the extreme North quadrants of the lower & center shafts, to achieve a 0.0010" nominal knife height gap is defined as:

$$\text{Shaft Height Gap} = 0.0010'' + 0.21250'' * D_{N-S} \quad (\text{OUTSIDE BURR})$$

$$\text{Shaft Height Gap} = 0.0010'' + 0.50666'' * D_{N-S} \quad (\text{INSIDE BURR})$$

This may be likewise determined on the following graphs:

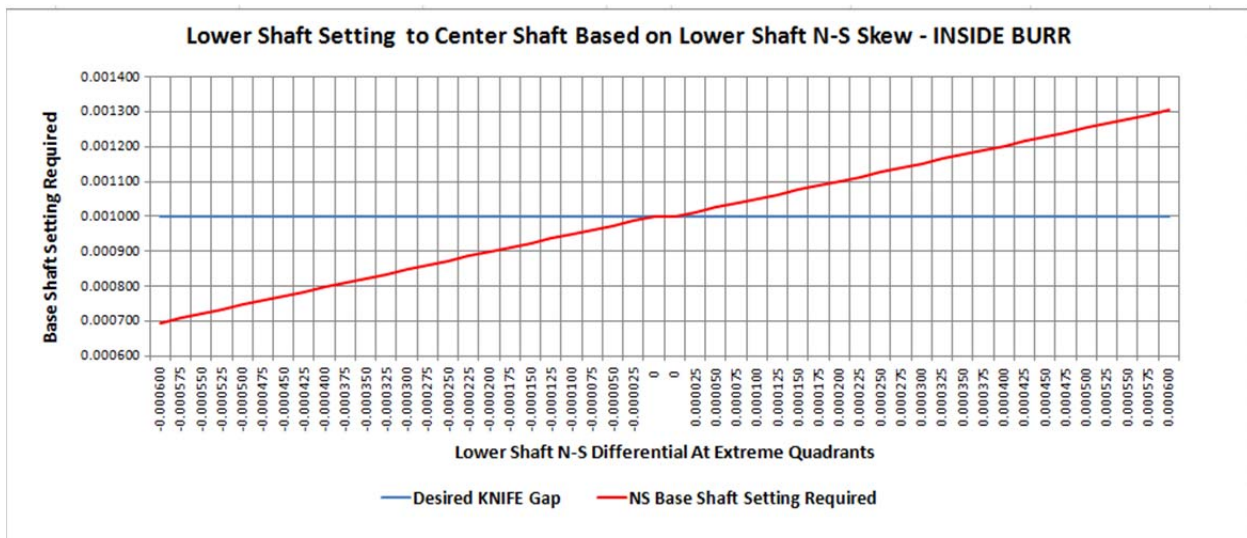
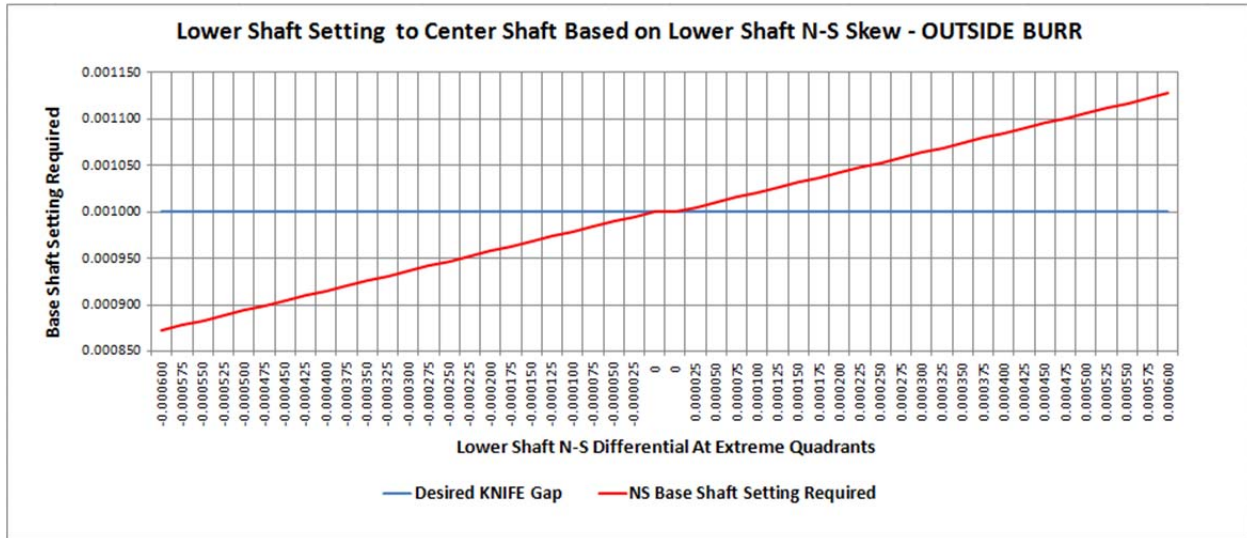


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- 8) Adjust lower housing using item #2061 to calculated/graphed shaft height gap in order to achieve a 0.0010" nominal knife gap (refer to example below for an outside burr configuration).  
NOTE: setting the shaft height gap is a preliminary setup procedure for the EMC, with the knife height gap setting being most critical to cartridge performance (continue through steps below for proper knife gap setting).

Example: Calculation of Shaft Height Gap (OUTSIDE BURR)



1. Set dial indicator to zero (0) at North quadrant of lower shaft (see left image).
2. Relocate dial indicator to South quadrant of lower shaft and note reading -0.0004" (see right image): this value is equivalent to the lower shaft North-South differential,  $D_{N-S}$ .
3. Calculate shaft height gap with respect to  $D_{N-S} = -0.0004$ " using above equation:

$$\text{Shaft Height Gap} = 0.0010'' + 0.21250'' * D_{N-S}$$

$$\text{Shaft Height Gap} = 0.0010'' + 0.21250'' * (-0.0004'')$$

$$\text{Shaft Height Gap} = 0.000915''$$

Note: This value may also be extracted from the above graph for a  $D_{N-S} = -0.0004$ "

4. Adjust lower housing to calculated shaft height gap 0.000915" in order to achieve a 0.0010" nominal knife gap.





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- 9) Slightly back off adjusting screw #2061 without affecting the lower housing position to ensure #2061 is not bound and is centered in a free state: this is done to prevent the lower housing from binding as a result of screw #2061 sitting offset to the housing.
- 10) As a best practice, use two torque wrenches to simultaneously torque the bottom two #2023 screws and then the top two #2023 screws in increments of 40 in-lbs to a final torque value of 120 in-lbs each. Alternatively, use a single torque wrench to first torque the bottom and then the top #2023 screw on one side of the housings, and then the bottom and top #2023 screw on the other side of the housings: repeat this process in increments of 40 in-lbs to a final torque value of 120 in-lbs each. If the torque sequencing causes the lower knife to “twist/cant”, the knife gap may be compromised sufficiently to cause knife crashes. Verify this by using an indicator to measure the total height differential between the East and West extreme lower shaft quadrants (refer to example below for an outside burr configuration):
  - a. For an outside burr configuration: lower shaft East-West differential should be less than or equal to 0.0010”.
  - b. For an inside burr configuration: lower shaft East-West differential should be less than or equal to 0.0007”.
  - c. If not within specification, reference below section “Adjusting Lower Shaft East-West Height Differential” for instructions on how to achieve East-West total height differential specifications.



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Example: Measuring Lower Shaft East-West Differential (OUTSIDE BURR)



1. Set dial indicator to zero (0) at East quadrant of lower shaft (see left image).
2. Relocate dial indicator to West quadrant of lower shaft and note reading +0.0009": this value is equivalent to the lower shaft East-West differential (see right image).
3. Differential 0.0009" is within the 0.0010" specification for an outside burr configuration, therefore, no further adjustment is required in this scenario.

- 11) Verify the shaft height gap to be at the calculated/graphed value: if not, repeat above steps 6 through 10.
- 12) Re-install the following lower shaft #2034 and center shaft #2050 components:
  - a. For Outside Burr: Items #131, #149, #154, #155, #157, #185, and #225. Item #156 must not be installed on the center shaft at this time.
  - b. For Inside Burr: Items #131, #149, #150, #154, #155, #157, #180, and #185. Item #156 must not be installed on the center shaft at this time.
- 13) Verify the total height differential between the East and West extreme lower knife quadrants to be less than or equal to 0.0014", and verify the knife height gap:
  - a. NOTE: The knife height gap is measured between the extreme North quadrants of the lower & center knives. (reference diagram below for definition of knife quadrants)
  - b. For an outside burr configuration, the lower knife face mating to #2034 should be between 0.0008" to 0.0012" above the center knife face mating to #156 (reference drawing number 9310000: see images below as an example for set-up).



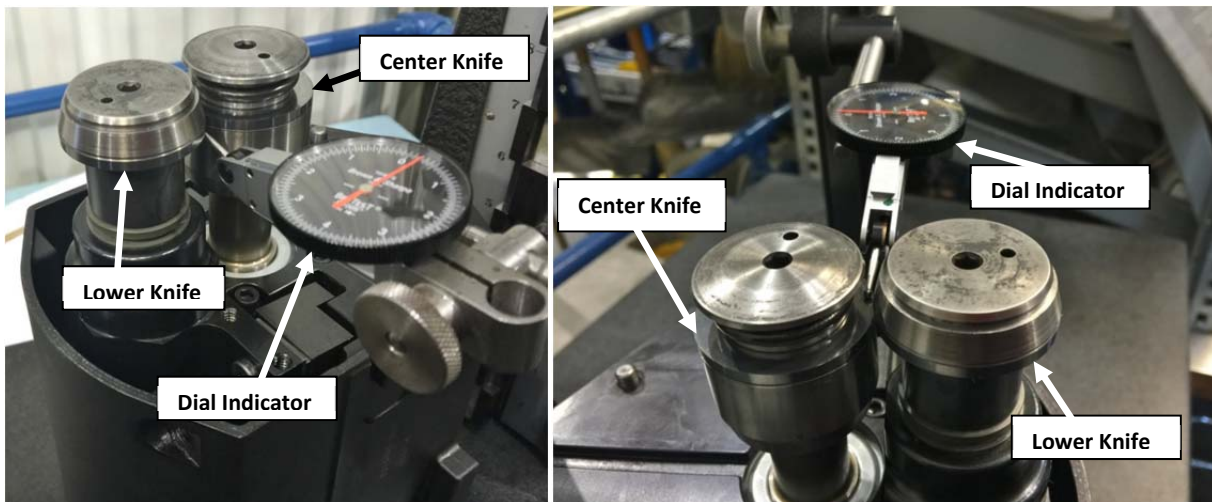
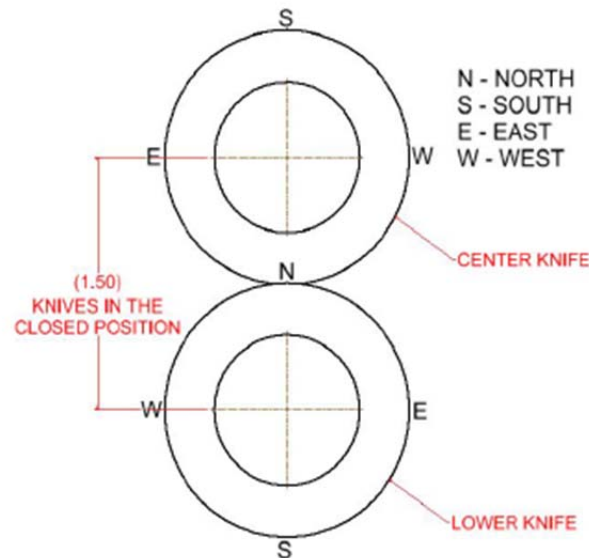
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- c. For an inside burr configuration, the lower knife face mating to #157 should be between 0.0008" to 0.0012" below the center knife face mating to #156 (reference drawing number 9310090).
- d. If not within specification, repeat above steps 6 through 12.



14) Measure depth of cut to be in specification of 0.1875" ± 0.010" (4.80 mm ± 0.25mm): if not, adjust accordingly (reference section on "Adjusting Lower Shaft Assembly for Depth of Cut" listed below).



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- 15) If depth of cut was adjusted, re-verify the lower knife East-West differential to be within 0.0014", and the knife height gap to be between 0.0008" to 0.0012":
  - a. If not within specification, repeat above steps 6 through 14.
- 16) Install item #156 onto the center shaft, completing the cartridge assembly.

## Adjusting Lower Shaft Assembly for Depth of Cut

*NOTE: Cartridge must be fully assembled (including lower & center shaft knife components) with the knife height gap set to 0.0008" – 0.0012", and with the East-West lower knife differential within 0.0014" prior to following procedure below.*

- 1) Actuate cartridge with setup gauge #GA410-CC51 to check penetration length on can.
- 2) Slightly deform the can against a flat surface, and measure penetration length accordingly: if cut is not to specification  $0.1875" \pm 0.010"$  (4.80 mm  $\pm$  0.25mm), adjustment is required.
- 3) Modify by changing spacers #2031 after removing screws #2045. These are accessed by removing (2) blanking screws #2025 from the lower housing. Existing spacers are removed first: ALWAYS REPLACE AS A PAIR. Thinner spacers increase the depth of cut.
  - a. In order to achieve desired #2031 spacer thickness, grind stock 0.090" thick spacer (reference part number 9310057) as necessary: grinding must be done in "pairs".
  - b. Belvac also provides varying thickness, pre-ground spacers per customer request (see part numbers listed below):
    - i. 9310057-070 through 9310057-086 (thicknesses 0.070" through 0.086" in increments of 0.001")
- 4) Tighten screws #2045 to 60 in-lbs (5 ft-lbs). Make sure the depth of cut feet #2035 are sitting naturally on the pin #2012 and counter-bore screw #2045. As the screw #2045 is tightened, wiggle the foot #2035 gently to allow the unit to align itself on the dowel and the countersink.
- 5) Refit blanking plugs #2025.

## Adjusting Lower Shaft East-West Height Differential

*(Refer to drawing number 9310000 & 9310090 for Outside Burr or Inside Burr, respectively)*

*NOTE: Cartridge must be fully assembled, with exception of lower & center shaft knife components, prior to following procedure below.*

- 1) Remove blanking screws #2025 from lower housing #2021 to gain access to #2045 screws.
- 2) Loosen screws #2023 and remove lower shaft assembly from center housing #2001: this will consist of all lower shaft components and the lower housing #2021 (reference Sheet 3 of drawing).



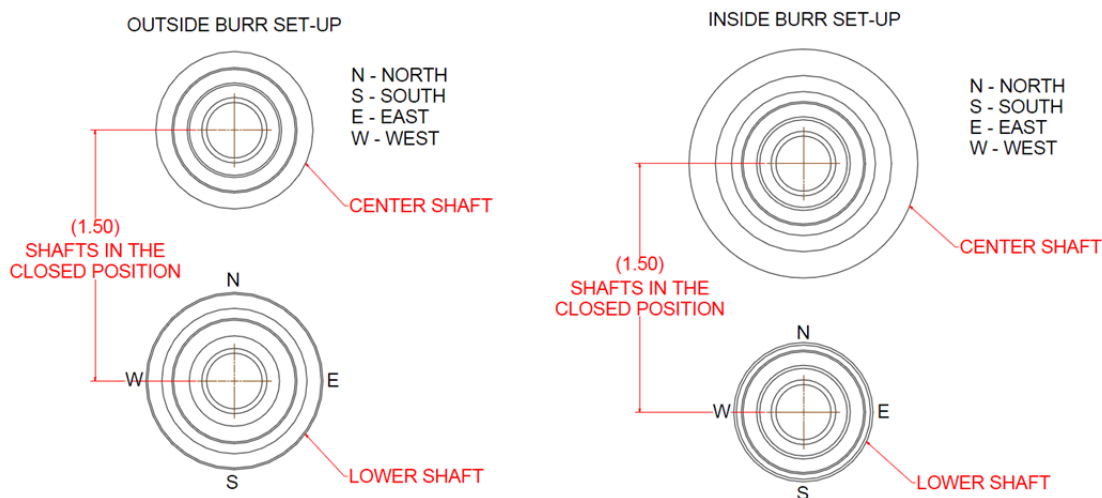
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- 3) Ensure #2011 screws are loose for adjustment.
- 4) Ensure #2045 screws are loose for adjustment.
- 5) Re-assemble the lower shaft assembly onto the center housing #2001: ensure screws #2023 are torqued to 120 in-lbs (10 ft-lbs).
- 6) Lightly adjust tilt of lower shaft #2034 in order to achieve the desired East-West total height differential:
  - a. For an outside burr configuration: lower shaft East-West differential should be less than or equal to 0.0010".
  - b. For an inside burr configuration: lower shaft East-West differential should be less than or equal to 0.0007".
  - c. NOTE: The East-West differential is measured between the extreme East and West quadrants of the lower shaft (reference below for definition of shaft quadrants).



- 7) Loosen screws #2023 and remove lower shaft assembly from center housing #2001, being mindful not to hinder the location of the lower shaft: this will consist of all lower shaft components and the lower housing #2021 (reference Sheet 3 of drawing).
- 8) Torque #2011 screws to 155 in-lbs (12.92 ft-lbs), being mindful not to hinder the location of the lower shaft.
- 9) Torque #2045 screws to 135 in-lbs (11.25 ft-lbs), being mindful not to hinder the location of the lower shaft:
  - a. NOTE: The above step does not apply for all lower housings #2021 dating prior to April 2015. If so, please apply maximum allowable torque to #2045 screws given tools and space limitation.



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- 10) Re-assemble the lower shaft assembly onto the center housing #2001: ensure screws #2023 are torqued to 120 in-lbs (10 ft-lbs).
- 11) Confirm East-West height differential is still within specification: if not, repeat above steps 2 through 10.
- 12) Install blanking screws #2025 onto lower housing #2021.
- 13) Run the cartridge on Belvac's Cartridge Run-In Unit (Ref. 703717) for duration of 5 hours: reference section "Cartridge Run-in Requirement" for further instructions.

## Cartridge Run-in Requirement

- 1) Once the shaft height gap has been set to the calculated value and the lower shaft East-West differential is within specification, the cartridge is to be run-in without knives for 5 hours on Belvac's Cartridge Run-In Unit (Ref. 703717).
- 2) After the initial run-in, reinstall knives and all essential retaining components onto the center and lower shafts.
- 3) Verify knife height gap to be within specification of 0.0008" to 0.0012": if not, readjust lower housing as necessary and run-in & verify knife height gap accordingly.