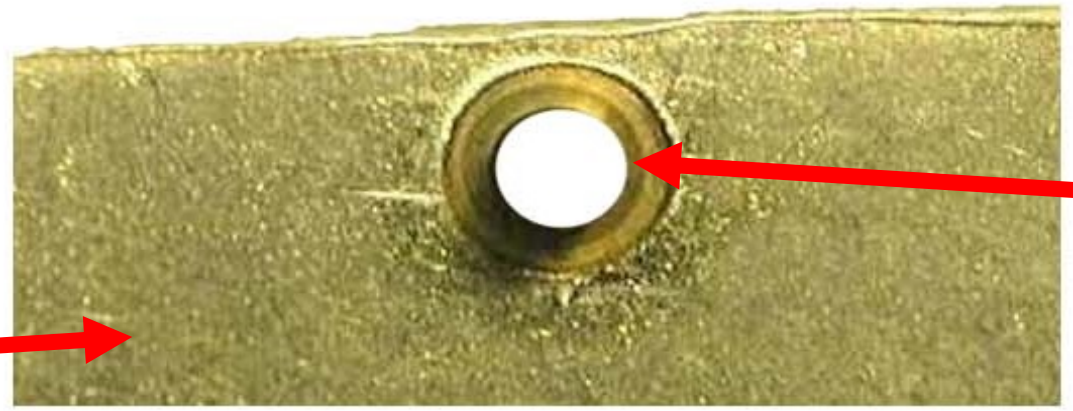
Lets Talk Bushings

Chapter 6, February 26, 2023, Meeting
Edited by Raymond Fowler

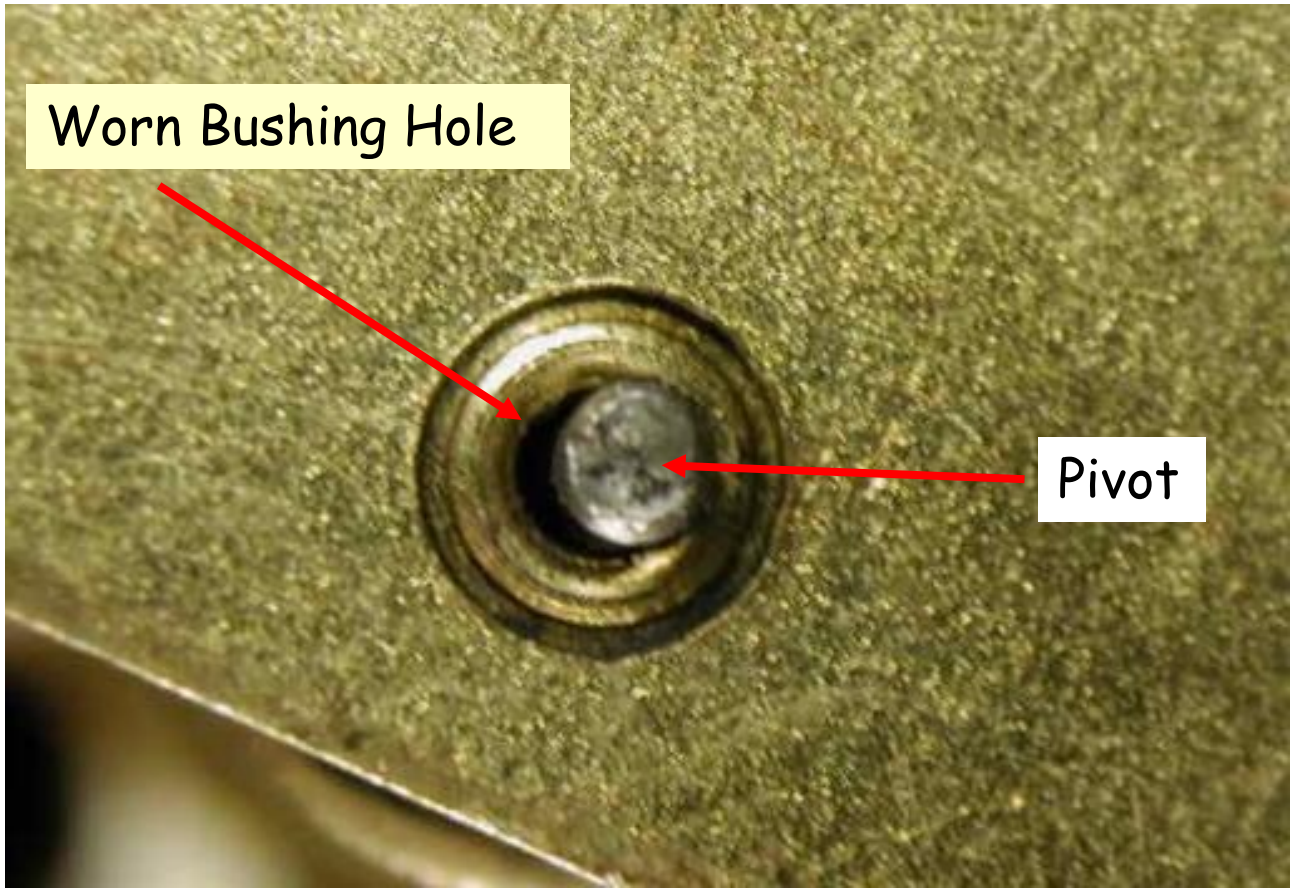
With Permission from Gary Combs, NAWCC Field Suitcase Instructor

More Definitions

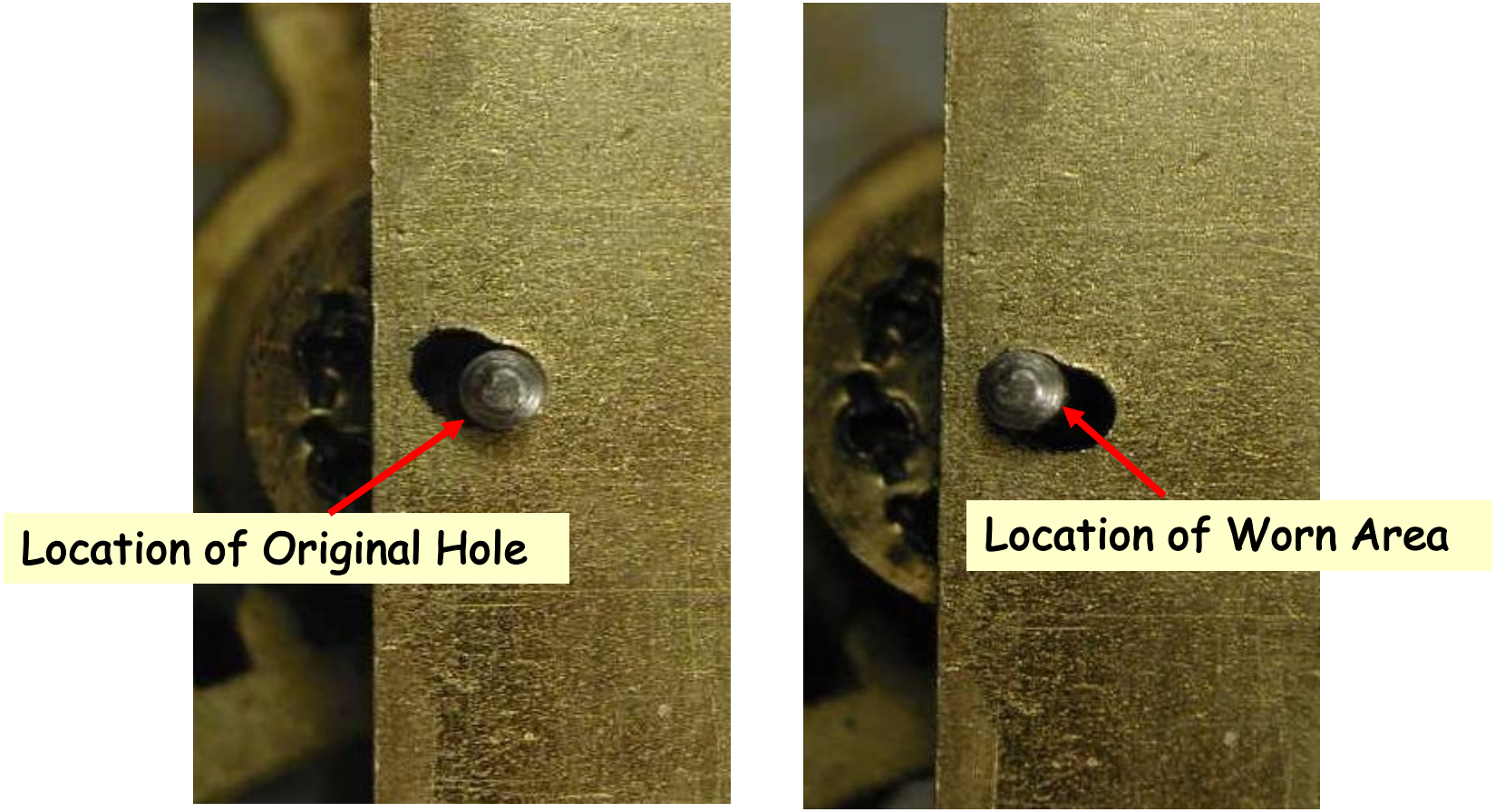
Bushing holes are the **bearing surfaces** of the clock plate



Typical Example of a worn Bushing



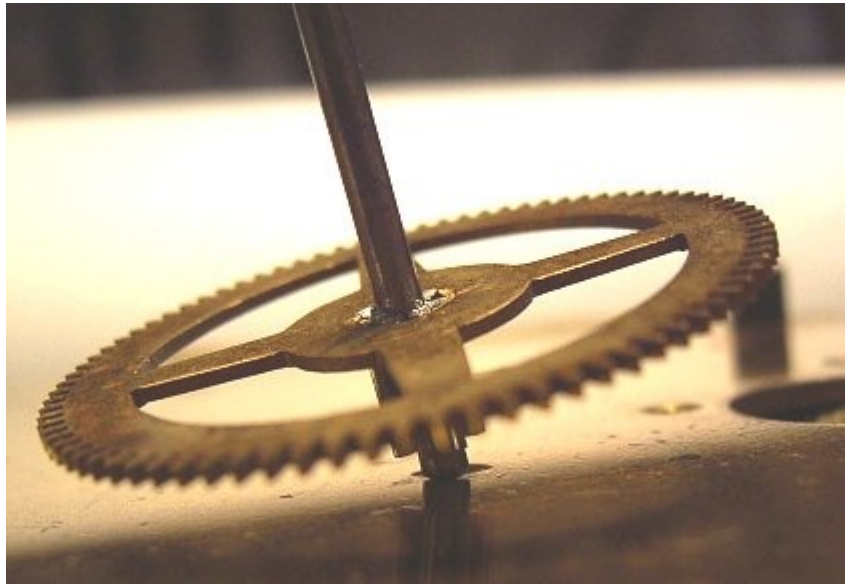
Examples of a Worn Pivot Hole

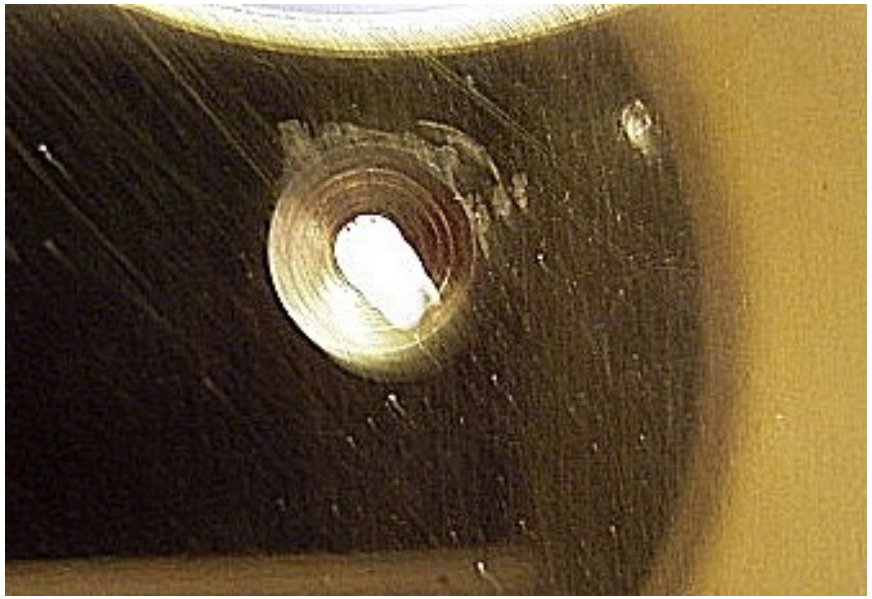


No Power on Movement

Power applied

Needs bushing



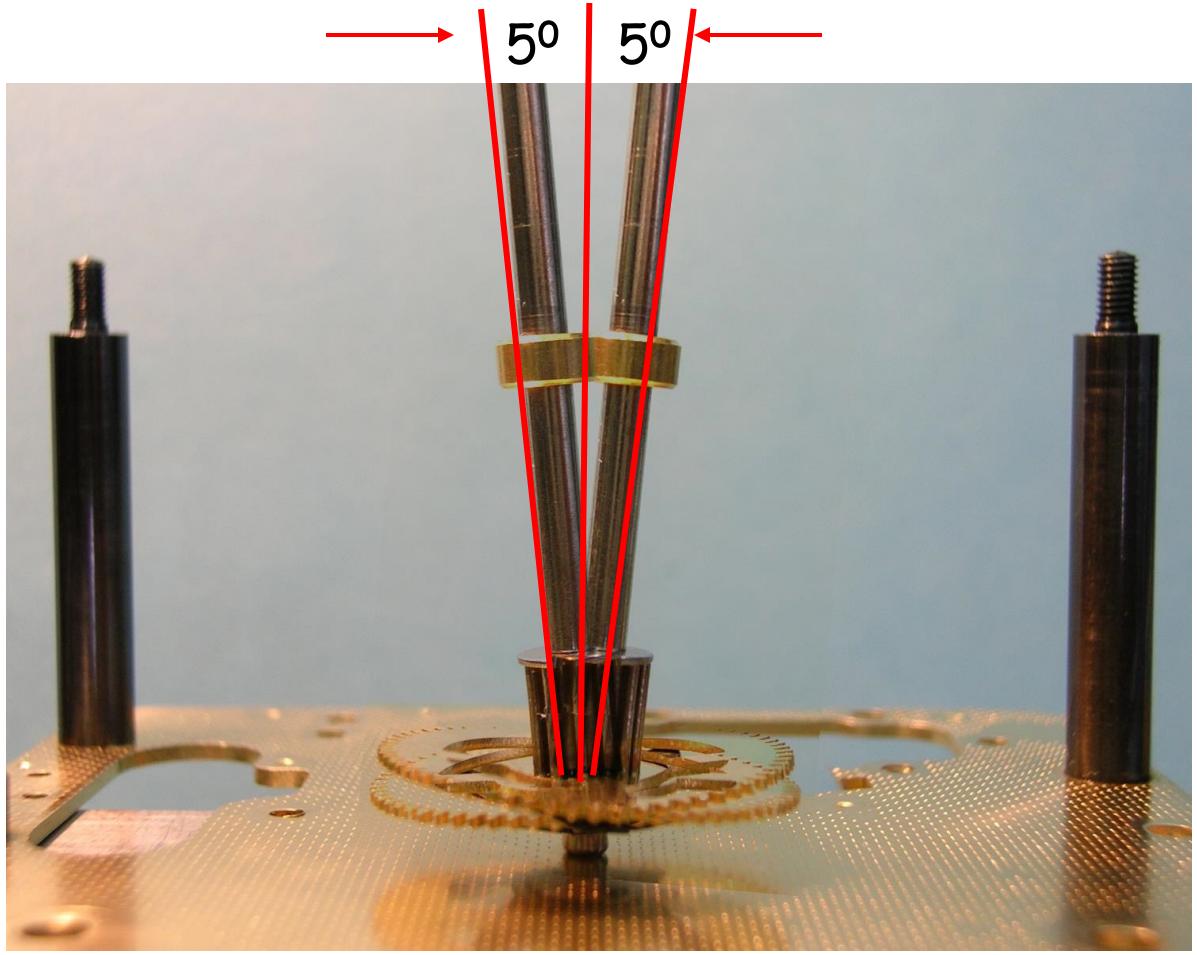


Bushing Replacement Criteria

- **In many cases the decision to replace a bushing is a judgment call based on many factors:**
  - **Degree of wear and/or surface condition**
  - **Location in train**
  - **Type of clock**
  - **Wheel and pinion teeth depthing**

Angle of Wheel Arbor Test

- Arbor leans due to bushing wear
- Lean criteria is >+-5 degrees
- Difficult criteria to judge
  - *+-5 degrees
  - *1-3mm plates
- It does work with experience



Which Bushing System KWM or Bergeon?

- **Both Bushing Systems are:**
  - **European.**
  - **Dimensioned in millimeters.**
  - **Can be used with bushing tools.**
  - **Or with an inexpensive hand operated tool.**
- **Bushings are not:**
  - **Interchangeable, but both Systems offer reamers that adapt bushings to the other's bushing tools.**

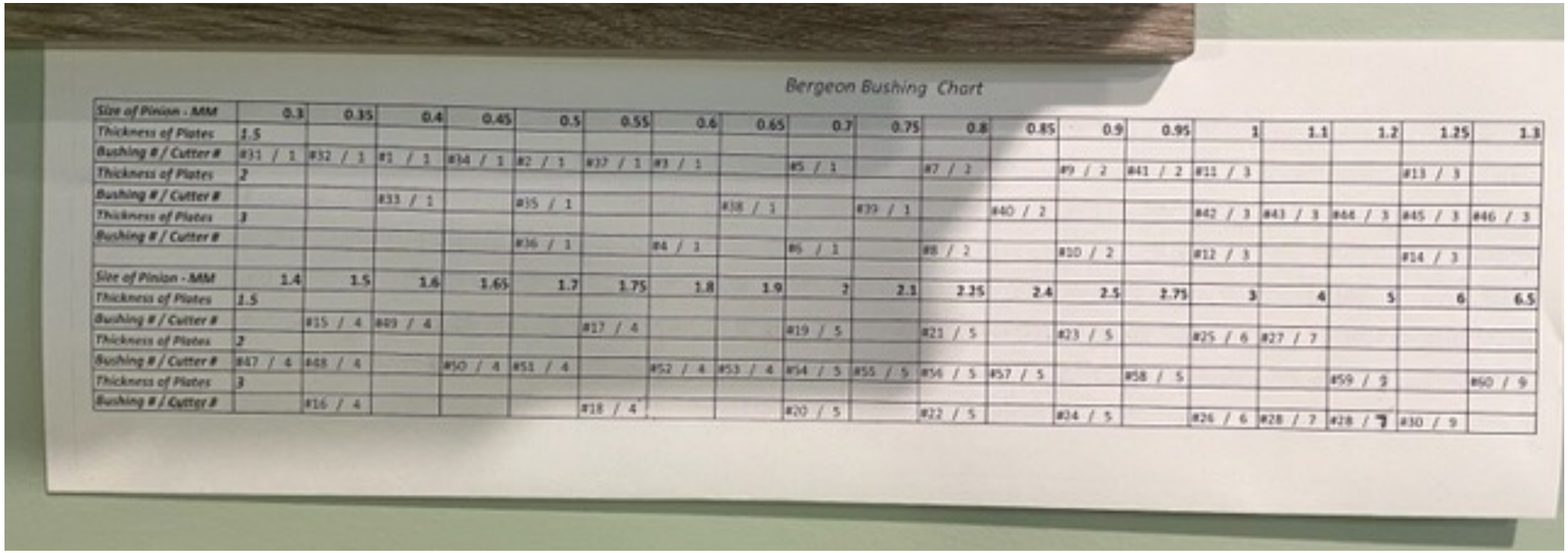
Both Systems are very good and recommended

Bergeon Bushing Tool

- Old Add, Same Machine! New Price For 2023 $1150.

Bergeon Bushings

Bergeon Bushing Guide



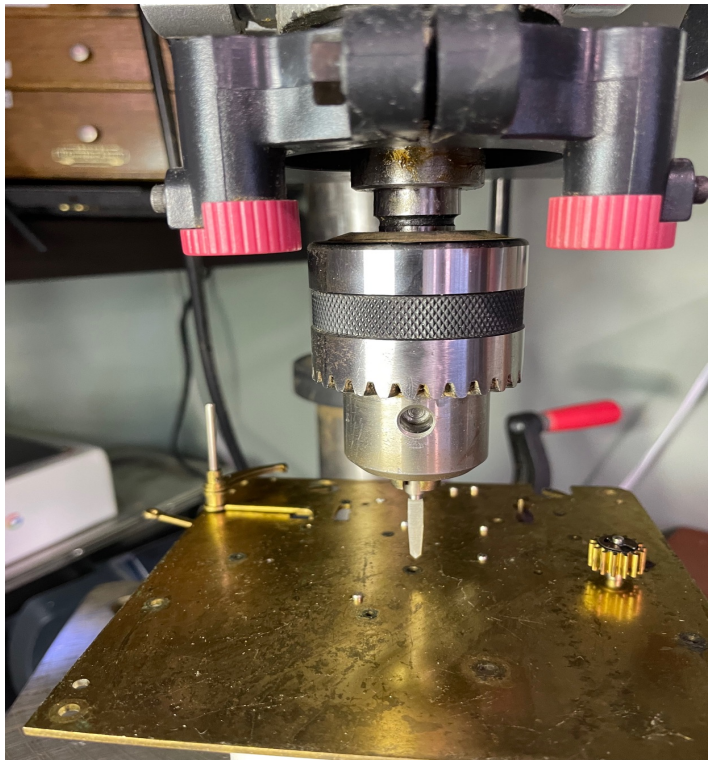
Bergeon Bushing Chart

Size of Pinion - MM	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.65	0.7	0.75	0.8	0.85	0.9	0.95	1	1.1	1.2	1.25	1.3
Thickness of Plates	1.5																		
Bushing # / Cutter #	#31 / 1	#32 / 1	#1 / 1	#34 / 1	#2 / 1	#37 / 1	#3 / 1		#5 / 1		#7 / 2		#9 / 2	#41 / 2	#11 / 3			#13 / 3	
Thickness of Plates	2																		
Bushing # / Cutter #			#33 / 1		#35 / 1			#38 / 1		#39 / 1		#40 / 2			#42 / 3	#43 / 3	#44 / 3	#45 / 3	#46 / 3
Thickness of Plates	3																		
Bushing # / Cutter #					#36 / 1		#4 / 1		#6 / 1		#8 / 2		#10 / 2		#12 / 3			#14 / 3	
Size of Pinion - MM	1.4	1.5	1.6	1.65	1.7	1.75	1.8	1.9	2	2.1	2.25	2.4	2.5	2.75	3	4	5	6	6.5
Thickness of Plates	1.5																		
Bushing # / Cutter #		#15 / 4	#49 / 4			#17 / 4			#19 / 5		#21 / 5		#23 / 5		#25 / 6	#27 / 7			
Thickness of Plates	2																		
Bushing # / Cutter #	#47 / 4	#48 / 4		#50 / 4	#51 / 4		#52 / 4	#53 / 4	#54 / 5	#55 / 5	#56 / 5	#57 / 5		#58 / 5			#59 / 9		#60 / 9
Thickness of Plates	3																		
Bushing # / Cutter #		#16 / 4				#18 / 4			#20 / 5		#22 / 5		#24 / 5		#26 / 6	#28 / 7	#28 / 9	#30 / 9	

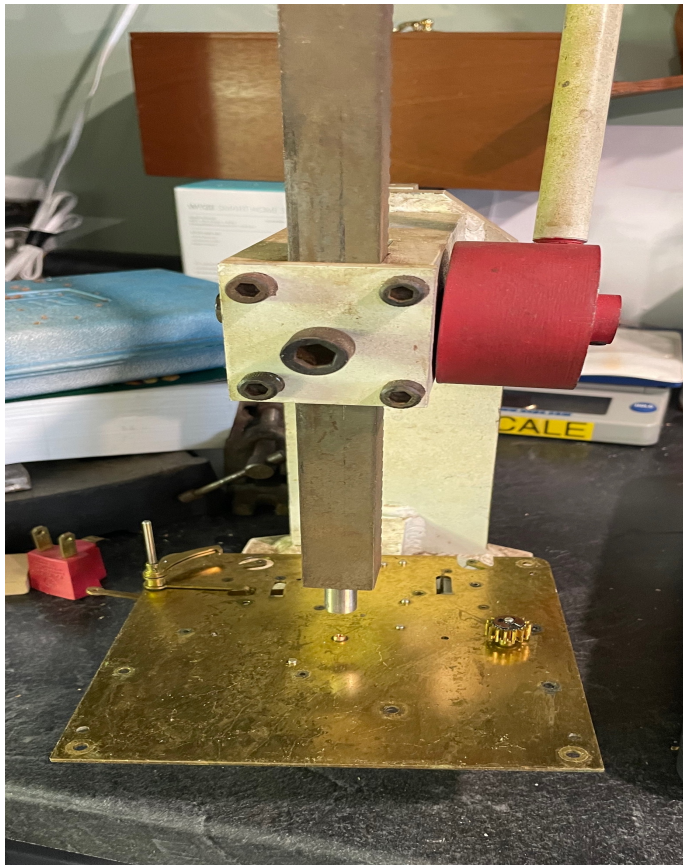
Using Drill Press

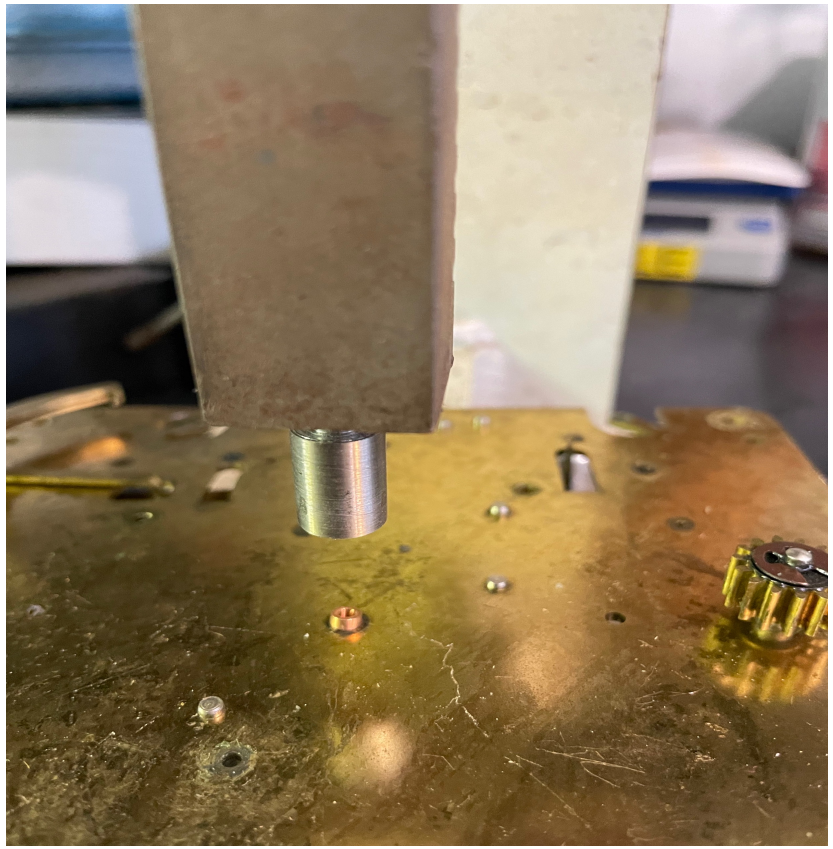
Checking with Square

Cutting Plate for Bushing



Using Arbor Press

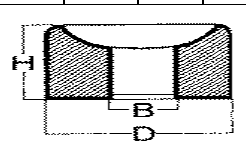




A KWM Bushing Tool With Accessories

KWM Bushing Sheet

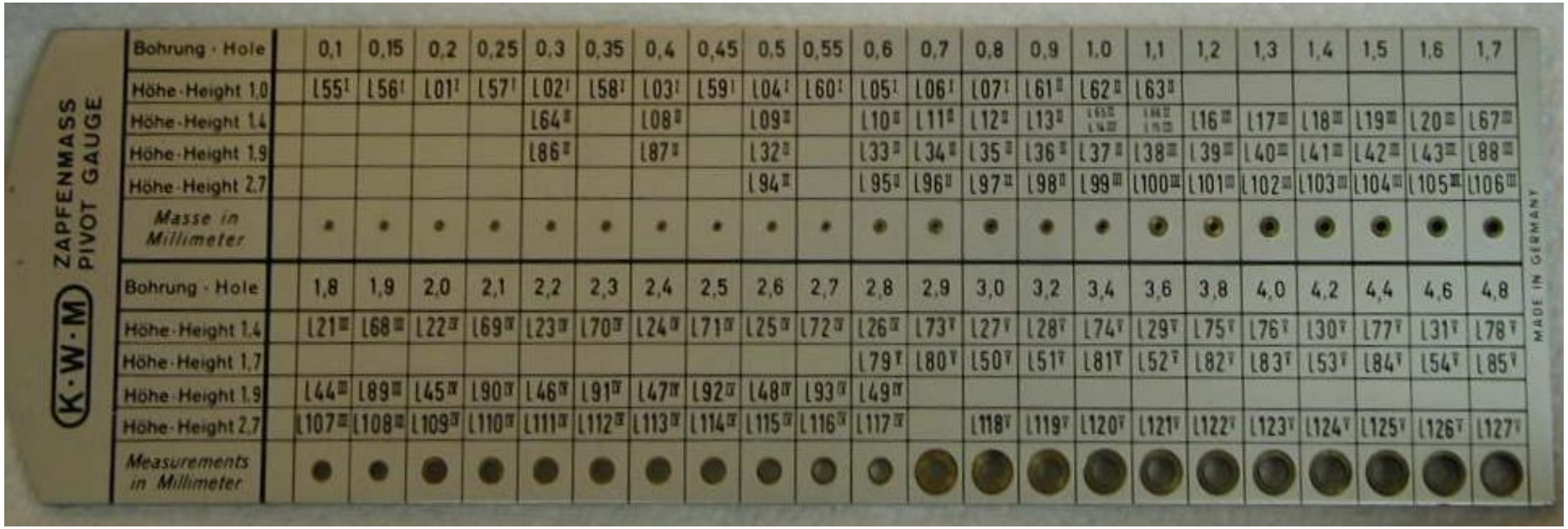
Z Pivot Diameter	B Bore	H	1.0		1.4					1.7	1.9			2.7					3.0	4.0
		D	1.2	1.8	1.8	2.7	3.5	4.7	5.9	5.9	1.8	2.7	3.5	1.8	2.7	3.5	4.7	5.9	8.7	8.7
		R	1.18	1.78	1.78	2.68	3.48	4.66	5.85	5.85	1.78	2.68	3.48	1.78	2.68	3.48	4.66	5.85	8.64	8.64
		RN	I	II	II	III	IV	IVa	V	V	II	III	IV	II	III	IV	IVa	V	VI	VI
0.07-0.08	0.1		L55																	
0.10-0.12	0.15		L56																	
0.15-0.17	0.2		L01																	
0.19-0.21	0.25		L57																	
0.23-0.25	0.3		L02		L64						L86									
0.27-0.30	0.35		L58																	
0.32-0.35	0.4		L03		L08						L87									
0.38-0.40	0.45		L59																	
0.42-0.45	0.5		L04		L09						L32			L94						
0.48-0.50	0.55		L60																	
0.53-0.55	0.6		L05		L10						L33			L95						
0.57-0.60	0.7		L06		L11						L34			L96						
0.65-0.70	0.8		L07		L12						L35			L97						
0.75-0.80	0.9			L61	L13						L36			L98						
0.85-0.90	1.0			L62	L65	L14					L37				L99					
0.95-1.00	1.1			L63	L66	L15						L38			L100					
1.05-1.10	1.2					L16						L39			L101					
1.15-1.20	1.3					L17						L40			L102					
1.25-1.30	1.4					L18						L41			L103					
1.35-1.40	1.5					L19						L42			L104					
1.45-1.50	1.6					L20						L43			L105					
1.55-1.60	1.7					L67						L88			L106					
1.65-1.70	1.8					L21						L44			L107					
1.75-1.80	1.9					L68						L89			L108					
1.85-1.90	2.0						L22						L45			L109				
1.95-2.00	2.1						L69						L90			L110				
2.05-2.10	2.2						L23						L46			L111				
2.15-2.20	2.3						L70						L91			L112				
2.25-2.30	2.4						L24						L47			L113				
2.35-2.40	2.5						L71						L92			L114				
2.45-2.50	2.6						L25						L48			L115				
2.55-2.60	2.7						L72						L93			L116				
2.65-2.70	2.8						L26			L79			L49			L117				
2.75-2.80	2.9							L138	L73	L80							L143			
2.85-2.90	3.0							L139	L27	L50							L144	L118		
2.95-3.05	3.2							L140	L28	L51							L145	L119		
3.10-3.25	3.4							L141	L74	L81							L146	L120		
3.30-3.45	3.6							L142	L29	L52							L147	L121		
3.55-3.65	3.8								L75	L82								L122		
3.75-3.85	4.0								L76	L83								L123		
3.90-4.05	4.2								L30	L53								L124		
4.15-4.25	4.4								L77	L84								L125		
4.35-4.45	4.6								L31	L54								L126		
4.55-4.65	4.8								L78	L85								L127		
4.75-4.85	5.0																		L128	
5.00-5.05	5.2																		L129	
5.15-5.25	5.4																		L130	
5.35-5.45	5.6																		L131	
5.55-5.65	5.8																		L132	
5.75-5.85	6.0																		L133	
5.95-6.05	6.2																			L134
6.15-6.25	6.4																			L135
6.35-6.45	6.6																			L136
6.55-6.65	6.8																			L137



How to use this chart

The numbers prefixed by the letter "L" such as L57 in the chart Indicates the bushing number. The number serves as a refill number for various assortments. To select the correct bushing, first Measure the pivot, & find it size in the range of sizes shown in column Z. By reading across, you Will find the various bushing that Will fit the size pivot.
Select the thickness of bushing by Referring to letter "H" & the correct diameter by the letter "D". After choosing the bushing, read Up the column to line "RN" which indicates the size reamer to Be used for the selected bushing. Reamers are identified by Roman numerals.

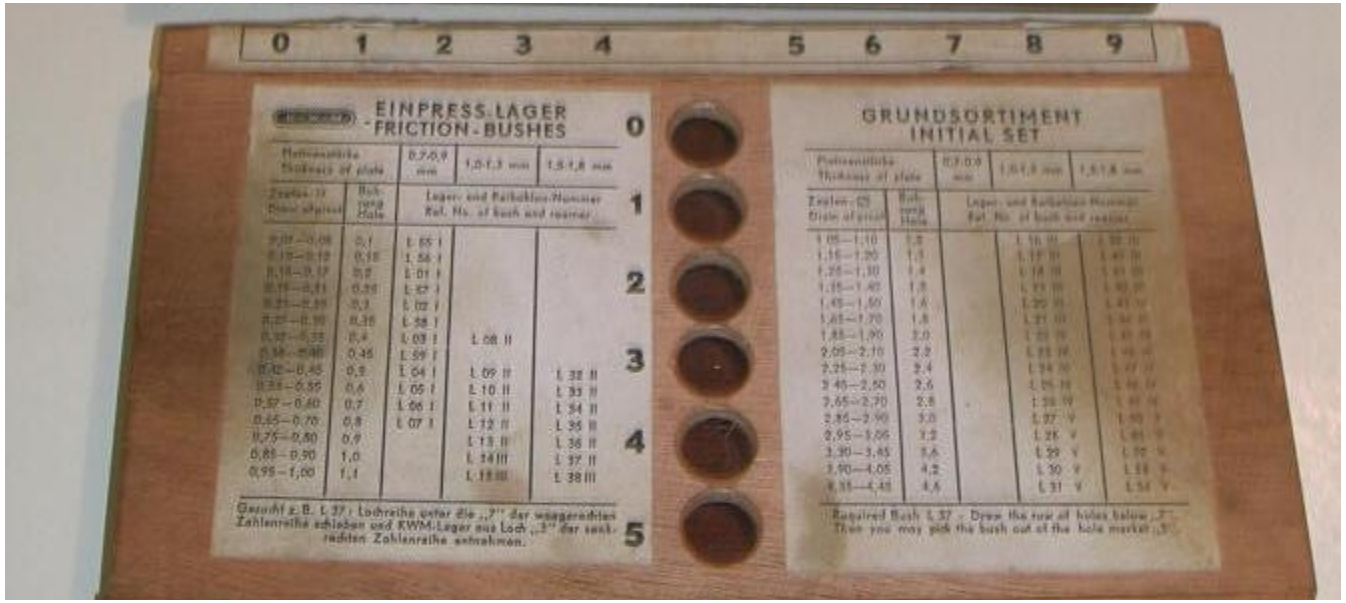
KWM Bushing Template



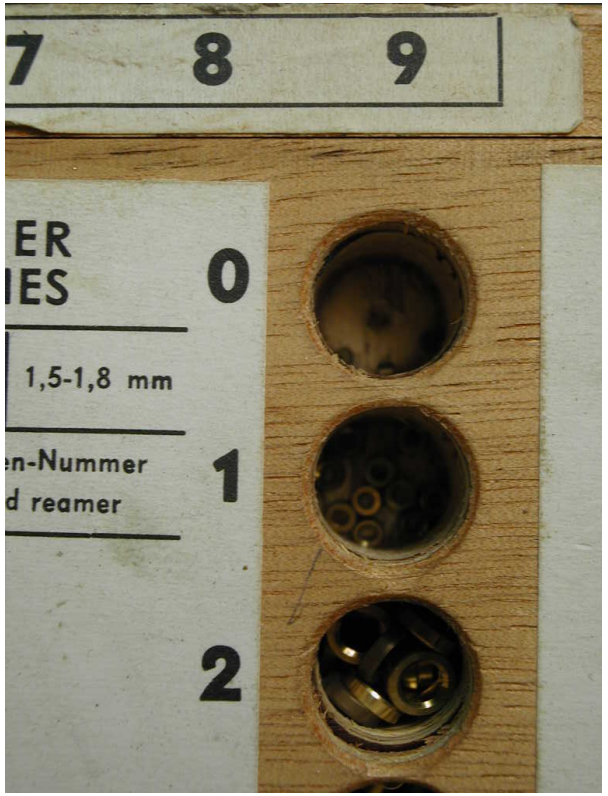
This template contains the same info as the table

KWM Bushings

KWM Bushings



Select a Bushing



Reaming Hole for New Bushing

Reamer in Hole

Hole Ready for Bushing

Inserting Bushing in Hole

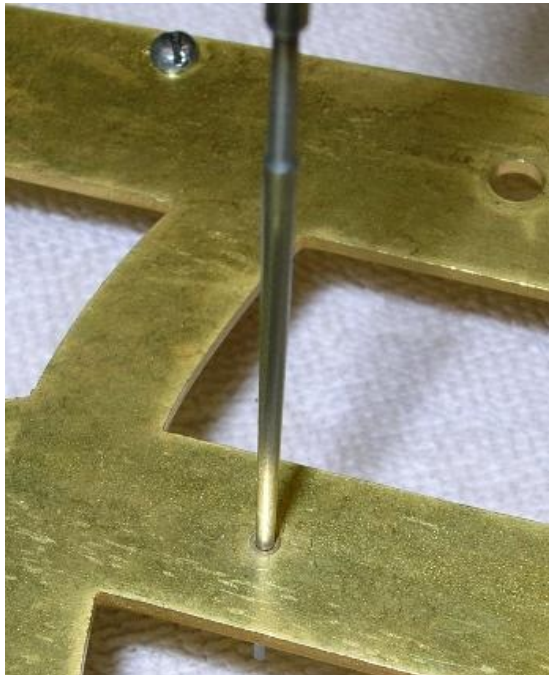
Bushing in Hole

Bushings: Final Fit

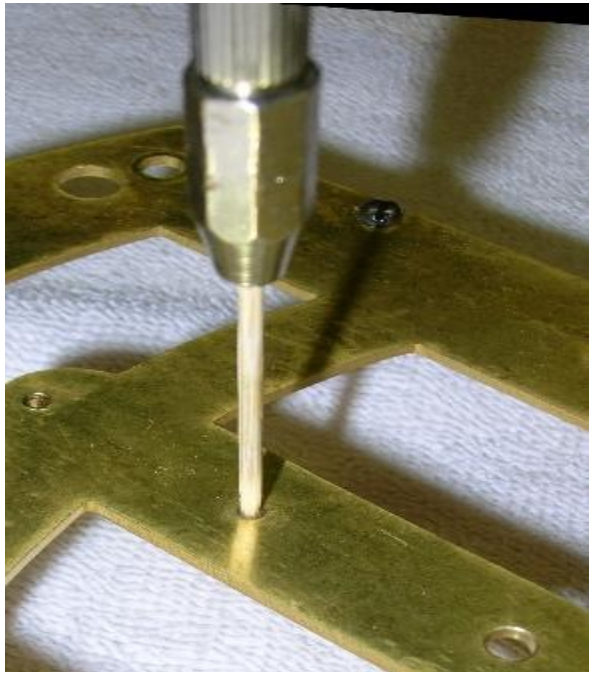
- Bush tight and broach to final fit
- Every wheel needs clearance to spin
  - Side shake and end shake
- Broaches
  - Cutting From Both Sides
    - 5-sided with taper
    - To enlarge the bushing hole for pivot clearance
    - Used dry
    - Twist with very light pressure to remove a little material at a time
    - Monitor results often
    - Maintain upright
  - Smoothing
    - Round with taper
    - To burnish and harden the bearing surface
    - Used with oil
    - Twist with light pressure. Do NOT jam into the bushing

Burnish All Bushing Holes

All bushing holes need to be burnished with a smoothing broach and peg-wood or toothpick

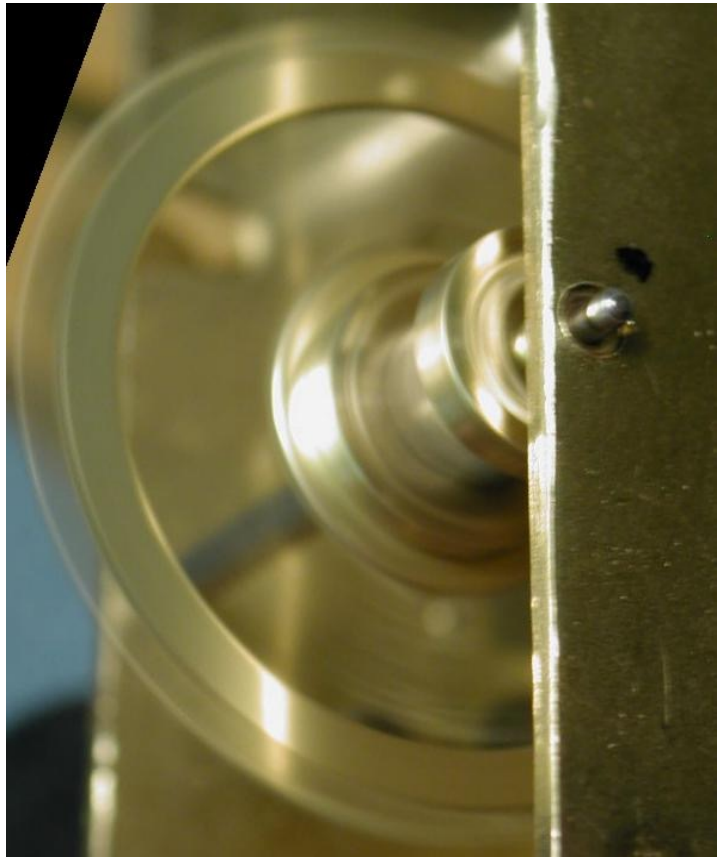


Use oil on smoothing broach



Burnish dry with wooden burnisher

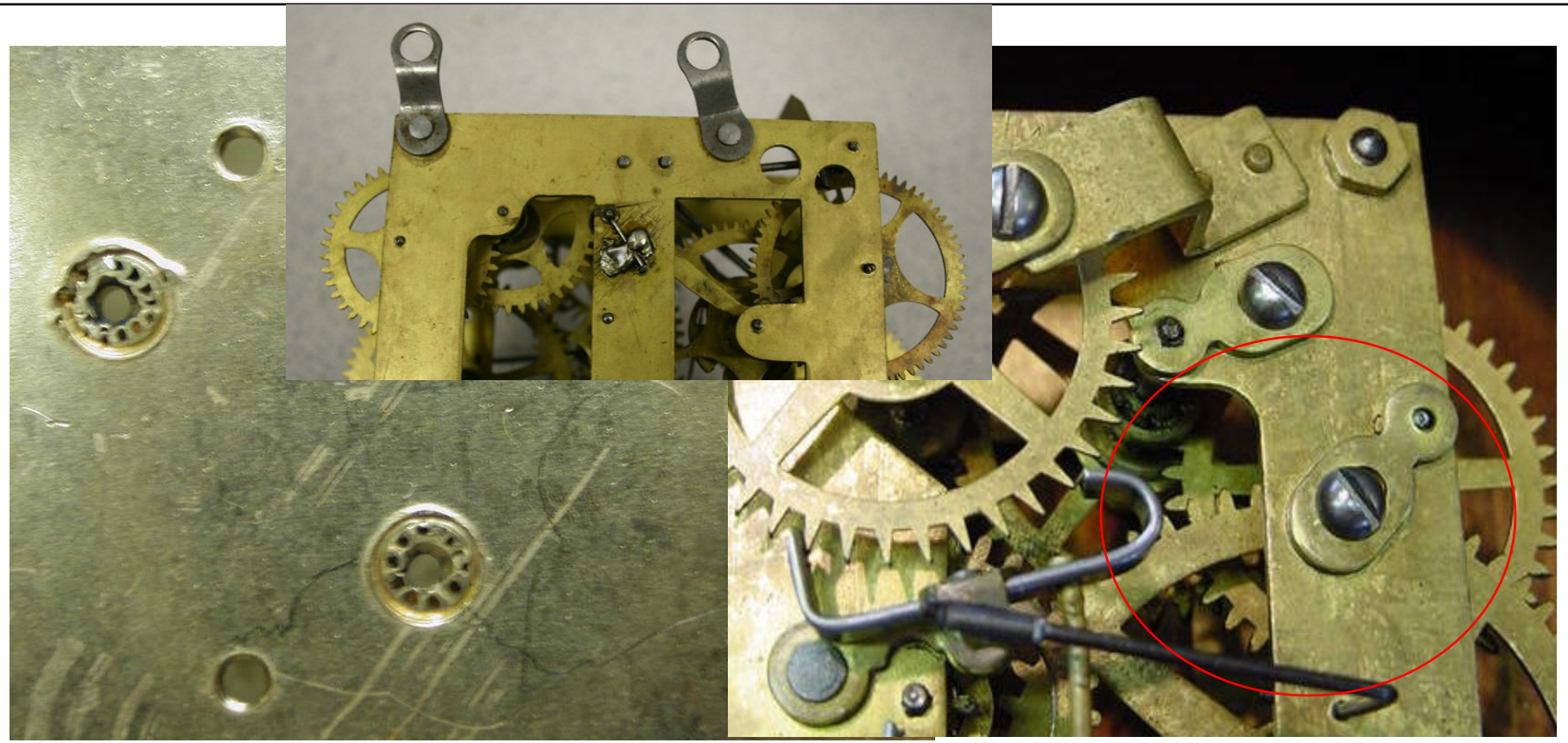
Testing New Bushing



Finally, Test all Wheels in the Train

- Final test of the bushing job is to assemble all wheels in each train.
- Leave the verge off the time train and the levers out of the strike and chime train.
- Apply a small amount of power and wheels should turn freely. If not, look for:
  - Bushings that are too tight
  - Bent pivots
  - Depthing issues
  - Too little end-shake
  - NEED to correct these issues now!

Rathburn (band-aide) bushing tabs and Hole Closing are Destructive Practices



http://masterclockrepair.com/hallofshame.html