2024
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CJWINTER
A Brinkman International Group, Inc. Company

Manual of End Rolling Attachments

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Section 1: Introduction

Fig. 00 – CJWinter Assembly Technician In Action

1.1 Foreword

Congratulations on the purchase of your CJWinter End Rolling Attachment! This investment will provide reliable service with a great degree of versatility and ease of use. Our products are unmatched in the Axial Thread Rolling Industry and our patented designs focus on providing uncommon results in quality and productivity.

This manual will describe how to use your Attachment to its full potential, from installation and setup to operation and maintenance.

1.2 About CJWinter

C. J. Winter Machine Works, Inc. (later changed to CJWinter Machine Technologies, Inc.) was incorporated in 1956 and acquired by Robert J. Brinkman in 1969. CJWinter is known worldwide for its high-quality thread rolls, easy-to-adjust thread rolling attachments, competitive pricing, and the industry's fastest turnaround times.

A leading manufacturer of cold-displacement, cylindrical dies, and threading attachments, CJWinter's products are found in a number of applications from multi-spindle screw machines to rotary transfer machines and CNC lathes.

CJWinter's products and dies are also found in specialty applications like cold-root rolling and in industries using dedicated rolling, forming and shaping mills.

CJWinter should be your first choice when it comes to your material forming needs.

All CJWinter Products are Made Proudly in the USA 

1.3 Other Media

From educational videos and quick and easy calculators to high quality manuals and schematics, CJWinter is proud to provide complete support for all of your manufacturing needs.

For more information on the installation, operation, or maintenance of your attachment, please visit us at: https://www.CJWinter.com/

To make use of our precision thread rolling calculators: https://www.CJWinter.com/calculators/

For in depth overviews of attachments and critical manufacturing concepts, see our YouTube Channel at: https://www.youtube.com/@CJWinter

To stay up to date with our business, follow our LinkedIn page here:

https://www.linkedin.com/company/cjwinter-machine-technologies-inc-

Contact us at:

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Section 2: Reference Information

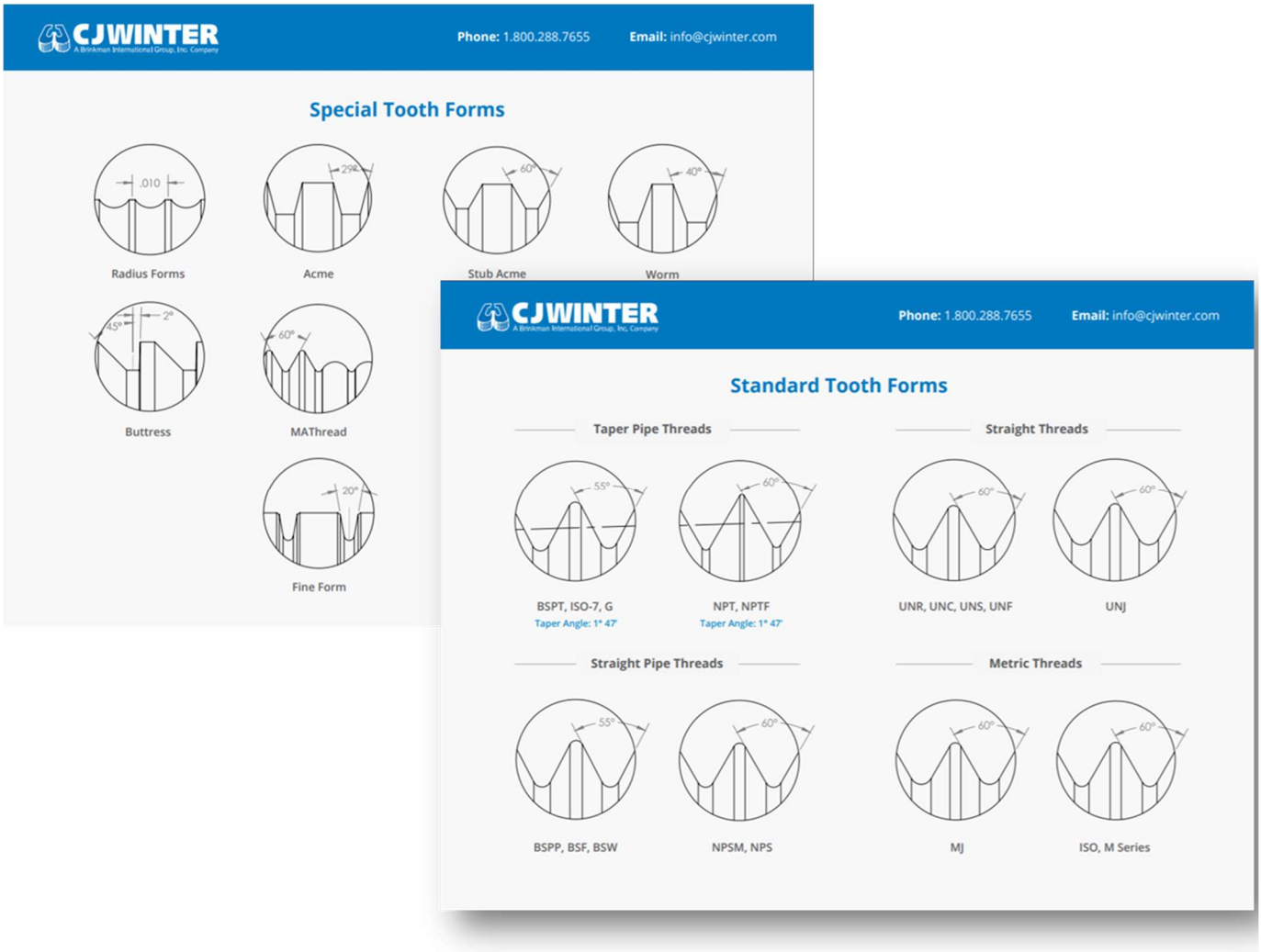


Fig. 01 – Reference Sheets

2.1 Definition: Thread Rolling

Threads are a series of raised crests and grooves running perpendicularly to the axis of a part. Threads are a vital feature on all modern fasteners and an innumerable quantity of connectors, and parts.

Thread rolling is a cold forming material displacement process where through the action of a set of hardened rolling dies a thread, spline, or knurl form is rolled onto a segment of blank material.

Thread rolling provides a number of advantages over traditional thread manufacturing processes, including but not limited to: strengthened tooth forms, improved surface finish, increased precision, faster average cycle times, and several additional benefits.

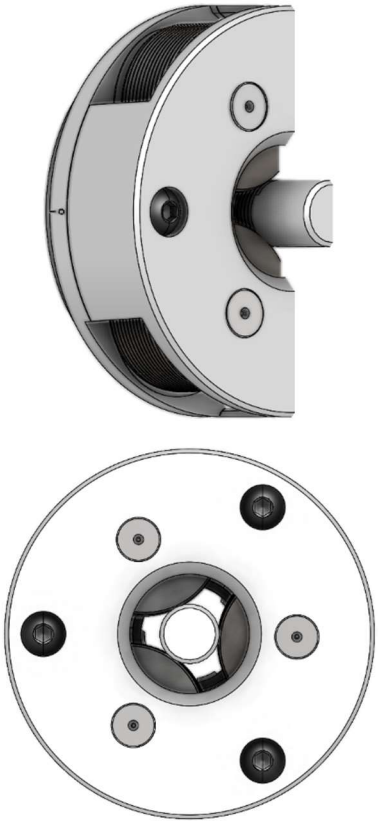


Fig. 02 - Thread Rolling Diagram

2.2 Definition: End Rolling

End rolling is a thread rolling process where, through purely linear motion of the thread rolling head, a thread form, knurl, or spline is rolled onto the surface of a rotating part.

2.1.b Reasons to End Roll Threaded Parts

Threaded connections can be manufactured by a wide variety of means, turning, milling, tangential rolling, etc. However, none of these processes can match the speed at which end rolling can form a thread, the process economy, the convenience of operation in a traditional lathe or mill, or the strength of the product.

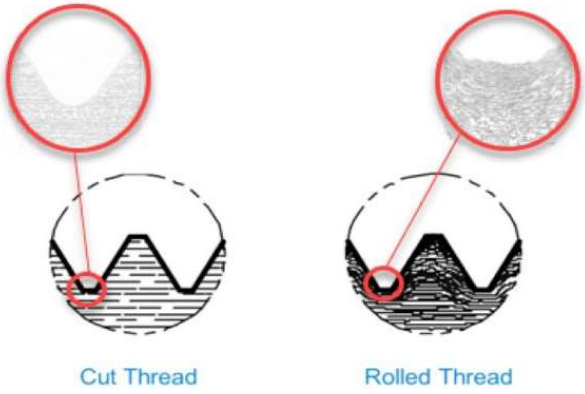


Fig. 03 – Cut vs. Rolled Thread Diagram

2.3 Definition: Involute Knurl or Spline

Involute knurls and involute splines are two names for the same type of feature. They are a series of ridges formed on the periphery of a cylinder, where the shape of each ridge is defined by the involute formulas of a gear tooth. They are primarily used as shaft connection devices to transmit torque to components that are pressed onto or over-molded the end of a shaft. The involute ridges transmit torque more effectively than a simple press into a round hole, and can orient features between the shaft and the pressed component.

2.3.a Reasons to Roll Involute Knurl Connections

Involute Knurl connections can be manufactured by a wide variety of means, including casting, forging, cutting, broaching, milling etc. However, none of these processes can match the speed at which rolling can form a knurl, the economy of the process, the convenience of performing the operation in a traditional metalworking lathe or mill without specialized equipment, nor the strength of the final product.

Knurl rolling typically occurs in 2 to 3 seconds. Time will naturally vary with the knurl length, and diameter, but in virtually all cases, rolling is an order of magnitude faster than conventional machining processes. Tooling cost per part is extremely competitive to all other processes, usually 5 to 10 times less expensive than the next closest option, which makes it perfect for high volume, low margin jobs.

Knurling can be completed on virtually any lathe, mill, or multi-spindle machine. No specialized equipment is required, and no secondary processes are required. For the most part, if you can machine the blank, you can knurl the part.

Knurl rolling is a cold-forming process, where material is displaced and formed into the final shape at room temperature. The material's grain structure is refined, and the grain boundaries are forced to flow smoothly past all root radii, rather than being cut. As a result, the final part is work-hardened into a tougher connection. The knurl tooth is more resistant to deformation and cracking, and can carry a higher load than a cut counterpart.

2.4 Why Use CJWinter End Rolling Attachments?

Since 1956, CJWinter has been an industry leader in supplying thread rolls, knurling dies, burnishing rolls and thread rolling tools globally. CJWinter has used that experience to design thread rolling tools specifically for sustained use in industrial applications. We are certain our attachments are the easiest to use and most precise way to manufacture rolled threads and splines on the market. Our in-house engineering staff is always available to assist with any technical manufacturing situation.

CJWinter End Rolling Attachments and rolls incorporate unique, Patented features and advantages not always found on other thread rolling tools.

2.4.a Features & Advantages

Precision - All Standard CJWinter and 193 type attachments utilize a one-piece front plate with integral standoffs. The rigid construction of our end rolling attachments provide the best of reliability and precision. With sealed pitch adjustment gear trains, fine-adjust screws, low friction ultra-hard coatings, and fewer wear parts than a comparable heads, the CJWinter lineup of end rolling attachments are certain to overmatch the competition.

One-Twist Adjustment - CJWinter end rolling attachments require the loosening of only three locking screws and a simple twist of the head to adjust the distance between the three rolls. This one twist will cause all three rolls move equally towards or away from the centerline of the attachment.
This ensures that each roll does an equal amount of work and that the work piece is always evenly supported. This facilitates the best concentricity of the roll surfaces to the part centerline.
Other axial rolling tools on the market require as many as 27 separate screws to adjust size, and have no means of keeping the rolls concentric to the tool axis. This can lead to one die working harder than the others, bent parts, damaged tooling, and material slivering.

Graduated Scale - Adjustments to size are made while referencing a graduated scale on the side of the head. The scale is clearly labeled (+) and (-) so fine adjustments can be made with confidence.

Wide Range of Sizes – CJWinter End Rolling Attachments and their derivatives can accommodate a substantial range of sizes with optional variants and modifications the CJWinter catalog of end rolling heads is certain to meet your manufacturing needs.

Section 3: Selecting the Right Attachment

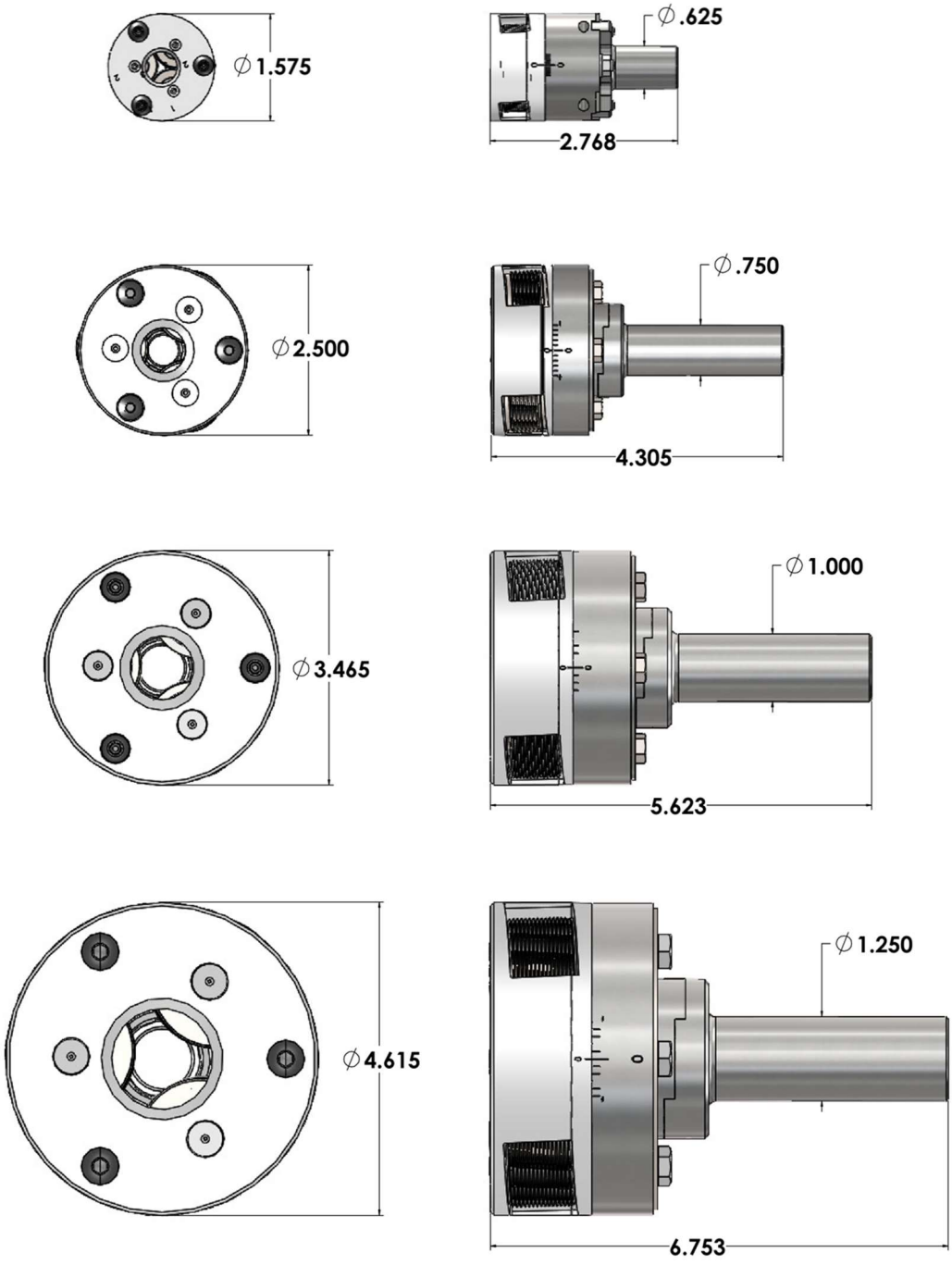
Fig. 04 – Attachment Spread

In order to best meet a particular application, selecting the appropriate thread rolling head is essential. The following diagrams will cover

- The general dimensions of CJWinter End Rolling Heads
- The fundamental capacity and thread sizes supported by a given attachment
- The comparison of these capabilities
- Provide a basic illustration of the physical difference between the attachments

Note: All of the following graphics are not to actual scale, but maintain relative scale.
i.e. the size difference will be consistent but actual product size will not be equivalent.
Each subsequent chart will maintain its respective Unit System.

3.1 Standard ER Attachment Sizing



CJWinter 189 ER Attachment

CJWinter 190 ER Attachment

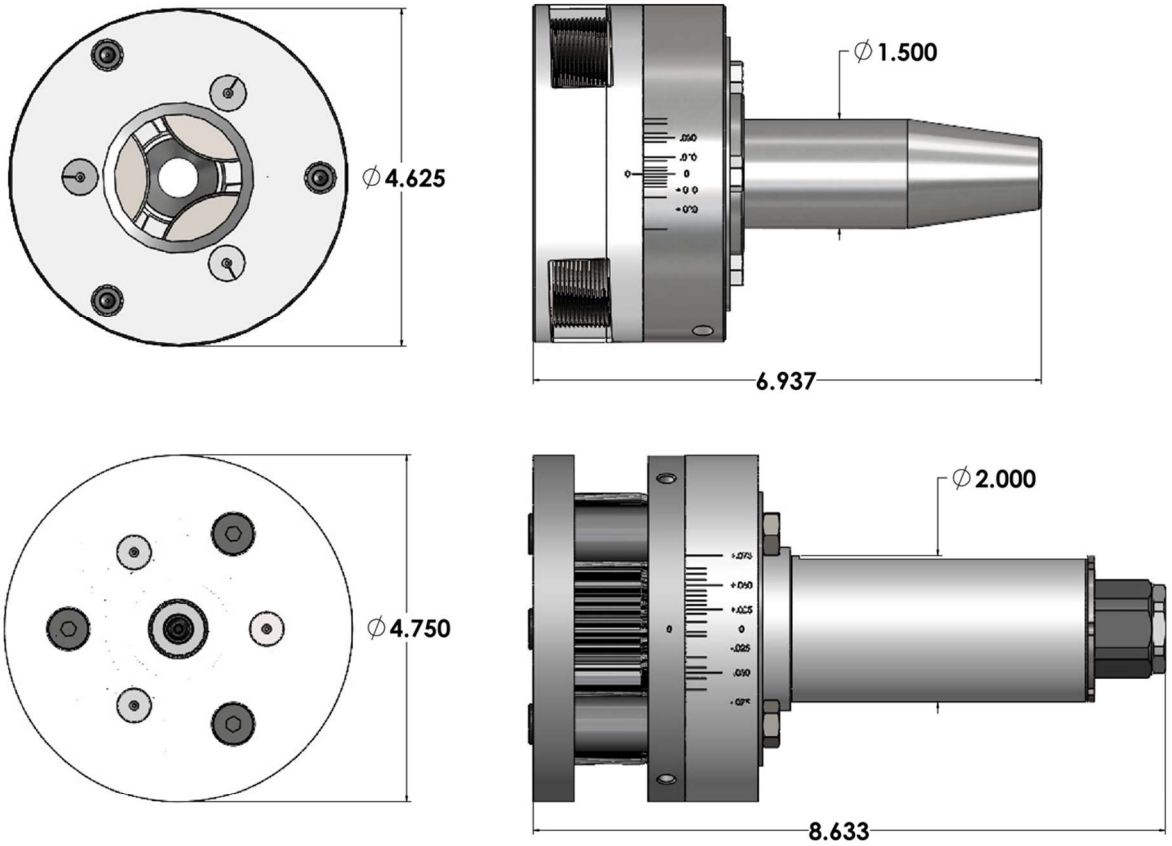
CJWinter 191 ER Attachment

CJWinter 194 ER Attachment

Attachment scale relative, actual size not represented.

Fig. 05 - CJWinter ER Attachment Visual Size Comparison

3.2 Specialty ES Attachment Sizing



CJWinter 193 ES Attachment

Specialty Roll-on roll-off attachment.

CJWinter 192 ES Attachment

Specialty Knurling Head

Attachment scale relative, actual size not represented.

Fig. 05a - CJWinter ER Attachment Visual Size Comparison Cont.

3.3 Standard ER Series Attachment Capacity

Metric Sizing Chart					189	190	191	193	194
Thread Size			Pitch Diameter (6g)						
			Max	Min					
M	3.5	x 0.5	3.155	3.080					
M	3.5	x 0.6	3.089	3.004					
M	4	x 0.5	3.655	3.580					
M	4	x 0.7	3.523	3.433					
M	4	x 0.75	3.491	3.391					
M	4.5	x 0.5	4.155	4.080					
M	4.5	x 0.75	3.991	3.901					
M	5	x 0.75	4.491	4.391					
M	5	x 0.8	4.456	4.361					
M	5	x 0.9	4.390	4.287					
M	5.5	x 0.75	4.991	4.891					
M	5.5	x 0.9	4.890	4.787					
M	6	x 0.75	5.491	5.391					
M	6	x 1	5.324	5.212					
M	7	x 0.75	6.491	6.391					
M	7	x 1	6.324	6.212					
M	8	x 0.75	7.513	7.453					
M	8	x 1	7.324	7.212					
M	8	x 1.25	7.160	7.042					
M	9	x 1	8.324	8.212					
M	9	x 1.25	8.160	8.042					
M	10	x 1	9.324	9.212					
M	10	x 1.25	9.160	9.042					
M	10	x 1.5	8.994	8.862					
M	11	x 1.5	10.026	9.936					
M	12	x 0.5	11.655	11.580					
M	12	x 0.75	11.491	11.391					
M	12	x 1	11.974	11.794					
M	12	x 1.25	11.160	11.028					
M	12	x 1.5	10.994	10.854					
M	12	x 1.75	10.863	10.768					
M	13	x 0.75	12.491	12.391					
M	13	x 1	12.324	12.206					
M	13	x 1.5	11.994	11.854					
M	14	x 0.75	13.491	13.391					
M	14	x 1	13.324	13.206					
M	14	x 2	12.663	12.503					
M	14	x 1.5	12.994	12.854					
M	14	x 1.75	12.863	12.768					

Metric Sizing Chart				Pitch Diameter (6g)		189	190	191	193	194
Thread Size				Max	Min					
M	15	x	0.75	14.491	14.391					
M	15	x	1	14.325	14.206					
M	15	x	1.5	13.994	13.854					
M	16	x	1	15.324	15.206					
M	16	x	1.5	14.994	14.854					
M	16	x	2	14.663	14.503					
M	17	x	1	16.974	16.794					
M	18	x	1	17.324	17.206					
M	19	x	0.75	18.487	18.310					
M	20	x	1.5	18.994	18.854					
M	20	x	2	18.663	18.503					
M	20	x	2.5	19.623	19.958					
M	22	x	2	20.663	20.503					
M	22	x	2.5	21.623	21.958					
M	24	x	1.5	22.994	22.854					
M	27	x	1.5	25.994	25.854					

Fig. 06 - Metric End Rolling Attachment Capacity Chart

Standard Sizing Chart					189	190	191	193	194
Thread Size			Pitch Diameter (3A)						
			Max	Min					
#	6	- 40	0.1218	0.1198					
#	8	- 32	0.1437	0.1415					
#	8	- 36	0.1460	0.1439					
#	10	- 24	0.1629	0.1604					
#	10	- 32	0.1697	0.1674					
#	12	- 24	0.1889	0.1863					
#	12	- 28	0.1928	0.1904					
#	12	- 32	0.1957	0.1933					
	1/4	- 20	0.2175	0.2147					
	1/4	- 24	0.2218	0.2181					
	1/4	- 27	0.2249	0.2214					
	1/4	- 28	0.2268	0.2243					
	1/4	- 32	0.2297	0.2273					
	5/16	- 18	0.2764	0.2734					
	5/16	- 20	0.2800	0.2770					
	5/16	- 24	0.2854	0.2827					
	5/16	- 28	0.2893	0.2867					
	3/8	- 16	0.3344	0.3311					
	3/8	- 18	0.3376	0.3333					
	3/8	- 20	0.3425	0.3394					
	3/8	- 24	0.3479	0.3450					
	7/16	- 14	0.3911	0.3876					
	7/16	- 16	0.3969	0.3935					
	7/16	- 18	0.4001	0.3958					
	7/16	- 20	0.4050	0.4019					
	1/2	- 13	0.4500	0.4463					
	1/2	- 16	0.4594	0.4559					
	1/2	- 18	0.4626	0.4582					
	1/2	- 20	0.4675	0.4643					
	1/2	- 24	0.4717	0.4678					
	9/16	- 12	0.5084	0.5045					
	9/16	- 14	0.5146	0.5096					
	9/16	- 16	0.5219	0.5184					
	9/16	- 18	0.5264	0.5230					
	9/16	- 20	0.5300	0.5268					
	9/16	- 24	0.5625	0.5553					
	9/16	- 28	0.5625	0.5560					
	9/16	- 32	0.5625	0.5565					
	5/8	- 11	0.5660	0.5619					
	5/8	- 12	0.5709	0.5668					
	5/8	- 16	0.5844	0.5808					
	5/8	- 18	0.5889	0.5854					

Standard Sizing Chart			189	190	191	193	194
Thread Size	Pitch Diameter (3A) Max	Pitch Diameter (3A) Min					
5/8 - 20	0.6250	0.6169					
5/8 - 24	0.6250	0.6178					
5/8 - 28	0.6250	0.6185					
5/8 - 32	0.6047	0.6020					
11/16 - 20	0.6862	0.6781					
11/16 - 24	0.6875	0.6803					
11/16 - 28	0.6875	0.6810					
3/4 - 10	0.6832	0.6773					
3/4 - 16	0.7079	0.7029					
3/4 - 20	0.7175	0.7142					
3/4 - 28	0.7500	0.7435					
13/16 - 16	0.8125	0.8031					
13/16 - 20	0.7800	0.7764					
13/16 - 28	0.8125	0.8060					
7/8 - 9	0.8009	0.7946					
7/8 - 12	0.8750	0.8636					
7/8 - 14	0.8270	0.8216					
7/8 - 16	0.8750	0.8656					
7/8 - 20	0.8750	0.8669					
7/8 - 28	0.8750	0.8685					
15/16 - 12	0.9375	0.9261					
15/16 - 16	0.9375	0.9281					
15/16 - 20	0.9375	0.9294					
1 - 12	1.0000	0.9886					
1 - 16	1.0000	0.9906					
1 - 20	0.9675	0.9641					
1 1/16 - 12	1.0625	1.0511					
1 1/16 - 16	1.0625	1.0531					
1 1/16 - 18	1.0625	1.0538					
1 1/16 - 20	1.0625	1.0544					
1 1/8 - 18	1.1250	1.1163					
1 1/8 - 20	1.1250	1.1169					
1 1/8 - 16	1.1250	1.1156					
1 3/16 - 12	1.1875	1.1761					
1 3/16 - 16	1.1469	1.1431					
1 3/16 - 18	1.1875	1.1788					
1 3/16 - 20	1.1875	1.1794					

Fig. 07a - Standard End Rolling Attachment Capacity Chart

NPT Pipe Sizing Chart				189	190	191	193	194
Thread Size		NPT Pitch						
		Max	Min					
NPT 1/16 - 27		0.2712	0.1171					
NPT 1/8 - 27		0.3635	0.1632					
NPT 1/4 - 18		0.4774	0.2109					
NPT 3/8 - 18		0.6120	0.2782					
NPT 1/2 - 14		0.7584	0.3435					
NPT 3/4 - 14		0.9677	0.4481					

Fig. 08 – Pipe Thread End Rolling Attachment Capacity Chart

3.4 Specialty 192 ES Series Attachment Capacity

1. Min and Max Bolt Circle (Same for both 1" and 2" wide Rolls)
    - FCD Max: 2.456
    - FCD Min: 2.396

2. Max Roll OD: 2.000"

3. Plate Max Diameters:
    - Front Plate: .950 (If bigger thrust washer may need to be Modified)
    - Back Plate: .920

4. Part Major Diameter: 0.625" to 1.000" Max (If part is under or over, review application with CJWinter)

Section 4: Blank Preparation

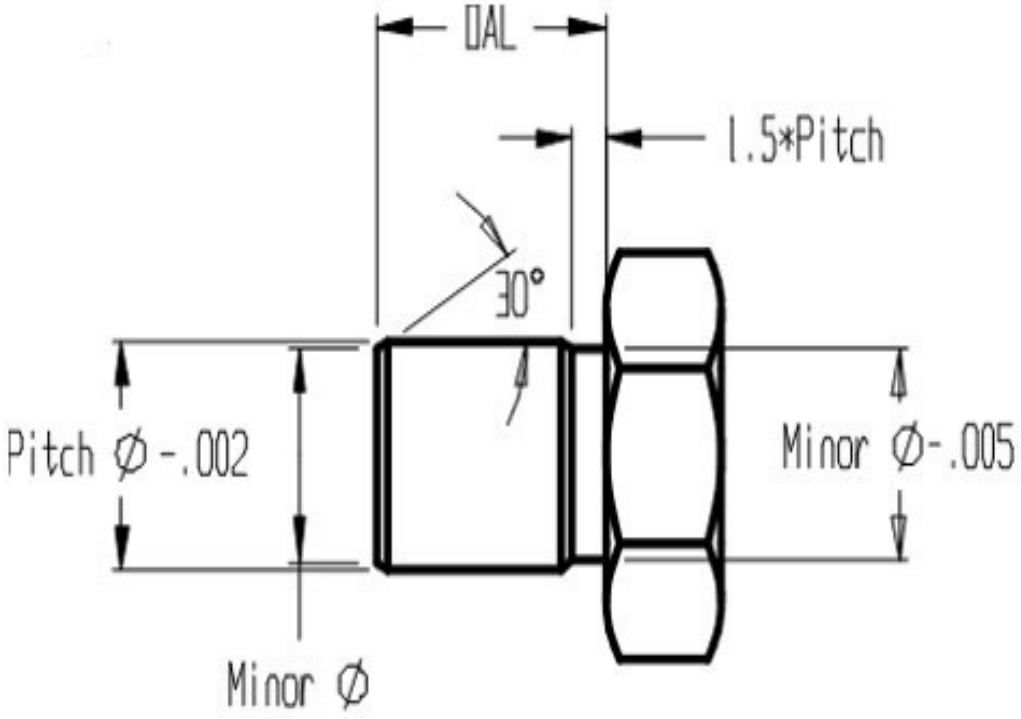


Fig. 09 – Blank Example Dimensions

This is perhaps the most important part of the setup for thread rolling. Poor blank design or inconsistent blank preparation will lead to a poor finished part that no amount of adjustment to the thread rolling head can correct.

4.1 Blank Dimensions

4.1.a Blank Diameter

The formula for the recommended blank diameter is Max Pitch Diameter - .002. This is a starting point and may have to be adjusted during the rolling process to achieve the finished Major Diameter.

4.1.b Chamfer Angles

The leading and trailing edges of a blank should have a "flat" 30° angle leading up to the blank diameter. This chamfer will result in a 45° chamfer on the finished part. The chamfer also helps to alleviate unsupported side pressure on the first engaging tooth of the thread-rolling die. Unsupported side pressure on the first tooth is the leading cause of premature die failure.

4.1.c Length of Thread Blank

The blank length varies with desired thread length, material, and the configuration of your part. As a general rule of thumb, the first and last full threads will occur between ½ and 1 full pitch inside the ends of the blank.

4.2 Material Quality

End Rolling can be performed on almost any high quality, ductile metal material under
Rc40. Rolling threads or splines on poor material can result in splines with cracks, flaking, uneven splines, deformed splines, rolling die breakage, and reduced roll life, amongst other problems.

Seaming, tubing or bars, voids, hard spots, inconsistent chemical makeup, and inconsistent or nonsymmetric grain are all problems when rolling parts. Rolling threads on poor material can result in threads with cracks, flaking, uneven threads, elongated threads, thread rolling die breakage, and reduced roll life, amongst other problems.

Purchasing a higher quality material will not only improve the performance of the thread rolling process, but will add productivity on almost all stations of your machine. The increased cost of high-quality, consistent material is almost always offset by longer tool life, easier setup, reduced downtime, and fewer discrepancies.

4.3 Thin Walls

Rolling is always best done on a solid blank. That is not always practical due to the order of operations. Rolling on blanks with thin wall conditions presents a challenge. If the wall is too thin, it cannot support the high pressures needed to roll the thread.

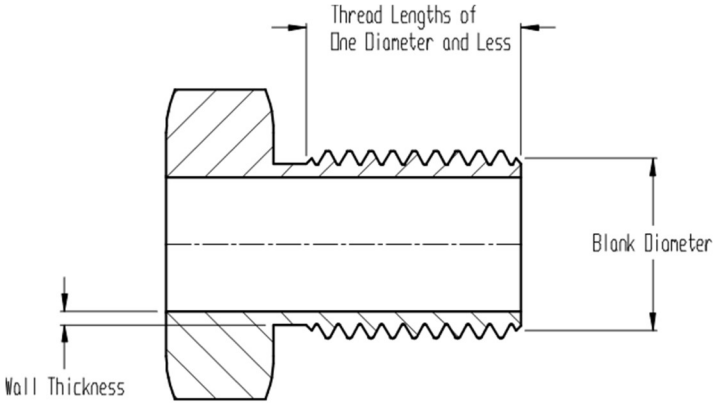


Fig. 10 – Thin Walled Blank

As a general rule for a UNR or M profile thread, the wall thickness should be a minimum of 1.35 X the tooth height for an arbor supported part, or 2.5 X the tooth height for an unsupported part. This can vary greatly with material, quality, and part diameter.

Wall Thickness using derived equations in Inches						
Threads per Inch	Blank Diameters - In Inches					
	Up to 1/2	1/2 to 1	1 to 2	2 to 3	3 to 4	4 to 5
32	.038 - .048	.048 - .060	.072 - .090	.091 - .114	.110 - .138	.129 - .162
24	.051 - .064	.064 - .080	.096 - .120	.121 - .152	.147 - .184	.173 - .216
20	.061 - .077	.077 - .096	.115 - .114	.146 - .182	.176 - .220	.207 - .259
18	.068 - .085	.085 - .106	.128 - .160	.162 - .202	.196 - .245	.230 - .288
16	.077 - .096	.096 - .120	.144 - .180	.182 - .228	.220 - .276	.259 - .323
14	.088 - .110	.110 - .137	.164 - .205	.208 - .260	.252 - .315	.296 - .370
12	.102 - .128	.128 - .160	.192 - .240	.243 - .304	.294 - .367	.345 - .431
10	..	.153 - .192	.230 - .288	.291 - .364	.353 - .441	.414 - .518
8	..	..	.288 - .359	.364 - .455	.441 - .551	.518 - .647
Wall Thickness using derived equations in mm						
Threads per mm	Blank Diameters - In Inches					
	Up to 1/2	1/2 to 1	1 to 2	2 to 3	3 to 4	4 to 5
0.50	.024 - .030	.030 - .038	.045 - .057	.057 - .072	.069 - .087	.083 - .103
0.60	.029 - .036	.036 - .045	.054 - .068	.069 - .086	.083 - .104	.099 - .124
0.75	.036 - .045	.045 - .057	.068 - .085	.086 - .108	.104 - .130	.124 - .155
1.00	.048 - .060	.060 - .075	.091 - .113	.115 - .143	.139 - .174	.165 - .207
1.25	.060 - .075	.075 - .094	.113 - .142	.143 - .179	.174 - .217	.207 - .258
1.50	.072 - .091	.091 - .113	.136 - .170	.172 - .215	.208 - .260	.248 - .310
1.75	.085 - .106	.106 - .132	.158 - .198	.201 - .251	.243 - .304	.289 - .362
2.00	..	.121 - .151	.181 - .226	.229 - .287	.278 - .347	.331 - .414
2.50	..	..	.226 - .283	.287 - .358	.347 - .434	.414 - .517

Fig. 11 – Thin Wall Sizing Chart

Section 5: Preparation and Installation

Fig. 12 – Setup of a CJWinter 191 ER Attachment

CJWinter Attachments are shipped complete from the manufacturer, ready to be installed immediately after a short preparation procedure.

5.1 Package Contents

Fig. 13 – Example of a 191 ER-01 Attachment Package

CJWinter End Rolling Attachments are shipped within a custom tooling case with everything you need to roll your parts.

Note: this excludes thread rolls, which are application specific and must be ordered separately.

In the event spares are needed, each part (size permitting) is permanently identified with a laser-marked CJWinter part # for easy identification and replacement.

All part identification in this manual will refer to the BOM Balloon # on the Assembly Drawing contained in Section 10 of this manual, and will be noted in parentheses after the part name, i.e.: Center Plate (#3).

5.2 Selecting Thread Rolls

The thread rolls used on these ER series attachments have an annular groove geometry. Rolls are mounted and tilted to the approximate helix angle in the attachment. This allows for the production of the proper thread geometry on parts during the thread rolling process.

Thread rolls can be supplied with a .6L, 1L or 2L lead.
This lead determines how close the attachment can get to the shoulder of the part.

- A .6L lead can roll very close to a shoulder, but tends to be more aggressive and sacrifices thread roll life.
- A 1L lead is the most popular lead as it provides a good balance between thread roll life and being able to get somewhat close to a shoulder.
- A 2L lead can't roll very close to a shoulder, but tends to be less aggressive and provides for the best thread roll life.

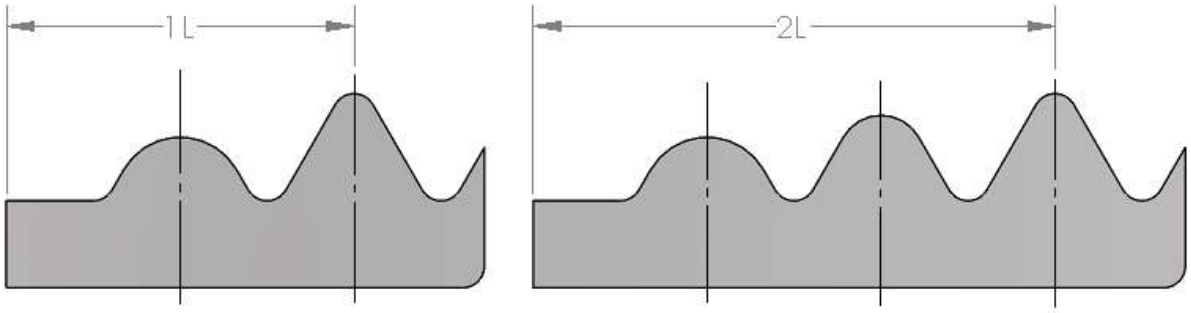


Fig. 14 - Lead Diagram

5.2.a Reversible Rolls

The rolls (as well as the master pinion on the 192 Series) are reversible. This allows for an entirely "new" rolling die simply with the inversion of the thread rolls or knurl rolls when one worksurface wears out. This enables each set of CJWinter thread rolls to provide twice the life of a set of comparable roll dies.

5.3 Attachment Assembly

Your attachment will come pre-assembled from the factory. In the event you need to disassemble your attachment, please refer to the supplied assembly drawing for an exploded view and proper part assembly order.

- Place attachment on a flat surface, remove the (3) Socket Head Cap Screws and Front Plate from attachment.

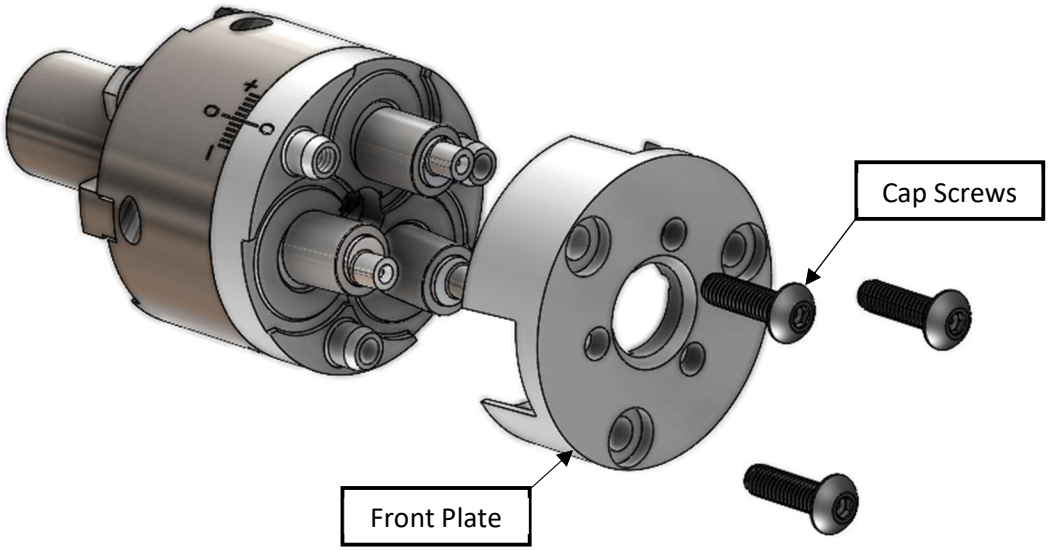


Fig. 15 – 189 ER-01 Attachment with Front Plate Removed

- Verify the carbide bushings, center plate, and rolls are clean and lubricated.

- Assemble rolls over Carbide Bushings in a clockwise direction with either 1-2-3 or A-B-C facing up and replace front plate and Button Head Cap Screws.

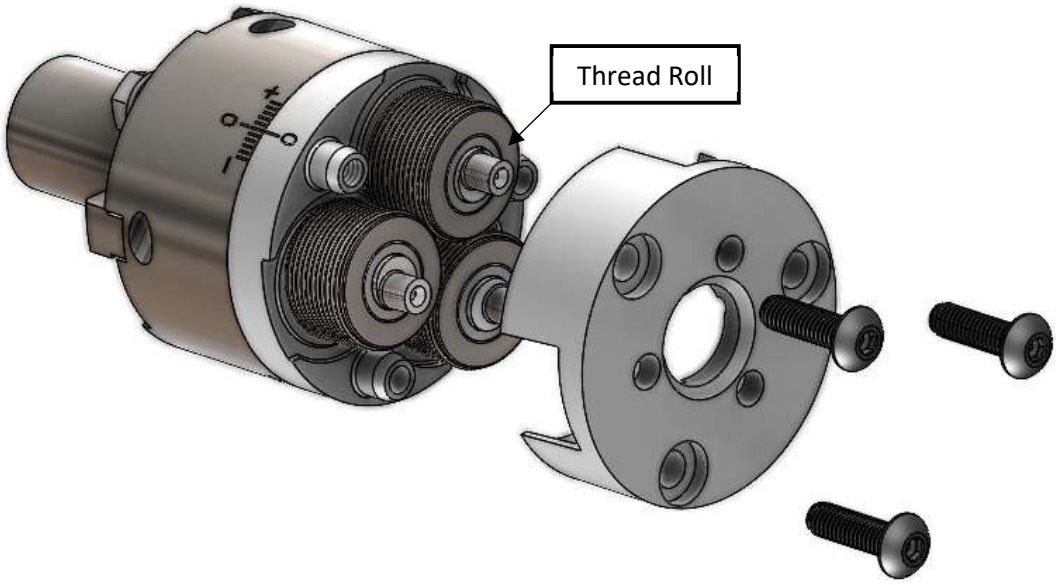


Fig. 16 – 189 ER-01 Attachment with Thread Rolls Installed

Refer to the Capacity Chart corresponding to your attachment model in Section 10 to see the distance to full thread form for each of the thread size and lead combinations. This attachment specific chart will show whether a given thread type will achieve the required thread lengths specified on the part print.

Distance to full thread is approximately how close the attachment can thread up to a shoulder or undercut.

Note: If you need to disassemble the gear train for the three eccentric roll pins, proper orientation at re-assembly is critical to ensure the rolls are concentric to the tool shank. See detailed instructions in the section titled "shifting the size adjustment range" for the recommended disassembly and reassembly procedure.

Note: During assembly the 0-0 scale does not need to be aligned.

5.4 Setting the Minor Diameter of the Thread

Look up the minor diameter of the thread that is going to be rolled. Find a gage pin that matches this size or use a part that has the same thread that is going to be rolled. Loosen the (3) hex bolts and turn head assembly until it touches the pin/part. Tighten the (3) hex bolts.

- Loosen Bolts to allow the head to be adjusted freely.

- Pull the shank to set the attachment into the open position. The head will rotate to the right (when viewed from the front).

- Insert gage or part into the attachment and turn the shank in the opposite direction to set the minor diameter. Ensure the fitment between the head and gage is snug without play.

- With the gage still in the attachment, tighten the three bolts into place. This will lock the head and ensure no movement. Once the position is set, remove the gage from the attachment.

To adjust the attachment to a smaller size, remove the (3) hex bolts and disengage head assembly from center gear. Rotate head in the (-) direction 120°. To adjust the head to a larger size, rotate the head in the (+) direction. Repeat above step until the rolls touch the pins. Reassemble the head assembly and (3) hex bolts.

5.5 Changing the Size Range on the Attachment

Check the rotation of the eccentric. If the eccentric is closing the rolls rather than opening them, this section will help you to reverse the problem.

- Remove the (3) hex bolts on the back of the attachment.
- Remove the corresponding cover washer.

- Take the attachment apart and locate the gears with the D shaped diameter on them. All three gears move proportionally to each other. If one is turned 180° the others will automatically be set as well.

- Turn the center gear until the gears with the D shaped diameters are rotated 180° from their current position.

- When putting the assembly back together make sure the slots on the bottom of the attachment line up with orientation of the screw on top of the assembly.

For additional information, please refer to our in-depth instructional video linked below:
https://www.CJWinter.com/ty-er-series-operation-video

5.6 Machine Mounting

CJWinter End Rolling attachments are available with multiple standard and specialty shanks to achieve a high standard of compatibility and ease of mounting.

Refer to section 10.1 – General Dimensions for additional information and sizing of CJWinter end rolling attachments

Overall dimensional drawings are available from our sales department to help determine if our attachments fit your application.

Alternate shank diameters are available on a custom order basis. Drill bushings can also be used to adapt to larger tool holders.

Section 6: Setup and Configuration

Fig. 17 – CJWinter 191 ER Setup

In order to produce high quality parts at a rapid pace, it is vital to closely follow the attachment setup procedure.

6.1 Setting the Thread Length

1. Ensure the attachment is set to the "CLOSED" position.
Indicate off of the face of the attachment, this plane will be the datum.

2. Open the attachment and advance it over the blank to the desired length of the thread (L_T), plus the thickness of the attachment's front plate (T).

3. Subtract the length of pull (L_P) from distance $(L_T + T)$ to set the proper thread length.

$$Dist. = (L_T + T) - L_P$$

Note: All 192, 193 and standard attachments **with installed lockup plate** do not require this correction factor as they do not open/close during operation.

LENGTH OF PULL		
Attachment	[in]	[mm]
189 ER	0.62	15.748
190 ER	0.08	2.032
191 ER	0.12	3.048
192 ES	N/A	N/A
193 ES	N/A	N/A
194 ER	0.154	3.9116

Fig. 18 – Length of Pull for ER/ES Attachments

4. Verify any clearance issues and return the attachment.

6.2 Centering the Attachment

To verify that the attachment is on center load a part or gauge pin into the attachment.

Mount a centering type indicator opposite the part or gauge and check the circumference of the gauge to verify that the attachment is properly centered.

The acceptable range is within ±0.001"

6.2 Rolling Speeds

Material Rollability						
Material		Hardness [HRC]	Elongation	Tensile Strength [MPa]	Rolling Speed [SFM]	Formability Index
STEEL	Case Hardening	16.54 - 21.64	10 %	500 - 850	100-165	
		Below 20	16 %	500	130-230	
	Cast	21.64	11 %	650 -	100-165	
		16.54 - 21.64	17 %	500 - 600	130-200	
		Below 20	20 %	500	130-200	
	Free Cutting	20.62	18 %	500 - 600	100-200	
		Below 20	23 %	380	100-200	
		Below 20	25 %	360	100-200	
	Heat Treatable	36.94	9 %	1000 - 1400	65-130	
		36.94 - 42.04	9 %	1200 - 1400	65-130	
		27.76 - 36.94	11 %	900 - 1200	65-165	
		21.64 - 27.76	14 %	700 - 900	100-200	
		21.64	18 %	700	130-230	
	High Speed	25.72 - 31.84	%		65-130	
	Nitrided	30.82 - 40	11 %	1000 - 1300	65-130	
		30.82	14 %	1000	65-165	
	Stainless		12 %	800 - 900	100-165	
			18 %	550 - 650	100-165	
			20 %	500 - 800	100-165	
			30 %	500 - 700	100-165	
			40 %	500 - 700	100-165	
			50 %	500 - 700	115-175	
	Structural	20.62 - 26.74	15 %	500 - 600	65-165	
		20.62 - 26.74	15 %	650 - 850	65-165	
		16.5 - 20.62	22 %	500 - 600	100-200	
		Below 20	28 %	500	130-265	
	Tempered		9 %	500 - 600	65-130	
	Tool	24.7	%	800	100-165	
		24.7 - 30.82	9 %	800 - 1000	65-130	
		23.68	10 %	600 - 700	100-165	

Fig. 19 – Material Rollability - Steel

Material Rollability

Material		Hardness [HRC]	Elongation	Tensile Strength [MPa]	Rolling Speed [SFM]	Formability Index
NON FERROUS METALS	Aluminum Alloy	Below 20	7 %	530-540	100-165	
		Below 20	9 %	450	100-165	
		Below 20	5 - 10 %	400-450	100-165	
		Below 20	9 - 14 %	200-320	130-230	
		Below 20	4 - 15 %	150-210	130-230	
	Brass	Below 20	15 %	400	130-230	
		Below 20	19 %	430	130-230	
		Below 20	35 %	340	130-230	
		Below 20	40 %	300	130-265	
	Copper	Below 20	8 %	250	130-265	
		Below 20	30 %	200	130-350	
	Titanium Alloy		%	1030-1100	65-130	
		23.68 - 29.8	10 %	750-950	100-200	
		17.56 - 23.68	20 %	550-750	100-200	
		Below 20	22 %	290-550	100-200	
	Zinc Alloy	Below 20	23 %	180-200	130-230	
CAST IRON	Cast Iron	22.66 - 26.74	8 %	600-750	100-165	
		19.6 - 22.66	12 %	500-600	100-165	
		Below 20	15 - 27 %	400-500	100-200	
	Malleable Cast Iron		%		100-200	
		22.66 - 26.74	6 %	600-700	100-200	
OTHER	High Temp. Material	17.56 - 21.64	%	540-700	100-165	
		21.64 - 27.76	%	700-900	65-130	
	Nickel Alloys	27.76 - 34.9	%	900-1100	65-130	

NOTE:	Formability Index is to Be Read as follows:
	- The Material Can be rolled in its Current State
	- Consultation With a CJWinter Applications Engineer is Advised
	- The Material CAN NOT be rolled

Fig. 19a – Material Rollability – Other Materials

For specialized applications, please consult with a CJWinter specialist for best results.

6.3 Rolling a Part

Before producing a part, reduce the blank diameter by .002". This will help to avoid any accidental over-filling of the dies. Advance the attachment over the part. The feed rate should be .0002-.0005" less than the pitch of the thread.

Check pitch diameter of the thread with Pitch Mics or Go/No-Go Gages. If the pitch diameter is low, remove head, loosen the (3) hex head bolts, turn the head assembly in the (-) direction, and tighten the (3) hex head bolts.

Always turn the head in small increments until the pitch diameter is within tolerance.

> Note: If the pitch diameter of the thread is too small, repeat the aforementioned procedure, turning the head to the (+) direction.

Major diameter is brought into tolerance by adjusting the Blank diameter. Increase the blank diameter in small increments, because each .001" increase in blank diameter will increase Major diameter by about .003". As the blank diameter is increased, monitor both the Major and Pitch diameters.

The added material increases resistance to penetration, so as the blank diameter is increased, it may be necessary to adjust the pitch diameter. Continue increasing the blank diameter until the Major diameter is within tolerance.

Lastly, inspect the crest of the Major diameter under a magnifying glass or in an optical comparator. If the crest is highly burnished with no visible seam, the material is filling the dies and an over-rolling condition exists.

While cosmetically more appealing, burnishing the crest of a thread has little to no effect on the strength of the part. However, burnishing drastically increases the rolling pressure and will lead to premature roll failure.

Section 7: Attachment Options

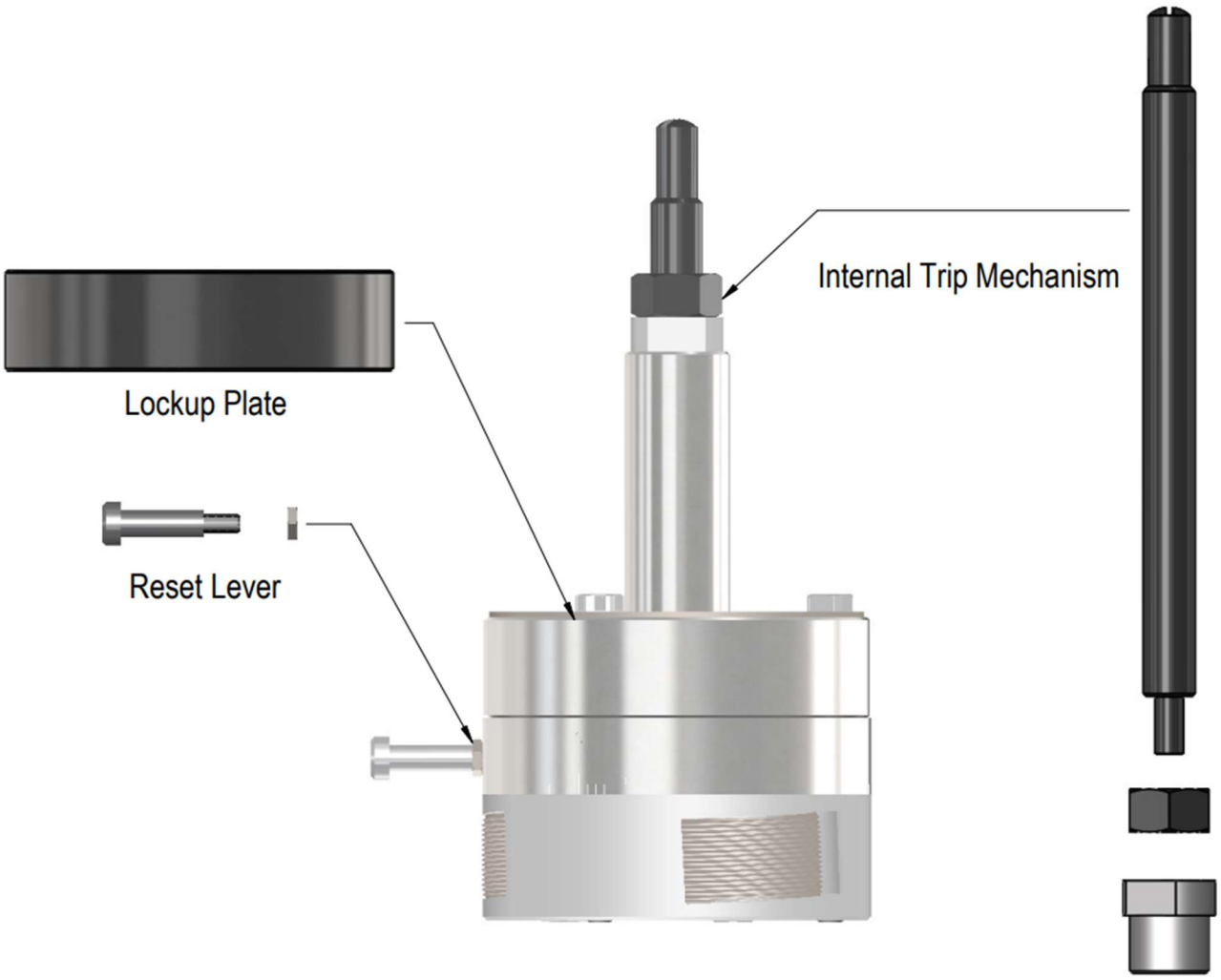


Fig. 20 – 194 ER-01 with select options Installed

To ensure that your CJWinter end rolling attachment meets all of your thread rolling needs, we offer a comprehensive option catalog.

All CJWinter End Rolling attachments can be ordered with optional tooling and hardware based on your application specific needs.

Below, you will find the main offerings in this lineup, but for application specific tooling or custom hardware, please speak to a CJWinter application specialist for more information.

CJWinter Attachment Options		189	190	191	192	193	194
Part Desc.	Quick Install						
Lockup Plate							
Internal Trip Mechanism							
Reset Lever							
Alternate Shank Sizes							
Coolant Adapters							

Fig. 21 – CJWinter Attachment Options

7.1 Lockup Plate

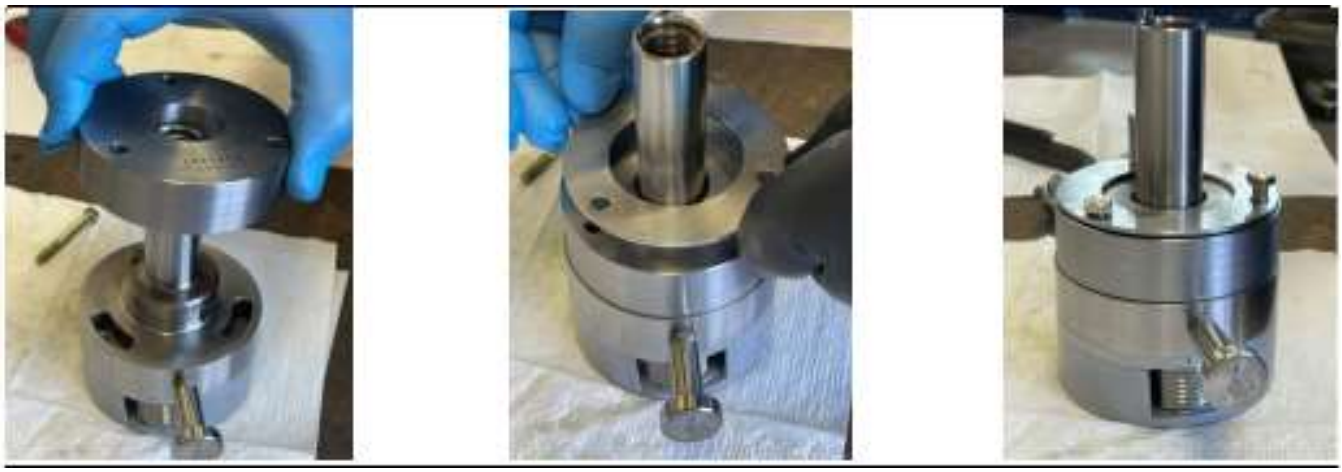
<SOLD SEPERATELY>

The lockup plate is the key offering in this category as it enables all of the CJWinter standard type end rolling heads to function in a similar manner to the 193 ES-01 head, feeding in and out from the part without opening.

Prepare the attachment to mount the lockup plate following the steps below.

Loosen and remove the three hex bolts on the attachment's top surface. Remove the cover washer and verify the top surface of the attachment is clean and free of debris.

Then, install the lockup plate using the procedure below.



Slide the lockup plate over the shank and onto the top of the attachment with the counterbore facing the top surface of the head. Replace the washer and align the bolt holes. Reinstall the bolts loosely to allow for adjustment.

Make sure fitment between the head and lockup plate is snug without play.

Set the attachment for the correct diameters using the same procedure in section 2.2 and ensure the bolts are snug.

Make sure there is no movement of shank when lockup plate is installed.

The distance to the bottom of the counterbore “W” may need to be adjusted to remove play.

This can be accomplished by grinding (or milling) the surface “A” until “W” is = X -0.001”

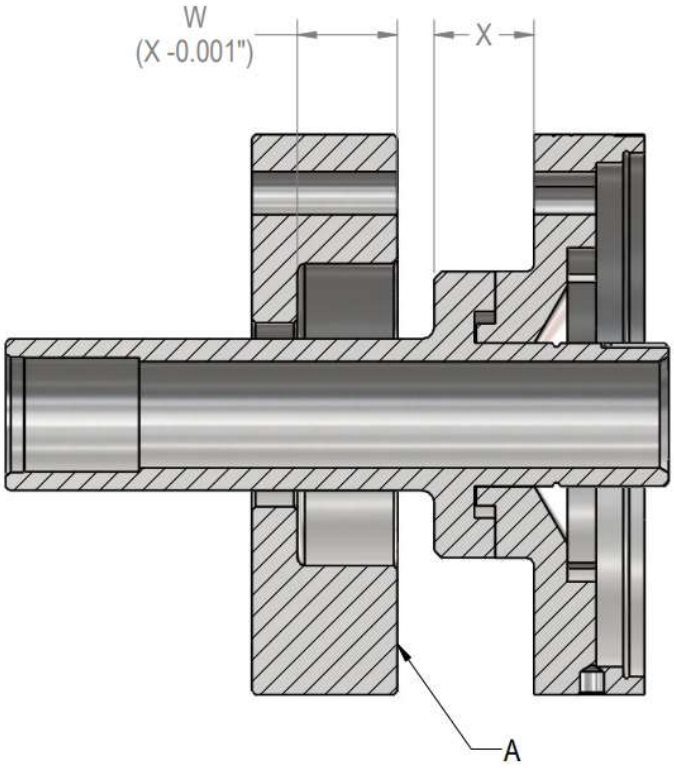


Fig. 22 – Section View of Lockup Plate

7.2 Internal Trip Mechanism

<SOLD SEPERATELY>

By placing a limit on the distance of travel, the internal trip mechanism provides a hard stop to the head which. This, when depressed by the part feeding in, will actuate the head into the open position, allowing it to back off and reset for the next part.

7.3 Reset Lever

The Reset Lever is a cylindrical stud that can be driven against a machined surface to set a specific open/ close timing on the attachment. For all standard type CJWinter ER attachments, this will be included as shipped, but is not required for attachment use.

CJWinter can provide machine specific specialty reset mechanisms

Note: This option is not available for the 192 & 193 ES attachments.

7.4 Alternate Shank Sizes

<SOLD SEPERATELY>

All CJWinter ER and ES attachments are available for order in multiple different configurations and shank sizes. For specific information and dimensions, please refer to the general dimensions reference tables.

7.5 Coolant Adapters

The shanks of the 192 and 193 Series attachments are equipped with a ¼-NPT port for thru-coolant connections. This enables direct injection of coolant between the parts and dies. Additionally, all Standard ER type heads have a machine screw thread tapped in the back of the shank which may be used for this purpose. Thread sizing and length vary by attachment and shank configuration.

Section 8: Maintenance and Wear

Fig. 23 – 191 ER attachment disassembled for periodic maintenance

To preserve the best performance and maintain a tight tolerance on manufactured parts, CJWinter recommends an annual teardown and inspection of all end rolling attachments.

8.1 Cleaning and Lubrication

Between jobs and during tooling changes, disassemble the major components of the head and clean any accumulations of chips or debris. Pay particular attention to gears, carbide bushings, and eccentric pins to be sure they are clear of foreign materials.

The frequency should be determined by your own in-shop experience and be scheduled in a preventative manner.

Periodic lubrication of all moving parts with oil and replacement of bearings and washers in the attachment are strongly recommended.

Lubricate all surfaces and moving components with a full synthetic oil. For this purpose, Mobile 1 Oil is recommended due to its superior film strength and lubricity. Use of other oils may result in galling of components under the working loads of rolling.

The frequency of lubrication and replacement depends greatly on the severity of usage the attachment sees, the type of material being rolled, and the adherence to proper setting and operation procedures.

8.2 Universal Maintenance

Areas to pay particular attention to are:
Eccentric Pin(s) - Verify there are no high spots or galling on the locating surface for the carbide bushings. Additionally, inspect the drive tang on the base of the pin (where it meets the retaining block) for the same conditions. If there are any signs of wear, the pins should be replaced.

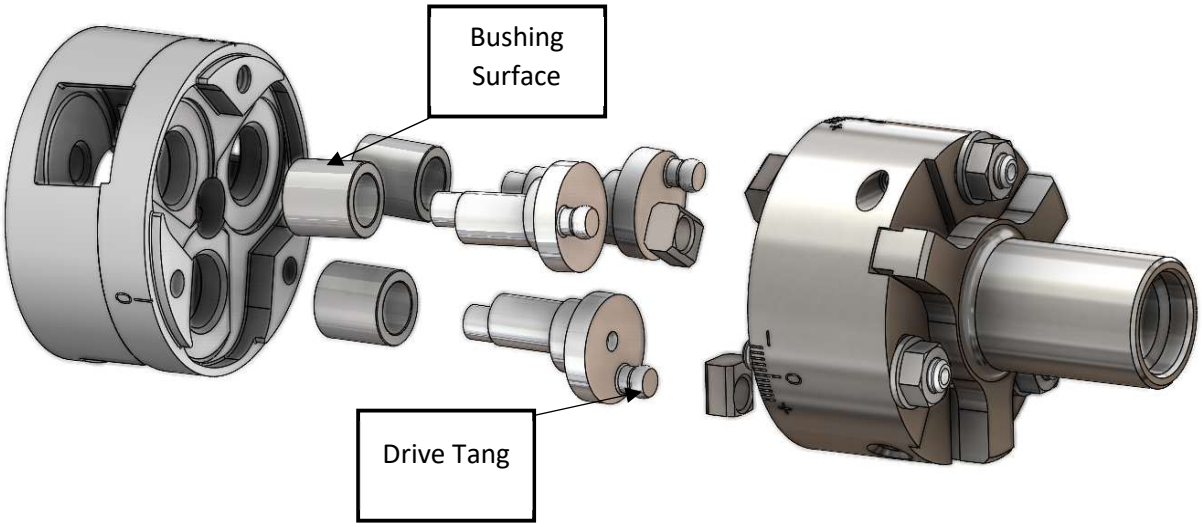


Fig. 24 – Opened 189 ER-01 Attachment, Exposed Bushings

- Front Plate & Center Plate – Verify the locating holes for the Eccentric pins show no signs of wear or fitment change. If this occurs, replace any worn-out parts.

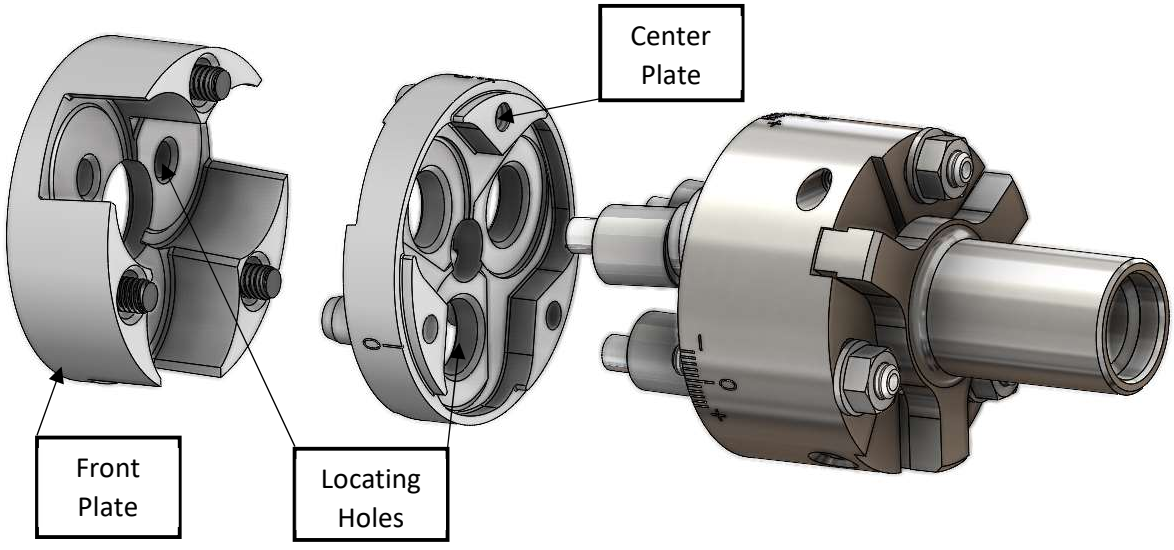


Fig. 25 – 189 ER-01 Attachment Exploded View

- Shaft, Spring Housing, Spring – Inspect the coupling, make sure the surfaces are not worn. Verify the shaft moves freely when disengaged. If the surfaces are worn and the attachment does not open up freely, replace the corresponding part.

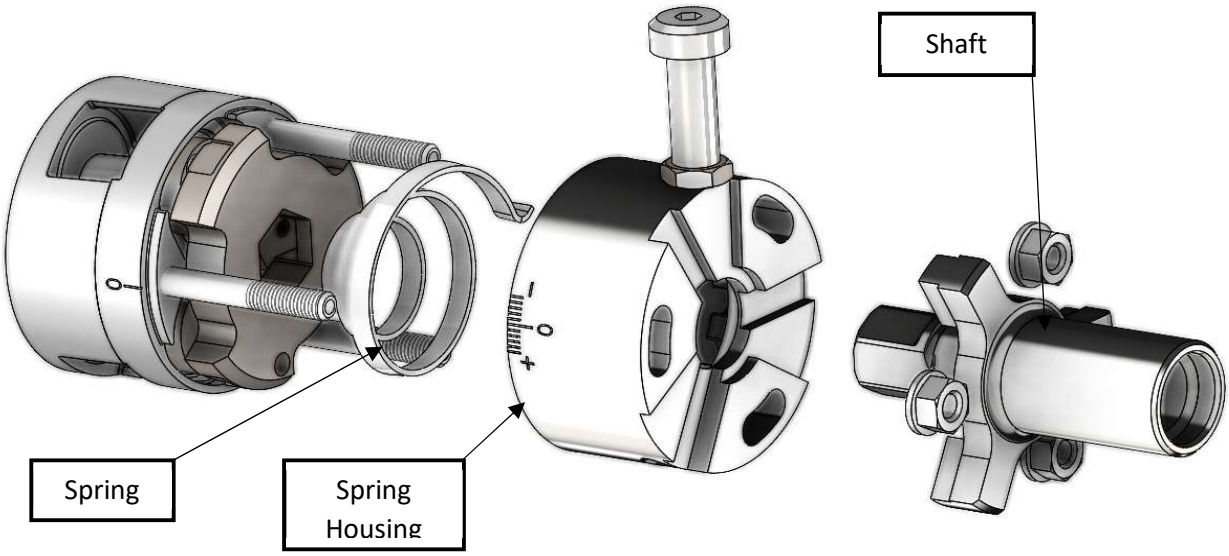


Fig. 26 – 189 ER-01 Attachment with Option Packages Exploded View

8.3 189 Specific Maintenance

Areas to pay particular attention to are:

- Retaining Blocks and Clutch Plate - Verify the blocks run freely but there is not an excessive amount of play.

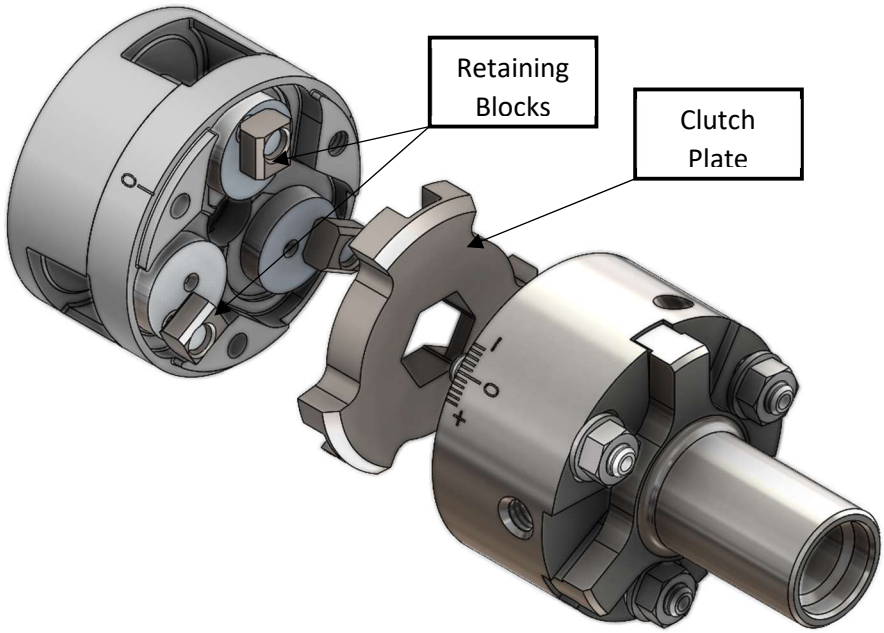


Fig. 27 – Opened 189 ER-01 Attachment

8.4 193 Specific Maintenance

Areas to pay particular attention to are:

- Eccentric Gear and Center Gear - Make sure that the gears mate correctly and there is not an excessive amount of play. If there is any noticeable change in gear fitment or loss of alignment due to deformation or damage, replace the components promptly.

Section 9: Contact and Ordering Information

Fig. 28 – CJW Team Photo

In order to best supply all of your tooling and hardware needs, please refer to the following information on ordering parts and tooling for your CJWinter attachment.

Shipping Address: 167 Ames Street | Rochester, NY 14611

Phone: 1-800-288-7655

For questions and information about CJWinter and our products, contact us at:

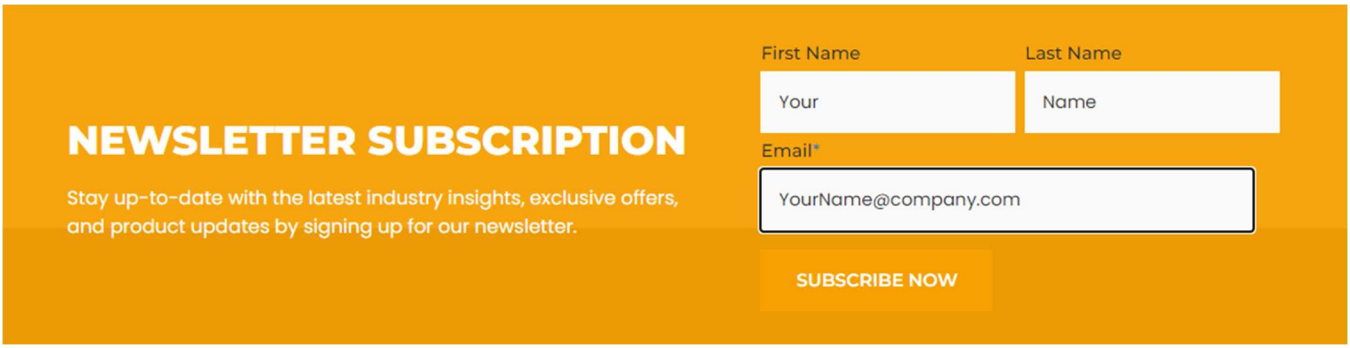
Email: info@cjwinter.com

For purchasing additional hardware, please contact CJWinter's sales Team:

Email: sales@brinkmanproducts.com

For more information or to keep up with the latest CJWinter innovations please follow our newsletter and Thread Rolling blog at our website.

https://www.cjwinter.com/contact-us/



Section 10: Technical Data

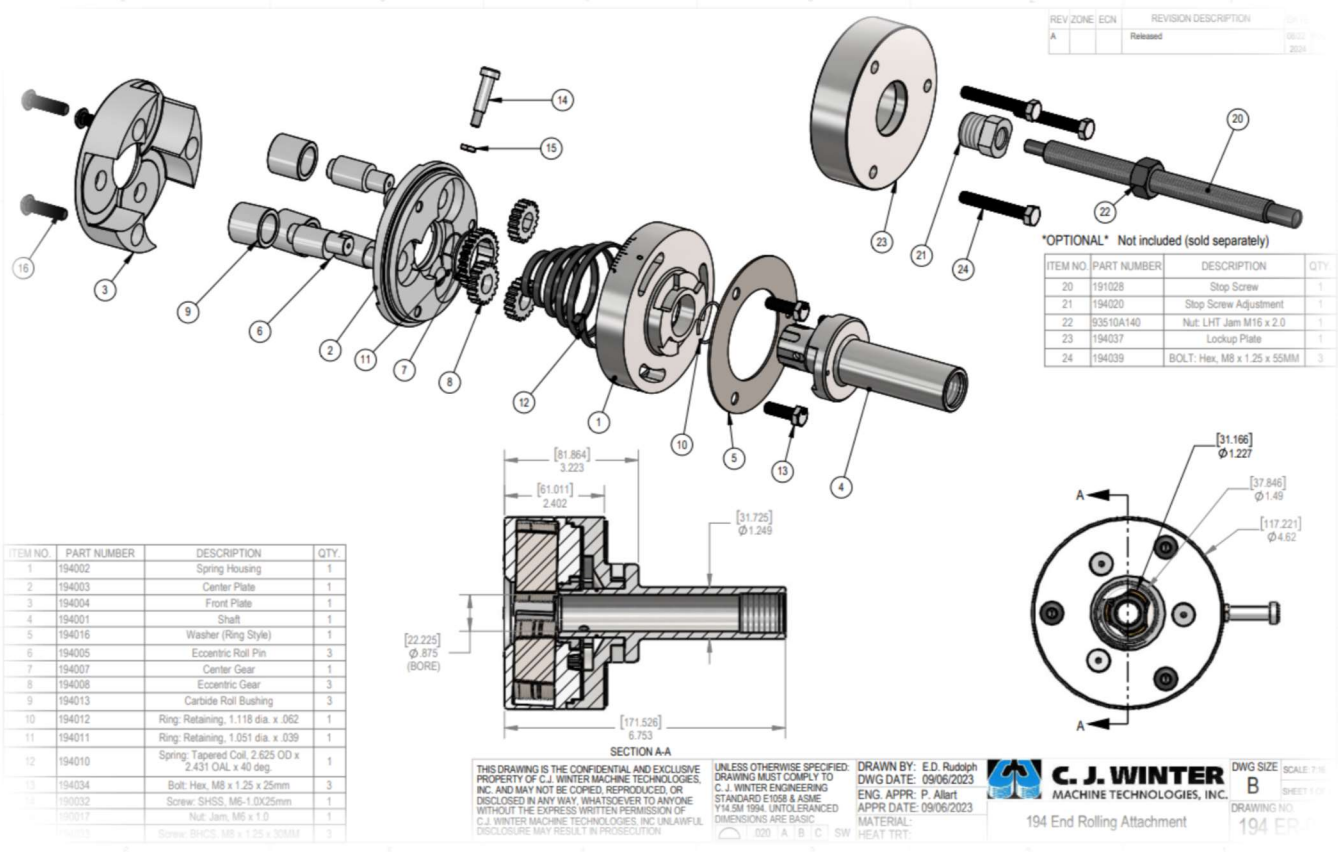


Fig. 29 – CJWinter ER Attachment Print

For Additional Technical Reference information for your attachment, please use the following link to select the attachment specific assembly drawing from our digital library:

https://www.CJWinter.com/assembly-drawings-library-ty/

10.1 General Dimensions

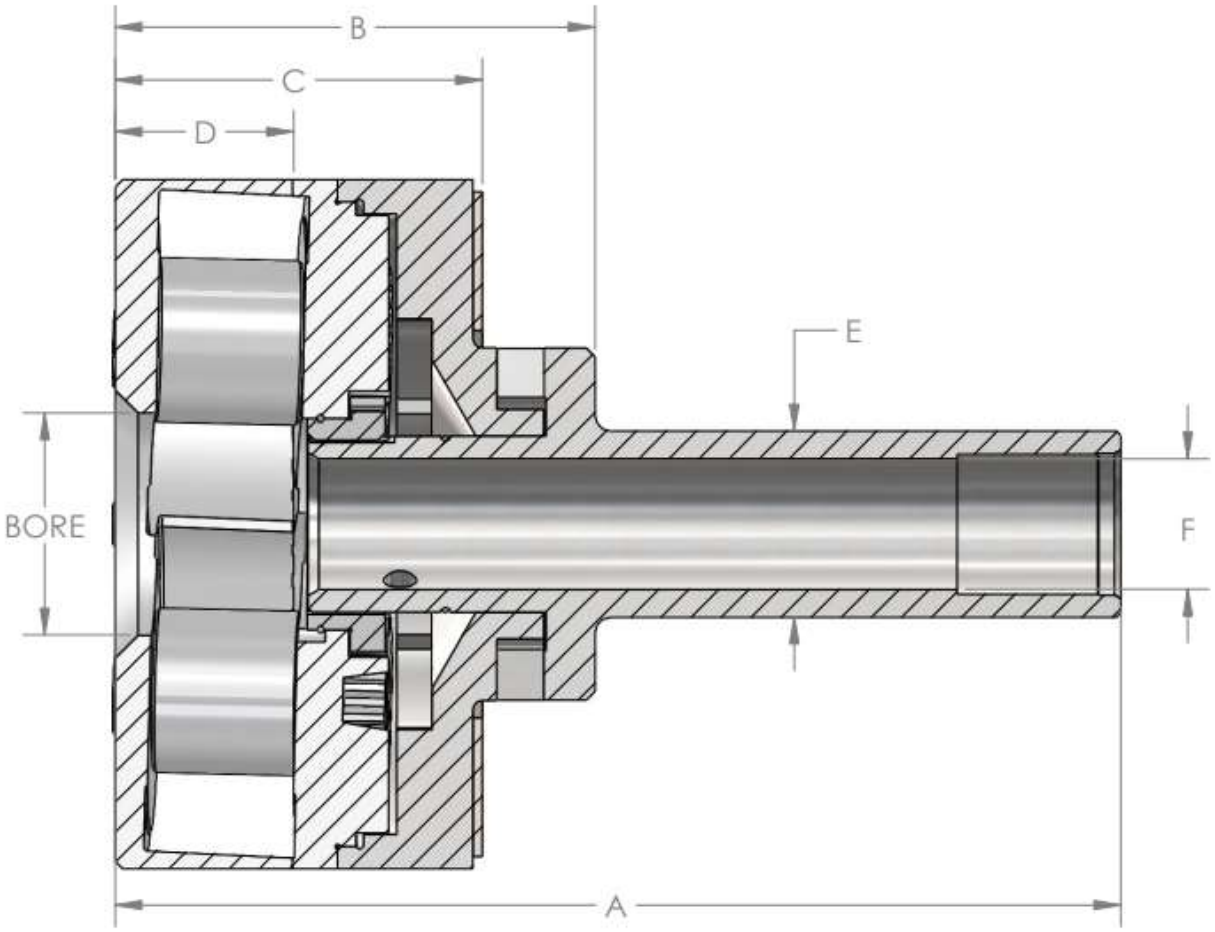


Fig. 30 – CJWinter Standard ER Attachment Section View

END ROLLING ATTACHMENT GENERAL DIMENSIONS								
Attachment	Version	A	B	C	D	E	F	BORE
189 ER	-02	2.768	1.787	1.614	0.537	0.750	0.295	0.295
	-03	3.287	1.787	1.614	0.537	0.866	0.295	0.295
190 ER	-02	3.805	2.133	1.498	0.750	0.749	0.432	0.432
	-03	4.305	1.945	1.498	0.750	0.983	0.432	0.432
	-04	4.305	1.945	1.435	0.750	22mm	0.432	0.505
	-05	4.305	1.945	1.498	0.750	25mm	0.432	0.456
	-06	4.305	2.01	1.498	0.750	0.625	0.313	0.450
191 ER	-02	5.623	2.673	2.133	1.010	0.999	0.665	0.665
	-03	5.623	2.673	2.133	1.010	0.983	0.665	0.665
194 ER	-01	6.753	1.249	3.223	1.198	2.402	0.875	0.875

Fig. 31 – CJWinter Standard Attachment Dimensions

10.2 192 Dimensions

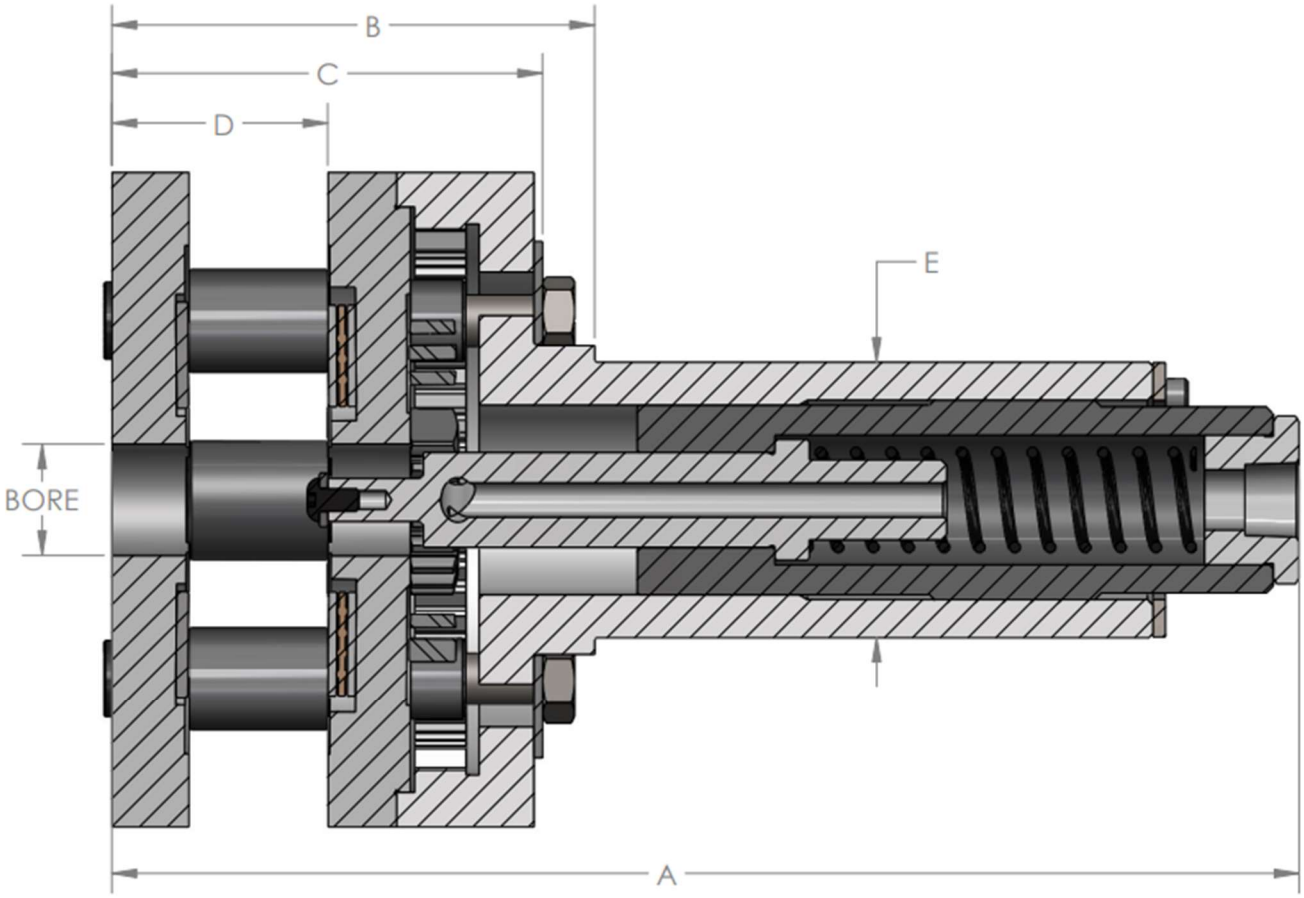


Fig. 32 – CJWinter 192 ES Attachment Section View

192 ATTACHMENT GENERAL DIMENSIONS							
Attachment	Version	A	B	C	D	E	BORE
192 ES	-01	8.633	3.510	3.131	1.570	2.000	0.810
	-02	8.373	3.750	3.371	1.810	2.000	1.125
	-05	9.133	4.510	4.131	2.570	2.000	0.810

Fig. 33 – CJWinter 192 ES Attachment General Dimensions

10.3 193 Dimensions

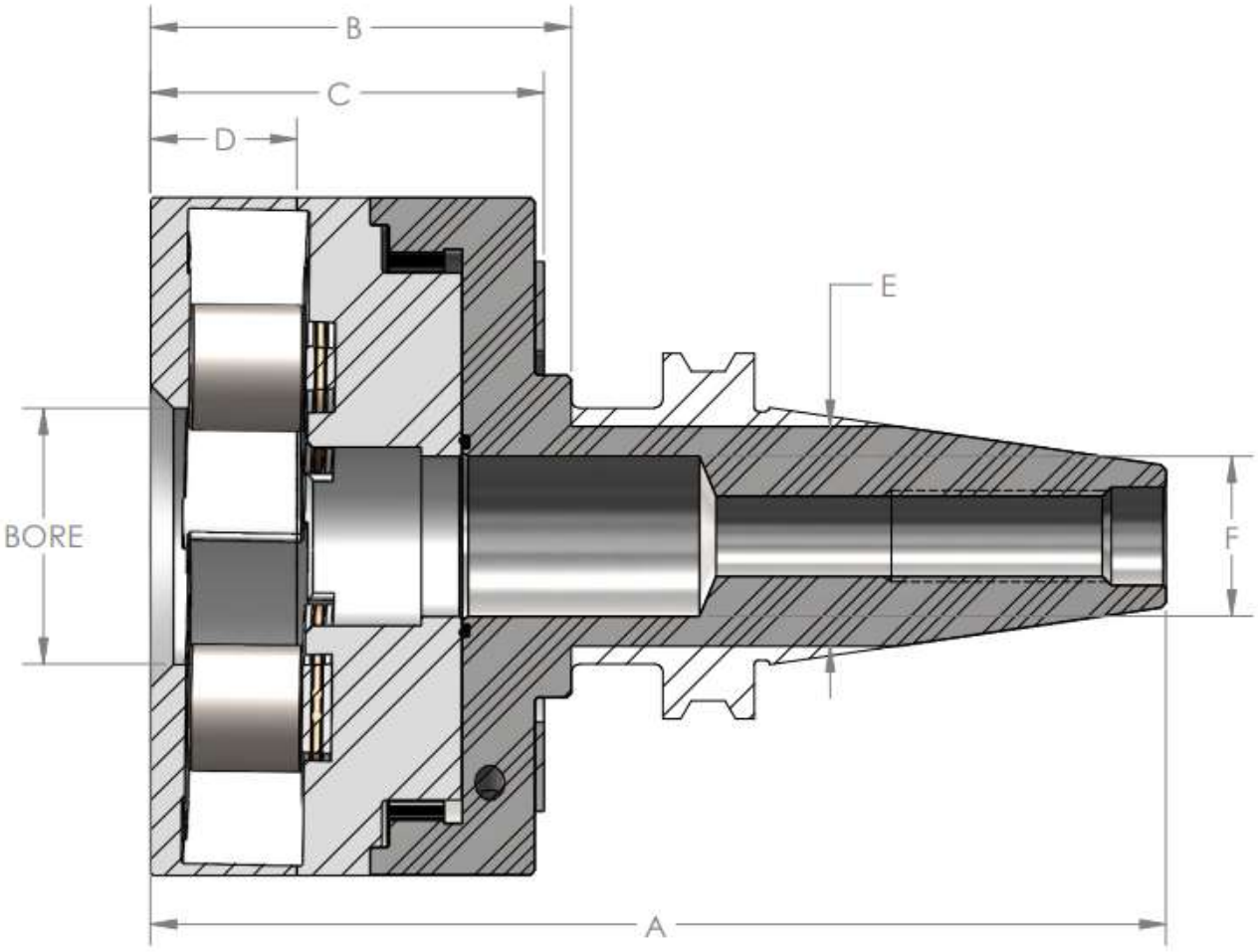


Fig. 34 – CJWinter 193 ES Attachment Section View

193 ATTACHMENT GENERAL DIMENSIONS								
Attachment	Version	A	B	C	D	E	F	BORE
193 ES	-01	6.937	2.875	2.688	1.000	CAT-40	1.094	1.681
	-02	6.937	2.875	2.688	1.000	1.417	1.094	1.681
	-03	6.937	2.875	2.688	1.000	1.681	1.094	1.681

Fig. 35 – CJWinter 193 ES Attachment General Dimensions

10.4 189 Series Attachment

Inclined Position of Rolls: 3° 30'

Thread Size				Pitch	Pitch Diameter		Minor Diameter	Blank Diameter	Roll Diameter	OAL	Distance to Full Thread		
					Max	Min					.6L	1L	2L
M	3.5	x	0.5	0.0197	0.1242	0.1213	0.1136	0.1222	0.6674	0.3932	0.0260	0.0326	0.0522
M	3.5	x	0.6	0.0236	0.1374	0.1335	0.1088	0.1354	0.6722	0.3932	0.0273	0.0352	0.0588
M	4	x	0.5	0.0197	0.1387	0.1352	0.1333	0.1367	0.6477	0.3932	0.0260	0.0326	0.0522
M	4	x	0.7	0.0276	0.1439	0.1409	0.1237	0.1419	0.6573	0.3932	0.0267	0.0358	0.0634
M	4	x	0.75	0.0295	0.1571	0.1536	0.1213	0.1551	0.6597	0.3932	0.0293	0.0391	0.0686
M	4.5	x	0.5	0.0197	0.1636	0.1606	0.1530	0.1616	0.6280	0.3932	0.0260	0.0326	0.0522
M	4.5	x	0.75	0.0295	0.1728	0.1688	0.1409	0.1708	0.6401	0.3932	0.0293	0.0391	0.0686
M	5	x	0.75	0.0295	0.1754	0.1717	0.1606	0.1734	0.6204	0.3932	0.0293	0.0391	0.0686
M	5	x	0.8	0.0315	0.1768	0.1729	0.1582	0.1748	0.6228	0.3932	0.0339	0.0444	0.0759
M	5	x	0.9	0.0354	0.1925	0.1885	0.1534	0.1905	0.6276	0.3932	0.0312	0.0431	0.0785
M	5.5	x	0.75	0.0295	0.1965	0.1926	0.1803	0.1945	0.6007	0.3932	0.0293	0.0391	0.0686
M	5.5	x	0.9	0.0354	0.2096	0.2052	0.1731	0.2076	0.6079	0.3932	0.0312	0.0431	0.0785
M	6	x	1	0.0394	0.2096	0.2052	0.1879	0.2076	0.5931	0.3932	0.0522	0.0654	0.1047
#	6	-	40	0.0250	0.1218	0.1198	0.1073	0.1198	0.6737	0.3932	0.0299	0.0383	0.0633
#	8	-	32	0.0313	0.1437	0.1415	0.1257	0.1417	0.6553	0.3932	0.0351	0.0456	0.0768
#	8	-	36	0.0278	0.1460	0.1439	0.1299	0.1440	0.6511	0.3932	0.0253	0.0346	0.0623
#	10	-	24	0.0417	0.1629	0.1604	0.1389	0.1609	0.6421	0.3932	0.0438	0.0577	0.0994
#	10	-	32	0.0313	0.1697	0.1674	0.1517	0.1677	0.6293	0.3932	0.0351	0.0456	0.0768
#	12	-	24	0.0417	0.1889	0.1863	0.1649	0.1869	0.6161	0.3932	0.0438	0.0577	0.0994
#	12	-	28	0.0357	0.1928	0.1904	0.1722	0.1908	0.6088	0.3932	0.0299	0.0418	0.0776
#	12	-	32	0.0313	0.1957	0.1933	0.1777	0.1937	0.6033	0.3932	0.0351	0.0456	0.0768
	1/4	-	20	0.0500	0.2175	0.2147	0.1887	0.2155	0.5923	0.3932	0.0633	0.0799	0.1299
	1/4	-	28	0.0357	0.2268	0.2243	0.2062	0.2248	0.5748	0.3932	0.0299	0.0418	0.0776
	1/4	-	32	0.0313	0.2297	0.2273	0.2117	0.2277	0.5693	0.3932	0.0351	0.0456	0.0768

Fig. 36 – 189 Thread Form Reference Table

10.5 190 Series Attachment Thread Capacity

Inclined Position of Rolls: 3° 30'

Thread Size			Pitch	Pitch Diameter		Minor Diameter	Blank Diameter	Roll Diameter	OAL	Distance To Full Thread		
				Max	Min					.6L	1L	2L
M	6	x 0.75	0.0295	0.216	0.212	0.2000	0.2142	1.1900	0.5900	0.0391	0.0489	0.0785
M	6	x 1	0.0394	0.249	0.245	0.1879	0.2470	1.2021	0.5900	0.0522	0.0653	0.1047
M	7	x 0.75	0.0295	0.256	0.252	0.2394	0.2536	1.1506	0.5900	0.0391	0.0489	0.0785
M	7	x 1	0.0394	0.282	0.277	0.2273	0.2799	1.1627	0.5900	0.0522	0.0653	0.1047
M	8	x 1	0.0394	0.288	0.284	0.2667	0.2863	1.1233	0.5900	0.0522	0.0653	0.1047
M	8	x 1.25	0.0492	0.321	0.317	0.2546	0.3193	1.1354	0.5900	0.0653	0.0817	0.1310
M	9	x 1	0.0394	0.328	0.323	0.3060	0.3257	1.0840	0.5900	0.0522	0.0653	0.1047
M	9	x 1.25	0.0492	0.354	0.349	0.2940	0.3521	1.0960	0.5900	0.0653	0.0817	0.1310
M	10	x 1	0.0394	0.361	0.356	0.3454	0.3586	1.0446	0.5900	0.0522	0.0653	0.1047
M	10	x 1.25	0.0492	0.367	0.363	0.3333	0.3651	1.0567	0.5900	0.0653	0.0817	0.1310
M	10	x 1.5	0.0591	0.354	0.349	0.3212	0.3521	1.0688	0.5900	0.0785	0.0981	0.1572
	1/4	- 20	0.0500	0.2175	0.2147	0.1887	0.216	1.201	0.590	0.0617	0.0783	0.1283
	1/4	- 24	0.0417	0.2218	0.2181	0.1989	0.220	1.191	0.590	0.0381	0.0519	0.0936
	1/4	- 27	0.0370	0.2249	0.2214	0.2046	0.223	1.185	0.590	0.0481	0.0604	0.0975
	1/4	- 28	0.0357	0.2268	0.2243	0.2062	0.225	1.184	0.590	0.0390	0.0510	0.0867
	1/4	- 32	0.0313	0.2297	0.2273	0.2117	0.228	1.178	0.590	0.0398	0.0502	0.0815
	5/16	- 18	0.0556	0.2764	0.2734	0.2443	0.274	1.146	0.590	0.0635	0.0820	0.1376
	5/16	- 20	0.0500	0.2800	0.2770	0.2512	0.278	1.139	0.590	0.0617	0.0783	0.1283
	5/16	- 24	0.0417	0.2854	0.2827	0.2614	0.283	1.129	0.590	0.0381	0.0519	0.0936
	5/16	- 28	0.0357	0.2893	0.2867	0.2687	0.287	1.121	0.590	0.0390	0.0510	0.0867
	3/8	- 16	0.0625	0.3344	0.3311	0.2983	0.332	1.092	0.590	0.0658	0.0867	0.1492
	3/8	- 18	0.0556	0.3376	0.3333	0.3068	0.336	1.083	0.590	0.0635	0.0820	0.1376
	3/8	- 20	0.0500	0.3425	0.3394	0.3137	0.341	1.076	0.590	0.0617	0.0783	0.1283
	3/8	- 24	0.0417	0.3479	0.3450	0.3239	0.346	1.066	0.590	0.0381	0.0519	0.0936
	7/16	- 14	0.0714	0.3911	0.3876	0.3499	0.389	1.040	0.590	0.0688	0.0926	0.1640
	7/16	- 16	0.0625	0.3969	0.3935	0.3608	0.395	1.029	0.590	0.0658	0.0867	0.1492
	7/16	- 18	0.0556	0.4001	0.3958	0.3693	0.398	1.021	0.590	0.0635	0.0820	0.1376
	7/16	- 20	0.0500	0.4050	0.4019	0.3762	0.403	1.014	0.590	0.0617	0.0783	0.1283

Fig. 37 – 190 Thread Form Reference Table

10.6 191 Series Attachment Thread Capacity

Inclined Position of Rolls: 3° 30'

Thread Size				Pitch	Pitch Diameter		Minor Diameter	Blank Diameter	Roll Diameter	OAL	Distance to Full Thread		
					Max	Min					.6L	1L	2L
M	8	x	0.75	0.0295	0.296	0.293	0.2787	0.2938	1.6113	0.7872	0.0343	0.0442	0.0737
M	8	x	1	0.0394	0.322	0.319	0.2667	0.3204	1.6233	0.7872	0.0524	0.0655	0.1049
M	8	x	1.25	0.0492	0.329	0.326	0.2546	0.3267	1.6354	0.7872	0.0655	0.0819	0.1311
M	9	x	1	0.0394	0.355	0.352	0.3060	0.3534	1.5840	0.7872	0.0524	0.0655	0.1049
M	9	x	1.25	0.0492	0.362	0.359	0.2940	0.3597	1.5960	0.7872	0.0655	0.0819	0.1311
M	10	x	1.25	0.0492	0.367	0.363	0.3333	0.3651	1.5567	0.7872	0.0655	0.0819	0.1311
M	10	x	1.5	0.0591	0.395	0.391	0.3212	0.3927	1.4900	0.7872	0.0590	0.0786	0.1377
M	11	x	1.5	0.0591	0.428	0.424	0.3606	0.4257	1.5294	0.7872	0.0590	0.0786	0.1377
M	12	x	1.25	0.0492	0.433	0.427	0.4121	0.4308	1.4779	0.7872	0.0655	0.0819	0.1311
M	12	x	1.5	0.0591	0.439	0.434	0.4000	0.4374	1.4900	0.7872	0.0590	0.0786	0.1377
M	12	x	1.75	0.0689	0.472	0.467	0.3879	0.4702	1.5021	0.7872	0.0721	0.0950	0.1639
M	13	x	1.5	0.0591	0.499	0.492	0.4394	0.4965	1.4506	0.7872	0.0590	0.0786	0.1377
M	14	x	1.5	0.0591	0.512	0.506	0.4787	0.5096	1.4113	0.7872	0.0590	0.0786	0.1377
M	14	x	1.75	0.0689	0.506	0.503	0.4667	0.5044	1.4233	0.7872	0.0721	0.0950	0.1639
M	14	x	2	0.0787	0.551	0.545	0.4546	0.5489	1.4354	0.7872	0.1049	0.1311	0.2099
M	15	x	1.5	0.0591	0.590	0.585	0.5181	0.5883	1.3719	0.7872	0.0590	0.0786	0.1377
M	16	x	2	0.0787	0.577	0.571	0.5333	0.5753	1.3567	0.7872	0.1049	0.1311	0.2099
	5/16	-	18	0.0556	0.2764	0.2734	0.2443	0.2744	1.6457	0.7872	0.0510	0.0695	0.1251
	5/16	-	24	0.0417	0.2854	0.2827	0.2614	0.2834	1.6286	0.7872	0.0533	0.0672	0.1089
	5/16	-	28	0.0357	0.2893	0.2867	0.2687	0.2873	1.6213	0.7872	0.0305	0.0424	0.0781
	3/8	-	16	0.0625	0.3344	0.3311	0.2983	0.3324	1.5917	0.7872	0.0707	0.0915	0.1540
	3/8	-	24	0.0417	0.3479	0.3450	0.3239	0.3459	1.5661	0.7872	0.0533	0.0672	0.1089
	7/16	-	14	0.0714	0.3911	0.3876	0.3499	0.3891	1.5401	0.7872	0.0603	0.0841	0.1555
	7/16	-	16	0.0625	0.3969	0.3935	0.3608	0.3949	1.5292	0.7872	0.0707	0.0915	0.1540
	7/16	-	20	0.0500	0.4050	0.4019	0.3762	0.4030	1.5138	0.7872	0.0603	0.0769	0.1269
	1/2	-	13	0.0769	0.4500	0.4463	0.4056	0.4480	1.4844	0.7872	0.0731	0.0987	0.1757
	1/2	-	16	0.0625	0.4594	0.4559	0.4233	0.4574	1.4667	0.7872	0.0707	0.0915	0.1540
	1/2	-	18	0.0556	0.4626	0.4582	0.4318	0.4606	1.4582	0.7872	0.0510	0.0695	0.1251
	1/2	-	20	0.0500	0.4675	0.4643	0.4387	0.4655	1.4513	0.7872	0.0603	0.0769	0.1269
	9/16	-	12	0.0833	0.5084	0.5045	0.4603	0.5064	1.4297	0.7872	0.0880	0.1158	0.1992
	9/16	-	14	0.0714	0.5146	0.5096	0.4749	0.5126	1.4151	0.7872	0.0603	0.0841	0.1555
	9/16	-	16	0.0625	0.5219	0.5184	0.4858	0.5199	1.4042	0.7872	0.0707	0.0915	0.1540
	9/16	-	18	0.0556	0.5264	0.5230	0.4943	0.5244	1.3957	0.7872	0.0510	0.0695	0.1251
	5/8	-	11	0.0909	0.5660	0.5619	0.5135	0.5640	1.3765	0.7872	0.1057	0.1360	0.2269
	5/8	-	12	0.0833	0.5709	0.5668	0.5228	0.5689	1.3672	0.7872	0.0880	0.1158	0.1992
	5/8	-	16	0.0625	0.5844	0.5808	0.5483	0.5824	1.3417	0.7872	0.0707	0.0915	0.1540
	5/8	-	18	0.0556	0.5889	0.5854	0.5568	0.5869	1.3332	0.7872	0.0510	0.0695	0.1251

Fig. 38 – 191 Thread Form Reference Table

10.7 192 Series Attachment Spline Capacity

1. Min and Max Bolt Circle (Same for both 1" and 2" wide Rolls)
   - FCD Max: 2.456
   - FCD Min: 2.396

2. Max Roll OD: 2.000"

3. Plate Max Diameters:
   - Front Plate: .950 (If bigger thrust washer may need to be Modified)
   - Back Plate: .920

4. Part Major Diameter: 0.625" to 1.000" Max (If part is under or over, review application with CJWinter)

10.8 193 Series Attachment Thread Capacity

Inclined Position of Rolls: 3° 30'

Thread Size				Pitch	Pitch Diameter		Minor Diameter	Blank Diameter	Roll Diameter	OAL	Distance to Full Thread		
					Max	Min					.6L	1L	2L
M	12	x	0.5	0.0197	0.4589	0.4559	0.4483	0.0161	2.2367	0.7862	0.0256	0.0322	0.0519
M	12	x	0.75	0.0295	0.4852	0.4806	0.4362	0.0171	2.2488	0.7862	0.0338	0.0437	0.0732
M	12	x	1	0.0394	0.4918	0.4878	0.4241	0.0174	2.2609	0.7862	0.0519	0.0650	0.1044
M	13	x	0.75	0.0295	0.5246	0.5199	0.4756	0.0187	2.2094	0.7862	0.0338	0.0437	0.0732
M	13	x	1	0.0394	0.5311	0.5272	0.4635	0.0189	2.2215	0.7862	0.0519	0.0650	0.1044
M	14	x	0.75	0.0295	0.5640	0.5593	0.5150	0.0202	2.1700	0.7862	0.0338	0.0437	0.0732
M	14	x	1	0.0394	0.5705	0.5666	0.5029	0.0205	2.1821	0.7862	0.0519	0.0650	0.1044
M	15	x	0.75	0.0295	0.6287	0.6194	0.5543	0.0228	2.1307	0.7862	0.0338	0.0437	0.0732
M	15	x	1	0.0394	0.6033	0.5987	0.5422	0.0218	2.1428	0.7862	0.0519	0.0650	0.1044
M	16	x	1	0.0394	0.6683	0.6612	0.5816	0.0243	2.1034	0.7862	0.0519	0.0650	0.1044
M	16	x	1.5	0.0591	0.7074	0.6981	0.5575	0.0259	2.1275	0.7862	0.0585	0.0781	0.1372
M	17	x	1	0.0394	0.6820	0.6774	0.6210	0.0249	2.0640	0.7862	0.0519	0.0650	0.1044
M	18	x	1	0.0394	0.7478	0.7423	0.6604	0.0274	2.0246	0.7862	0.0519	0.0650	0.1044
M	18	x	1.5	0.0591	0.9053	0.8998	0.6362	0.0336	1.9270	0.7862	0.0585	0.0781	0.1372
M	19	x	0.75	0.0295	1.0234	1.0179	0.7118	0.0383	1.9732	0.7862	0.0338	0.0437	0.0732
M	20	x	1.5	0.0591	0.6691	0.6635	0.7149	0.0243	1.9701	0.7862	0.0585	0.0781	0.1372
M	24	x	1.5	0.0591	0.9053	0.8998	0.8724	0.0336	1.8126	0.7862	0.0585	0.0781	0.1372
M	27	x	1.5	0.0591	1.0234	1.0179	0.9905	0.0383	1.6945	0.7862	0.0585	0.0781	0.1372

Fig. 39 – 193 Metric Thread Form Reference Table

10.8 193 Series Attachment Thread Capacity

Inclined Position of Rolls: 3° 30'

Thread Size	Pitch	Pitch Diameter		Minor Diameter	Blank Diameter	Roll Diameter	OAL	Distance to Full Thread		
		Max	Min					.6L	1L	2L
1/2 - 24	0.0417	0.4717	0.4678	0.4489	0.4697	2.236119	0.7862	0.0528	0.0667	0.1084
9/16 - 18	0.0556	0.5264	0.5230	0.4943	0.5244	2.190659	0.7862	0.0505	0.0690	0.1246
9/16 - 20	0.0500	0.5300	0.5268	0.5012	0.5280	2.183843	0.7862	0.0598	0.0764	0.1264
9/16 - 24	0.0417	0.5354	0.5324	0.5114	0.5334	2.173619	0.7862	0.0528	0.0667	0.1084
9/16 - 28	0.0357	0.5393	0.5365	0.5187	0.5373	2.166316	0.7862	0.0300	0.0419	0.0776
9/16 - 32	0.0313	0.5422	0.5396	0.5242	0.5402	2.160839	0.7862	0.0285	0.0389	0.0702
5/8 - 18	0.0556	0.5889	0.5854	0.5568	0.5869	2.128159	0.7862	0.0505	0.0690	0.1246
5/8 - 20	0.0500	0.5925	0.5893	0.5637	0.5905	2.121343	0.7862	0.0598	0.0764	0.1264
5/8 - 24	0.0417	0.5979	0.5949	0.5739	0.5959	2.111119	0.7862	0.0528	0.0667	0.1084
5/8 - 28	0.0357	0.6018	0.5990	0.5812	0.5998	2.103816	0.7862	0.0300	0.0419	0.0776
5/8 - 32	0.0313	0.6047	0.6020	0.5867	0.6027	2.098339	0.7862	0.0285	0.0389	0.0702
11/16 - 20	0.0500	0.6550	0.6517	0.6262	0.6530	2.058843	0.7862	0.0598	0.0764	0.1264
11/16 - 24	0.0417	0.6604	0.6574	0.6364	0.6584	2.048619	0.7862	0.0528	0.0667	0.1084
11/16 - 28	0.0357	0.6643	0.6614	0.6437	0.6623	2.041316	0.7862	0.0300	0.0419	0.0776
3/4 - 16	0.0625	0.7094	0.7056	0.6733	0.7074	2.011679	0.7862	0.0702	0.0910	0.1535
3/4 - 20	0.0500	0.7175	0.7142	0.6887	0.7155	1.996343	0.7862	0.0598	0.0764	0.1264
3/4 - 28	0.0357	0.7268	0.7239	0.7062	0.7248	1.978816	0.7862	0.0300	0.0419	0.0776
13/16 - 16	0.0625	0.7719	0.7682	0.7358	0.7699	1.949179	0.7862	0.0702	0.0910	0.1535
13/16 - 20	0.0500	0.7800	0.7767	0.7512	0.7780	1.933843	0.7862	0.0598	0.0764	0.1264
13/16 - 28	0.0357	0.7893	0.7864	0.7687	0.7873	1.916316	0.7862	0.0300	0.0419	0.0776
7/8 - 12	0.0833	0.8209	0.8167	0.7728	0.8189	1.912238	0.7862	0.0875	0.1153	0.1987
7/8 - 14	0.0714	0.8286	0.8245	0.7874	0.8266	1.897633	0.7862	0.0598	0.0836	0.1550
7/8 - 16	0.0625	0.8344	0.8307	0.7983	0.8324	1.886679	0.7862	0.0702	0.0910	0.1535
7/8 - 20	0.0500	0.8425	0.8391	0.8137	0.8405	1.871343	0.7862	0.0598	0.0764	0.1264
7/8 - 28	0.0357	0.8518	0.8489	0.8312	0.8498	1.853816	0.7862	0.0300	0.0419	0.0776
15/16 - 12	0.0833	0.8834	0.8792	0.8353	0.8814	1.849738	0.7862	0.0875	0.1153	0.1987
15/16 - 16	0.0625	0.8969	0.8932	0.8608	0.8949	1.824179	0.7862	0.0702	0.0910	0.1535
15/16 - 20	0.0500	0.9050	0.9016	0.8762	0.9030	1.808843	0.7862	0.0598	0.0764	0.1264
1 - 12	0.0833	0.9459	0.9415	0.8978	0.9439	1.787238	0.7862	0.0875	0.1153	0.1987
1 - 16	0.0625	0.9594	0.9557	0.9233	0.9574	1.761679	0.7862	0.0702	0.0910	0.1535
1 - 20	0.0500	0.9675	0.9641	0.9387	0.9655	1.746343	0.7862	0.0598	0.0764	0.1264
1 1/16 - 12	0.0833	1.0084	1.0041	0.9603	1.0064	1.7247	0.7862	0.0875	0.1153	0.1987
1 1/16 - 16	0.0625	1.0219	1.0181	0.9858	1.0199	1.6992	0.7862	0.0702	0.0910	0.1535
1 1/16 - 18	0.0556	1.0264	1.0228	0.9943	1.0244	1.6907	0.7862	0.0505	0.0690	0.1246
1 1/16 - 20	0.0500	1.0300	1.0266	1.0012	1.0280	1.6838	0.7862	0.0598	0.0764	0.1264
1 1/8 - 16	0.0625	1.0844	1.0806	1.0483	1.0824	1.6367	0.7862	0.0702	0.0910	0.1535
1 1/8 - 18	0.0556	1.0889	1.0853	1.0568	1.0869	1.6282	0.7862	0.0505	0.0690	0.1246
1 1/8 - 20	0.0500	1.0925	1.0890	1.0637	1.0905	1.6213	0.7862	0.0598	0.0764	0.1264
1 3/16 - 12	0.0833	1.1334	1.1291	1.0853	1.1314	1.5997	0.7862	0.0875	0.1153	0.1987
1 3/16 - 16	0.0625	1.1469	1.1431	1.1108	1.1449	1.5742	0.7862	0.0702	0.0910	0.1535
1 3/16 - 18	0.0556	1.1514	1.1478	1.1193	1.1494	1.5657	0.7862	0.0505	0.0690	0.1246
1 3/16 - 20	0.0500	1.1550	1.1515	1.1262	1.1530	1.5588	0.7862	0.0598	0.0764	0.1264

Fig. 40 – 193 Standard Thread Form Reference Table

10.9 194 Series Attachment Thread Capacity

Inclined Position of Rolls: 3° 30'

Thread Size				Pitch	Pitch Diameter		Minor Diameter	Blank Diameter	Roll Diameter	OAL	Distance to Full Thread		
					Max	Min					.6L	1L	2L
M	14	x	1.5	0.0591	0.5116	0.5061	0.4787	0.5096	2.1413	0.984	0.06877	0.08846	0.14751
M	14	x	1.75	0.0689	0.5064	0.5027	0.4667	0.5044	2.1533	0.984	0.06713	0.09010	0.15899
M	15	x	1.5	0.0591	0.5509	0.5454	0.5181	0.5489	2.1019	0.984	0.06877	0.08846	0.14751
M	16	x	1.5	0.5906	0.5903	0.5848	0.5575	0.5883	2.0625	0.984	0.06877	0.08846	0.14751
M	16	x	2	0.0787	0.5773	0.5710	0.5333	0.5753	2.0967	0.984	0.08518	0.11142	0.19016
M	20	x	2	0.7874	0.7348	0.7285	0.6908	0.7328	1.9392	0.984	0.08518	0.11142	0.19016
M	20	x	2.5	0.9843	0.7726	0.7857	0.6666	0.7706	1.9634	0.984	0.13111	0.16392	0.26234
M	22	x	2	0.7874	0.8135	0.8072	0.7695	0.8115	1.8605	0.984	0.08518	0.11142	0.19016
M	22	x	2.5	0.9843	0.8513	0.8645	0.7454	0.8493	1.8846	0.984	0.13111	0.16392	0.26234
	7/16	-	14	0.0714	0.3911	0.3876	0.3499	0.3891	2.2701	0.984	0.08724	0.11105	0.18248
	7/16	-	16	0.0625	0.3969	0.3935	0.3608	0.3949	2.2692	0.984	0.07533	0.09617	0.15867
	7/16	-	18	0.0556	0.4001	0.3958	0.3693	0.3981	2.2607	0.984	0.06607	0.08459	0.14015
	7/16	-	20	0.0500	0.4050	0.4019	0.3762	0.4030	2.2538	0.984	0.05867	0.07533	0.12533
	1/2	-	13	0.0769	0.4500	0.4463	0.4056	0.4480	2.2244	0.984	0.09456	0.12021	0.19713
	1/2	-	16	0.0625	0.4594	0.4559	0.4233	0.4574	2.2067	0.984	0.07533	0.09617	0.15867
	1/2	-	18	0.0556	0.4626	0.4582	0.4318	0.4606	2.1982	0.984	0.06607	0.08459	0.14015
	1/2	-	20	0.0500	0.4675	0.4643	0.4643	0.4655	2.1913	0.984	0.05867	0.07533	0.12533
	9/16	-	12	0.0833	0.5084	0.5045	0.4603	0.5064	2.1697	0.984	0.10311	0.13089	0.21422
	9/16	-	14	0.0714	0.5146	0.5096	0.4749	0.5126	2.1551	0.984	0.08724	0.11105	0.18248
	9/16	-	16	0.0625	0.5219	0.5184	0.4858	0.5199	2.1442	0.984	0.07533	0.09617	0.15867
	9/16	-	18	0.0556	0.5264	0.5230	0.4943	0.5244	2.1357	0.984	0.06607	0.08459	0.14015
	5/8	-	11	0.0909	0.5660	0.5619	0.5135	0.5640	2.1165	0.984	0.11321	0.14352	0.14352
	5/8	-	12	0.0833	0.5709	0.5668	0.5228	0.5689	2.1072	0.984	0.10311	0.13089	0.21422
	5/8	-	16	0.0625	0.5844	0.5808	0.5483	0.5824	2.0817	0.984	0.07533	0.09617	0.15867
	5/8	-	18	0.0556	0.5889	0.5854	0.5568	0.5869	2.0732	0.984	0.06607	0.08459	0.14015
	3/4	-	10	0.1000	0.6832	0.6773	0.6273	0.6812	2.0027	0.984	0.12533	0.15867	0.15867
	3/4	-	16	0.0625	0.7079	0.7029	0.6733	0.7059	1.9567	0.984	0.07533	0.09617	0.15867
	7/8	-	9	0.1111	0.8009	0.7946	0.7387	0.7989	1.8913	0.984	0.14015	0.17719	0.28830
	7/8	-	14	0.0714	0.8270	0.8216	0.8245	0.8250	1.8426	0.984	0.08724	0.11105	0.18248

Fig. 41 – 194 Standard Thread Form Reference Table

Section 11: Appendix

11.1 List of Figures

11.2 Revision History

Revision	Date	Comment	CA
A1	10/31/2024	Released	EDR

11.3 Legal Disclosure

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11.4 Afterword

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