CJWINTER

11070-SA Series

11071-SA Series

Cold Root Rolling Attachments

for Rotary Shouldered Connections

Informational Guide

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Introduction

Welcome to the introduction to cold root rolling and the CJ Winter line of cold root rolling tools. These tools have been designed specifically for use in the manufacture of Rotary Shouldered Connections using a CNC lathe. With proper use, these tool will cold root roll threads compliant with ANSI/API Specification 7.2:2008 and ISO 10424-2:2007, and in accordance with DS-1 Spec, Third Edition, Volume 3.33.6. This manual will help you use and maintain your tool.

What is Cold Root Rolling?

Cold root rolling is the process of burnishing the root radius of a previously cut thread, in a Rotary Shouldered Connection. A hardened roll, similar in profile to the thread being manufactured, is placed in contact with the root radius of the tapered thread, and pressure is applied to force the roller to penetrate into the cut surface of the root radius, displacing and cold-forming the thread material. This deformation cold-works the material, imparting an improved surface finish and compacts and displaces the grains of the root material. Industry experience with the cold root rolling process has suggested an increase in fatigue life of 3 to 5 times over similar un-treated connections under the same working environment. Some studies have noted laboratory results of up to 27 times better life attributable directly to cold root rolling process [(1)].

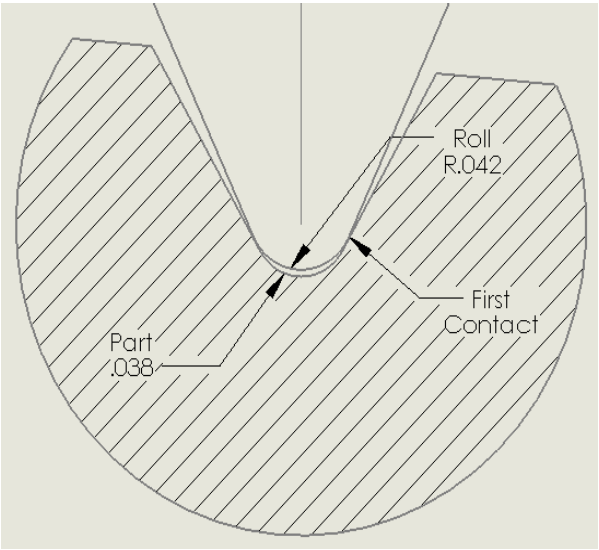


Figure 1: Roll Entering Root Contact

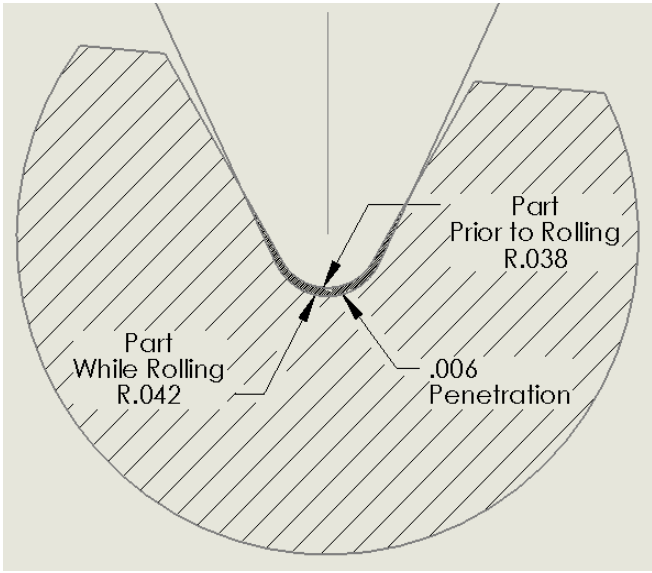


Figure 2: Roll Fully Engaged at .006" Penetration

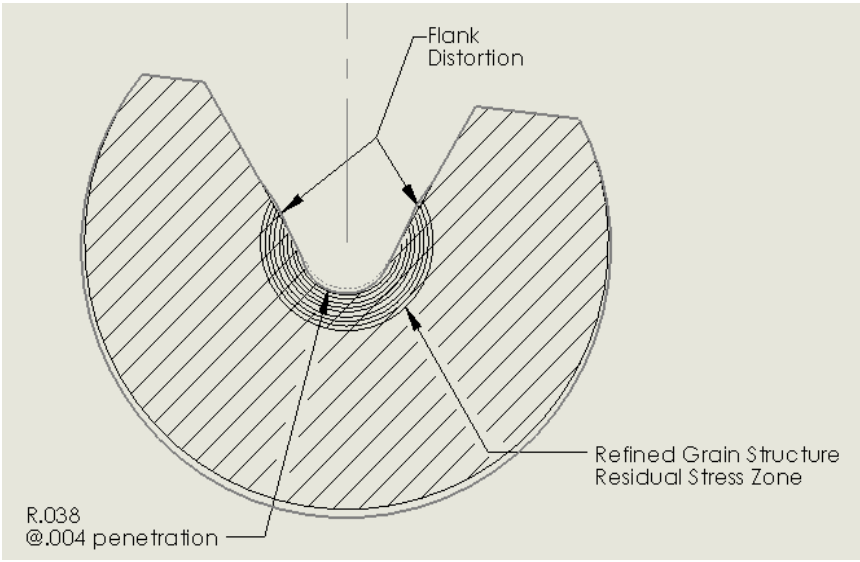


Figure 3: Final Result After Elastic Springback

Studies have attributed the increase of fatigue life to one or more important effects of cold root rolling:

1. Cold root rolling imparts a thin zone of residual compressive stress in the root region. This residual compressive stress offsets the tensile stresses induced in service, and lowers the overall stress in the critical stress region of the thread root. Figure 4.0 is an illustration of the typical residual stress patterns that remain in the part after cold root rolling, as well as the condition and displacement of material throughout the root rolling process *(Note: the magnitude and depth of the stress plot has been exaggerated for clarity).*

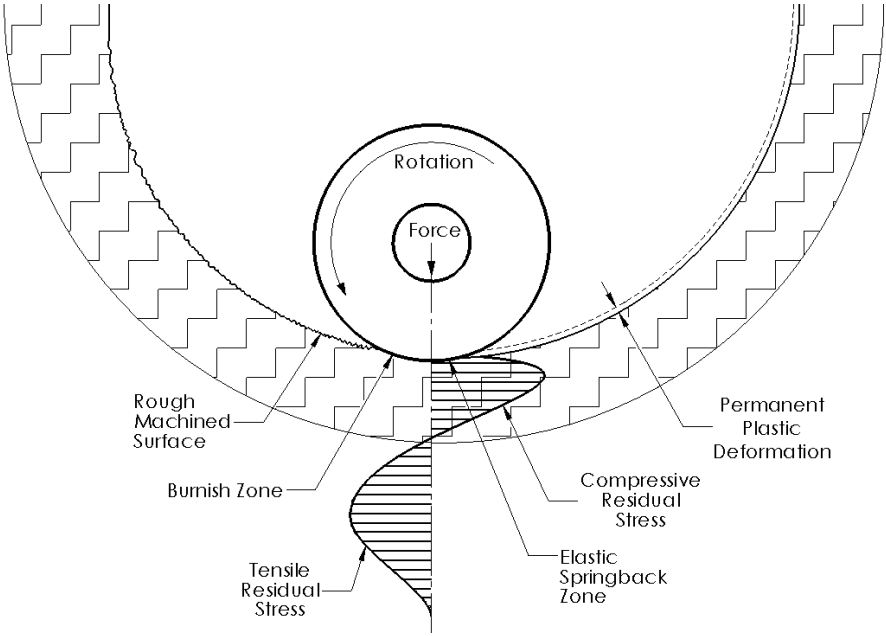


Figure 4: Residual Stress via Burnishing

2. The burnishing effect of the smooth roller on the root radius causes the small scratches and ridges left by the threading insert to flatten into a more uniform surface. These scratches have very small tip radii, at the leading edge, or bottom of the scratch. These small tip radii are considerable stress concentration factors, in one of the most highly stressed regions of the drill string connection. As a result, these scratches are the crack propagation points for most fatigue failures. Any method that minimizes or eliminates them enhances fatigue life.

3. Scratches provide prime locations for chemical erosion. The microscopic surface of a scratch is very jagged and porous, exposing a large surface area, and numerous molecular bonding sites, to the corrosive effects of liquids and gasses present in a drill string environment. The burnishing smoothes this surface, presenting a densely compressed and uniform surface. This burnishing eliminates outcroppings and inclusions, minimizes surface area, and inhibits chemical attack.

4. Root rolling the connection has a work-hardening effect on the surface of the material. On a molecular scale, the displacement of the crystalline lattice within the steel grain structure causes the crystal structure to change from a repetitive and uniform atomic structure, to one with many dislocations in the pattern. These dislocations in the iron matrix cause the crystal structure to interlock, and become more resistant to further deformation. This added resistance to deformation at the surface of the material helps prevent cracks from starting, and helps arrest microscopic cracks from growing into structural flaws that threaten the integrity of the joint. In lab studies, cracks that have occurred in cold rolled joints have exhibited a significantly lower Crack Aspect Ratio (Crack Length/Crack Depth). A 30% to 50% lower CAR means that cracks in cold root rolled products are more likely to be deep and short (as illustrated by the crack at the top of the pipe shown in Figure 5), rather than long and shallow (as illustrated by the crack at the bottom). A shallow crack is more likely to lead to a sudden and complete structural failure of the joint. A deep crack that partially penetrates the section wall is detectable via pressure drop of circulating drilling fluids, and allows for an early recovery of damaged string prior to complete structural failure of the joint [1].

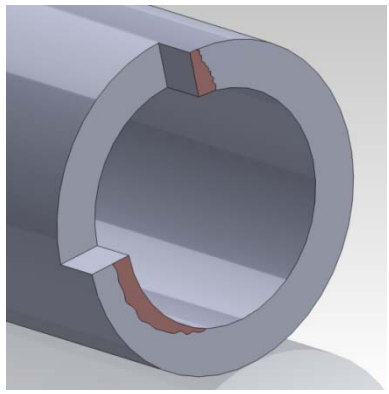


Figure 5: Crack Aspect Ratio

Why Root Roll Rotary Tapered Connections?

Cold Root Rolling is a requirement of DS-1 sec. 3.3.66, which requires all new and re-cut BHA and HWDP connections with API thread forms to be Cold Root Rolled.

Cold Root Rolling is also a money saving process. Cold Root Rolling can drastically increase the fatigue life of each rotary shouldered connection in a typical drill string. It can also reduce the frequency of repairing connections in the field, and of having to fish for down-hole failures. With the increasing popularity of extended reach drilling, multi-lateral wells, "hard rock" and horizontal well applications, the stress and bending moments being placed on rotary threaded connections, plus the sheer number of rotary threaded connections being placed into service, is growing each day [(2)]. With these increased stresses, and increased number of connections, also comes the increased chance of a down-hole failure of the drill string. T.H. Hill estimates that the cost of a single down-hole failure can surpass 1 million dollars [(3)]. With that kind of risk, Cold Root Rolling is cheap insurance, significantly reducing costly drill-string failures.

Why Use CJ Winter's Cold Root Rolling Tools?

For over 40 years CJ Winter has been the industry leader in supplying thread rolls and thread rolling tools globally. CJ Winter has used that experience to design tools specifically for Rotary Shouldered Connections in the Petroleum Industry. We believe this is the only self-contained, commercially available tool that will cold root roll threads compliant with ANSI/API Specification 7.2:2008 and ISO 10424-2:2007, and in accordance with DS-1 Third Edition, Volume 3.33.6. Our in-house engineering staff is always available to assist with any technical manufacturing situation.

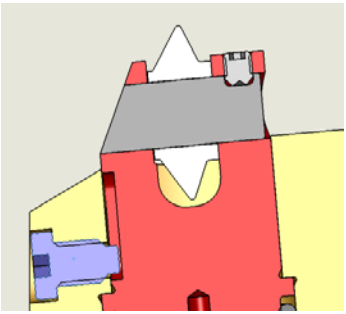
The CJ Winter cold root rolling tools and rolls also have some unique advantages.

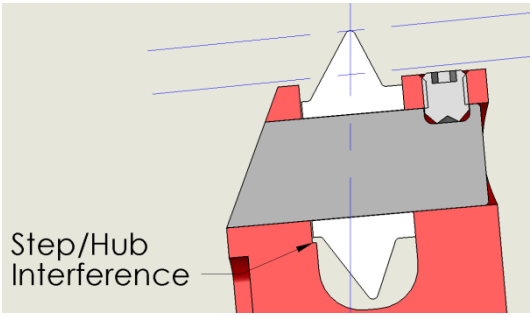
This tool does not require an external power device to pressurize the roller piston. No hoses to tangle, no shut-off valves to leak, no manual pumps to lose. The only tool required to pressurize this tool is socket wrench.

This tool does not require an external accumulator to roll the run-out thread. It is a requirement of DS-1 to maintain full pressure on the roller until the last

remnant of the run-out thread [4]. This requirement either forces perfect synchronization of the retraction of the cutting tool and roller, or an accumulator to allow the roller to retract into the holder body. Since perfect synchronization can be exceedingly difficult, the C.J. Winter holder comes standard with an integral accumulator to allow for the extra roller travel in this critical region.

The rolls in this tool *cannot* be loaded incorrectly. Rotary Tapered Connections use threads that are tapered. The rolls and roll pins on a Cold Rolling tool are tipped slightly to minimize side forces on the rolls and tool components as they travel up that taper. Because the form on a standard API roll is not symmetric, assembly orientation is critical. When using OEM supplied rolls with the **EPL® system** *(Error Proof Loading® - Patents Pending),* rolls CANNOT be loaded backwards. Unlike other tools, you do not rely on an imprecise and often over-looked, visual verification of the 5° skew on the thread form. The EPL system uses an asymmetric hub system where the hub on one side of the roll is larger than the other. The asymmetric hubs work in conjunction with a step in the roll holder to create Step/Hub interference if the user attempts to load the roll backwards. This eliminates this all too common mistake that can ruin a Rotary Shouldered Connection, and require a connection to be re-cut, or discarded.





This tool requires no conversion between the values of hydraulic pressure, and roller force. To simplify the process and reduce the chance for a damaging error, the numerical values of the pressure gage are the same for both PSI and Lbs force. Because we designed our working piston to be Ø1.128", which has an area of 1.00 in^2, no confusing lookup table is required to convert 1 PSI to 1 pound of force.

The supplied pressure gage is digital, and back-lit, making pressure adjustments easier to read than analog scales with small divisions. It also comes equipped with max/min recording functions so values can be observed after the cycle is complete, rather than during cycle with moving parts and coolant spraying about the lathe. The stainless body is IP65 rated against coolant, and come pre-calibrated and certified.

Also available is an *optional* wireless digital pressure gage and data acquisition unit. This optional wireless solution will allow for easy monitoring of the tool pressure, OUTSIDE the machine enclosure, and in real-time. It also allows you to record the pressure data digitally, for part quality and certification purposes.

The 11071-SA series of tools will roll all API Rotary Shouldered PIN connections.

The 11070-SA series of tools will roll API Rotary Shouldered BOX connections in the following ranges.

NC35 thru NC70
4-1/2 REG thru 8-5/8 REG
5-1/2 FH and 6-5/8 FH

Works Cited

1. *Fatigue life improvement of threaded connections by cold rolling.* **Knight, M.J., Brennan, F.P. and Dover, W.D.** 2, September 30, 2004, Journal of Strain Analysis, Vol. 40, pp. 83-93. DOI: 10.1243/030932405X7818.

2. *An Experimental Investigation of Fatigue-Crack Growth in Drillstring Tubulars.* **Dale, B.A.** 4, s.l. : Society of Petroleum Engineers, December 1998, SPE Drilling Engineering, Vol. 3. 15559-PA.

3. **T.H. Hill Associates, Inc.** Engineering Solutions - Failure Analysis. *www.thhill.com.* [Online] [Cited: February 13, 2012.] http://www.thhill.com/engineering_services/documents/failure_analysis.pdf.

4. **Tom H. Hill, P.E., et al.** Standard DS-1. 3 *Drill Stem Inspection.* s.l. : T.H. Hill Associates, January 2004. Vol. 3.

5. **API(American Petroleum Institute).** Specification for Threading and Gauging of Rotary Shouldered Thread Connections. s.l. : API Publishing Services, December 1, 2008. ANSI/API 7-2.

6. **Douglas, Jim.** "Prevent Rotary Shouldered Failures." April 13, 2011, American Association of Drilling Engineers. AADE-11-NTCE-31

Contact Information

167 Ames Street | Rochester, NY 14611
p: 800.288.7655 | f: 585.429.5095 | http://cjwinter.com/

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