

Cold Working Thread Roots with CNC Lathes for Rotary Shouldered Connections

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Introduction

Users of this technical report should be aware that further or differing requirements may be needed for individual applications. This technical report is not intended to inhibit a vendor from offering, or the purchaser from accepting, alternative equipment or engineering solutions for the individual application. This may be particularly applicable where there is innovative or developing technology. Where an alternative is offered, the vendor should identify any variations from this technical report and provide details.

In API 7-2, the term “cold worked (CW)” is used and not “cold root rolling”. This is done on purpose to be able to use multiple methods (such as shot peening) to deform the thread root. Thus, shot peening is acceptable. For any other method chosen, the thread height shall be gauged and recorded before the cold root rolling is done.

Thread root rolling has been performed on rotary shoulder connections and was first introduced by L. F. Irishman [2]. The purpose of CW is to put the thread root into a compressive state by yielding the surface of the thread root, burnish away tooling scratches, and blend the root radius into the lead and stab flanks. In the early days of machining rotary shoulder connections, cutting tools were hand ground to produce the thread form. The shape of the cutting tools was left more to imagination and less to quality control methods. It wasn't until the introduction of press carbide in the 1970s that threading inserts were made accurate enough to produce connections on a consistent basis. There are still procedures in effect today that require 1 RPM spindle speeds and 3 to 4 roller passes over the finished machined thread. None of the current procedures have stayed up with the technologies of CNC lathes to date regarding spindle speeds and single pass deformation of the root form. It is not known when the root roller radius was made larger than the threading insert radius, but this could be one reason why it has not been recommended to inspect standoff using ring and plug gauges after cold root rolling. Without procedures on how to design the CW roll to the threading tool paths is another cause of standoff change.

The radius on the CW roller has never been officially defined. Some suppliers use the same radius as the connection thread and others use a larger radius because of non-API requirements. This technical report will show the effects produced by a different root radius on the thread form.

Cold Working Thread Roots with CNC Lathes for Rotary Shouldered Connections

1 Scope

This technical report describes procedures for cold root rolling the thread roots on API 7-2 thread sizes using CNC Lathes (CW/CNC). Cold working can be applied by two methods: 1) cold rolling under pressure with a roller shaped like the thread form or 2) shot peening. Both methods achieve acceptable results, but machine thread root rolling is more controllable.

It is not the intent of this technical report to explain the benefits of thread root rolling, but the manufacturing process and quality control requirements. This technical report will address the best practices (or recommended practices) to cold root roll API 7-2 threads and identification marking.

This technical report will not address cold root rolling using manual lathes (CW/Manual)—a similar process but with different tools used for the pin and box. However, the tools described in this technical report can also be used on manual lathes. The steps to position the CW roll into the thread and the paths the tools move can vary between CNC machines controls.

2 Normative References

This technical report contains no normative references. For a list of documents and articles associated with API TR 7CR, refer to the bibliography.

3 Terms and Definitions

For the purposes of this technical report, the following terms, definitions, and abbreviations apply.

3.1

cold working

CW

Plastic deformation of the connection surface at a temperature low enough to induce strain hardening.

3.2

deburr

Removal of burrs or stringers created by the threading tool.

3.3

following error

The difference between where the “z” axis is based on feedback from the spindle encoder, and where it should be, based on what the CNC control program has commanded.

3.4

full-depth thread

A full form thread in which the thread root contacts on the minor cone of an external thread or contacts on the major cone of an internal thread.

3.5

G-code

The common name for the most widely used numerical control (NC) programming language.