

## **RA333 Flare Tip in Use at a Midwestern Oil Refinery Completes its 3-1/2 Year Tour of Duty and is Readied for a Second**



RA333 continues to be the material of choice for flare tips at one Midwestern refinery. The refinery, prior to 1992, had been using a refractory lined 310 stainless steel flare tip. This design was problematic for several reasons. One problem was the refractory broke away from the tip and dropped down into the stack. This created concerns of blockages in the stack and also led to increased maintenance costs. The 310 stainless possessed insufficient creep strength at temperature. It was prone to distortion whenever the refractory failed or there was flame impingement on the tip during high winds or low fire conditions. The distortion could negatively impact the flame characteristics of the flare and result in smoke. These issues also made it difficult to get continuous, reliable service in between shutdown periods. Improved service life and reliability of these flares were critical issues as this refinery was attempting to extend the operating period between scheduled major shutdowns. RA333 was selected for a new design of flare using no refractory lining.

This refinery now has nearly 10 years of service experience with the RA333 alloy flare tips. The first RA333 tip was installed on one side of the refinery in the autumn of 1992 and was used continuously until a plant shutdown in October 1995. At this point, the refinery installed a new RA333 flare in its place and did some repairs on this first tip. During the next scheduled shutdown, in the autumn of 1998, the refurbished RA333 flare tip was put back into service for a second time on the other side of the refinery.

The second RA333 tip, installed October 1995 was taken down during a shutdown in March 1999. After 3 1/2 years service, the RA333 portion (shown above) was like new. The only items requiring repair were those portions still made of 310 or HK castings such as steam nozzles and the pilot flares. Once these repairs are completed the flare will be kept on hand as a spare and will be installed during the next scheduled shutdown.

It was reported that one refractory lined 310 tip had failed in about one year of service. At the time of this writing, the first RA333 flare tip was in its fifth year of actual service. The second RA333 flare had provided 3-1/2 years of service to date.

The flare tips here consist of a 66 inch long cylinder of 3/8 inch thick RA333 plate at the top, (1676 mm long, 9.5 mm plate) butt welded to a like cylinder of carbon steel. The stack itself is a 30" diameter pipe, 237 feet tall from base to top (762 mm diameter, 72 m tall). Maximum capacity is 640,000 pounds per hour (290,000 kg/hr) of waste gas. To get a "Smokeless Flame" steam injection is used to increase combustion of the hydrocarbons. Flare tips are subjected to flame impingement on the outside, low flow conditions, and/or internal burning. Strong winds can blow the flame onto the flame retention rings, and on the outside. If the old refractory lining failed, air infiltration could cause internal burning to the point where the tip was seen to glow red.

RA333 alloy is a nickel base superalloy with outstanding resistance to high temperature carburization, oxidation, and flame impingement. The chemistry, 25Cr 45Ni 3Mo 3W 3Co 1Si, provides resistance to aqueous corrosion and stress corrosion cracking as well as to oxidizing hot corrosive environments.

Other applications for RA333 include rotary heat treating retorts, radiant tubes, muffles, catalyst calciners, thermowells, mixer blocks in petroleum coke calciners and crude unit tube hangers.



Web:  
<http://www.rolledalloys.com>  
E-mail:  
[sales@rolledalloys.com](mailto:sales@rolledalloys.com)

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**MIDWEST REGION:**

125 W. Sterns Road • Temperance, Michigan 48182-9546 USA • 1-734-847-0561 • 1-800-521-0332 • FAX: 1-734-847-6917

**CENTRAL REGION:**

9944 Princeton-Glendale Road • Cincinnati, Ohio 45246 USA • 1-800-521-0332

**EASTERN REGION:**

30 Baker Hollow Road • Windsor, Connecticut 06095 USA • 1-800-521-0332

**SOUTHERN REGION:**

9818 E. Hardy Rd. • Houston, Texas 77093 USA • 1-800-521-0332

**CANADA:**

Rolled Alloys-Canada, Inc. • 151 Brunel Road, Unit 23 • Mississauga, Ontario, Canada L4Z 2H6 • 1-905-501-7552  
1-800-521-0332 • FAX: 1-905-501-7553

**THE NETHERLANDS:**

Rolled Alloys BV • Voorerf 16 • 4824 GN Breda, The Netherlands • TEL: +31-(0)76-548 44 44  
FAX: + 31-(0)76-542 98 88

**ENGLAND:**

Rolled Alloys, Ltd. • Grangefield Industrial Estate • Grangefield Road • Pudsey, Leeds (UK) LS28 6JT  
TEL: +44-(0)113-236-2992 • FAX: +44-(0)113-236-2575

**INTERNATIONAL:**

Rolled Alloys International, Ltd. • 14, The Oaks, Clews Road • Redditch, Worcestershire (UK) B98 7ST  
TEL: +44-(0)1527-401101 • FAX: + 44-(0)1527-401013

**SINGAPORE:**

Rolled Alloys International, Ltd. • 10 Anson Road #24-06, International Plaza, Singapore 079903  
TEL: 65-2272725 FAX: 65-2272735