



## Rhino Tank Fittings Pressure Test

### Abstract

2", 3" and 4" NPT flanged type 316 stainless steel fittings manufactured by American Tank Company under the Rhino Tank Fitting name were pressure checked for structural and seal integrity. Three seal types were evaluated for each size of fitting: foam, EPDM, & Viton. The fittings were bolted into a 10" flanged, steel pipe test fixture using 15 ft-lb torque on all nuts. The fixture was filled with approximately  $\frac{3}{4}$  full of water while the remaining headspace was pressured with shop air. The seal integrity was observed & noted as either a leak or no leak condition. The fitting weldments and seals were tested up to 120 psig static head and withstood this load. This was equivalent to a 13:1 safety factor for a 20 ft. tall tank. In general, the foam seals did not leak if they were not mechanically disturbed; however, if the fitting was loosened, retightened, and then had a nipple (or plug) screwed into it, leaks developed at a vessel pressure of 20 psig. The EPDM and Viton seals were very mechanically durable. These seals held up to the static head in addition to impulse loading of approximately 400-500 ft-lb of torque applied by a large pipe wrench.

### Introduction

During the second quarter of 2002, American Tank Company commissioned a vendor to fabricate a line of bolted type 316 stainless steel tank fittings. As these fittings were to be a new product line for American Tank to sell to the general public, the company decided to mechanically verify the integrity of the fabricated fittings for structural and sealing considerations. These fittings are of a flanged type design where commercially available type 316 pipe nipples or full couplings are welded to a flange. Type 316 stainless steel studs are then stud welded onto the flange per American Water Works Association standard bolt pattern dimensions. The fitting and its gasket can then be assembled into the tank wall using  $\frac{1}{2}$ "-13 UNC type 316 stainless steel nuts once the appropriate hole have been cut/drilled into the tank. Three different gasket types are used to seal between the hole in the tank wall and the fitting:  $\frac{1}{2}$ " thick foam,  $\frac{1}{4}$ " thick EPDM, or  $\frac{1}{4}$ " thick Viton. It was felt that a robust assessment was required which did not involve field testing of the fittings.

## Procedure

To effectively test the fittings, an experimental fixture was fabricated out of 10" diameter schedule 40 steel pipe. The fixture was fabricated with standard 150 lb steel flanges on both ends. ¼" NPT air (valved inlet/outlet) and ¼" NPT water (valved inlet/outlet) threads were drilled & tapped into a 10" steel blank flange. This flange was then bolted to one end of the fixture. Three other 10" steel flanges were also machined to accept a 2", 3", and a 4" NPT full coupling type Rhino fitting, respectively. Each fitting was bolted to the inside face of its respective flange using the ½"-13 UNC studs. The fitting was then plugged or capped with a threaded PVC fitting and assembled to the open end of the fixture. The pipe fixture was filled about ¾ full with water. Regulated shop air was connected to the air supply fitting. The supply pressure was varied between 20 and 120 psig in 20 psi increments. At each pressure setting, the Rhino fitting was observed for a minimum of 1 minute before a leak or no leak condition was noted in the data sheet. This data has been summarized in Table I.

## Results

Vessel		2"			3"			4"		
Pressure	Foam	EPDM	Viton	Foam	EPDM	Viton	Foam	EPDM	Viton	
20	OK	OK	OK	Leak	OK	OK	OK	OK	OK	
40	OK	OK	OK	Leak	OK	OK	OK	OK	OK	
60	OK	OK	OK	Leak	OK	OK	OK	OK	OK	
80	OK	OK	OK	Leak	OK	OK	OK	OK	OK	
100	OK	OK	OK	Leak	OK	OK	OK	OK	OK	
120	OK	OK	Not Tested	Leak	OK	OK	OK	OK	Not Tested	

Table I – Rhino Fitting Assessment @15 ft-lb Stud Nut Torque

## Discussion

The data collected indicated that the flanged fittings and both the EPDM and Viton gaskets were very durable. Approximately 400 to 500 ft-lb torque was applied to each of the 2", 3" & 4" fittings using either an 18" or a 36" long pipe wrench. The EPDM & Viton gaskets were able to withstand this amount of torque consistently. This was not the case for the foam gasket. Furthermore, leaks of any kind were not observed from any of the fitting weldments.

There were only two significant issues which arose during the experimental testing. The first was the proper selection of pipe thread sealant. Initially, the NPT threads on the Rhino fitting were sealed with Teflon tape. This did not seal effectively as leaks occurred from the threaded portion of the fitting at pressures as low as 20 psig. To solve this problem, two paste type sealants were evaluated. Loctite 567 worked very well to seal the NPT threads up to 120 psig. Rectorseal Soft Set was also used and also worked very well up to 120 psig. The second issue was the amount of mechanical disturbance which the foam type gasket can handle. As long as the Rhino fitting was assembled onto the steel flange and left undisturbed, the foam gasket sealed well at the 15 ft-lb stud nut torque; however, once a pipe wrench was used to tighten either the plug or cap threaded into the fitting, slow leaks were observed from around the foam gasket. This was very evident in the 3" fitting as a pipe nipple and cap were used. A 36" pipe

wrench was required to adequately tighten these fittings. Finally, 15 ft-lb of torque flattened the foam gasket from its initial thickness of 1/2" to less than 1/8". Since this gasket was already compressed so much, any further disturbance of the gasket (from movement of the fitting by the pipe wrench) caused a leak.

## Conclusions

The Rhino tank fitting weldments and gaskets have been tested and structurally withstood pressures of 120 psig. For a large polyethylene tank containing a 20 ft high cylinder of water, the pressure developed at the tank bottom is  $0.4331 \text{ lb/in}^2/\text{ft} \times 20\text{ft} = 8.6 \text{ psig}$ . Thus, the weldment has been tested to a safety factor of  $120 \text{ psig} / 8.6 \text{ psig}$  or 13. The Rhino tank fitting gaskets have also been tested up to the same safety factor. EPDM & Viton gaskets withstood the 120 psi static head applied in addition to an impulse (or jerking type) load of approximately 400-500 ft-lb torque applied through a large pipe wrench. The foam type gasket could not handle this impulse load. Instead, the foam gaskets were capable of a 20 psi static head which is equivalent to a 46 ft tall cylinder of water. This gasket safety factor was then only  $46\text{ft}/20\text{ft}$  or 2 for a 20 ft tall tank.

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