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FAILURE ANALYSIS OF A SLIP-ON FLANGE

The installation of a 14" slip-on flange in a pipeline was recently witnessed by Al Justin, chief inspector for the State of Minnesota. The flange originally had a 14-3/4" inside diameter, which was reduced by welding a 3/4" ring and machine welding. The ring, however, separated from the flange, giving the appearance of a crack. The flange is reported to have been manufactured in the People's Republic of China.



Figure 1: Gasket side of flange.

Several such flanges have been reported in the field. All individuals in the industry should be on the alert for these flanges.

The following is a report by Columbus Metallurgical Services, Inc. on the failure analysis of a slip-on flange.

A "cracked" 14" diameter slip-on flange was non-destructively inspected by using magnetic particle, dye penetrant and ultrasonic test methods. The flange was also checked for material chemical analysis and macro and microstructure. On the basis of the results and observations reported, the following conclusion is drawn:

The subject slip-on flange is not an integral forging or a casting. It has been fabricated by welding and machining a ring insert within a large diameter flange. The flange "cracked" because the welds between the flange and the insert were inadequate to withstand the bolting pressures.

BACKGROUND

The "cracked" slip-on flange was received by Columbus Metallurgical Services, Inc. in one piece. It had two diametrically opposite cracks located on pipe and gasket sides. It has been reported that several such flanges are in the field. The subject flange has the following engraved markings on the outside diameter (OD):

"14 300 SO RF B16.5 A105 8-48 CHINA 02F"

To identify the cause of the failure it was planned to perform dye penetrant, dry magnetic particle, ultrasonic and radiographic tests on the subject flange.

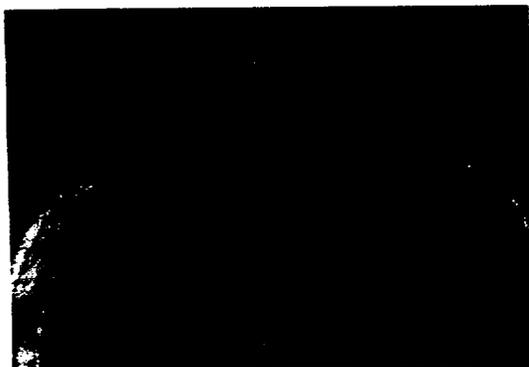


Figure 2: A close-up of the gasket side showing the "crack" indication.

NON-DESTRUCTIVE TESTS

First, the flange was UT tested from the OD. The indications were rather puzzling because the reflections were consistently from a cylindrical surface about 3.75" from the OD. A dry magnetic particle examination confirmed that the cracks extended more or less continuously in a circular path. The NDT examination was concluded with dye penetrant tests as shown in the photographs in Figures 1 through 4. It was quite evident that the flange was not a single piece component. A large inside diameter (ID) flange was reduced to a 14" ID unit by welding a 0.75" thick ring. The welding faces had been machined.

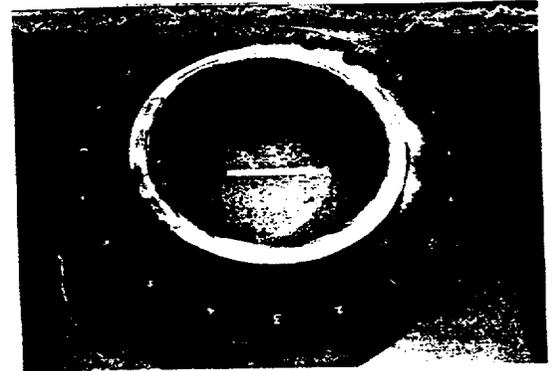


Figure 3: Pipe side of flange.

CHEMICAL ANALYSES AND METALLOGRAPHY

The flange was sectioned into four pieces to obtain specimens for chemistry, as well as for macro and microscopic examination. The original engraved markings have been retained on one of the segments. The chemical analyses are as follows:

C	Mn	P	S	Si	Cu	Sn	Ni	Cr	Mo	Al	V
Main Flange Steel											
.23	.62	.024	.038	.24	.27	.016	.094	.079	.026	.006	.003
Welded Insert Steel											
.26	1.02	.017	.039	.28	.063	.003	.050	.046	.032	.008	.000
ANSI/ASTM A 105											
.35	.60-1.05	.040	.050	.35	(listed for reference only)						



Figure 4: A close-up of the pipe side showing the "crack".

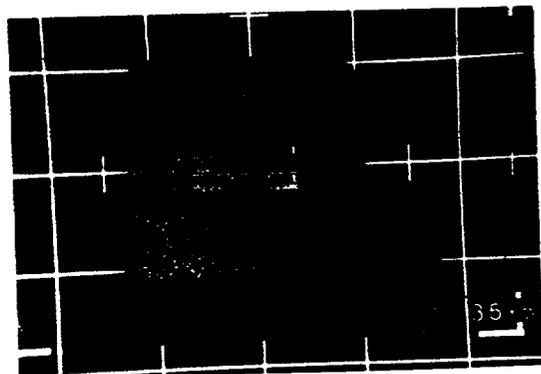


Figure 5: A macro of a radial section. Etched 50% HCl, 15 minutes.

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Number of Suspect Flanges Growing at Alarming Rate

The National Board continues to receive reports of several different types of flanges, ranging in sizes from 2" to 20" and marked "China," that do not appear to be in accordance with ANSI B16 as markings.

As the number of suspect flanges continues to grow, so does the different types of problems related to these flanges.

To date, over 7,000 have been removed from service, including 1,600 recently discovered in a newly-installed pipeline. An injunction has been ordered to cease work on the pipeline until the flange problem has been resolved. The remaining 5,200+ flanges have been found mostly in refineries.

The president of the China Association of Boiler and Pressure Vessel Inspection, Center of Boiler & Pressure Vessel Inspection & Research of the Ministry of Labour, P.R.C., Wang Hannuo, has agreed to meet with National Board Assistant Director of

Inspections John McLouglin, late in May in Beijing to discuss the problem.

NBBI continues to advise double-checking all flanges with the marking "China," especially before these flanges are placed in service.

Flanges that have visible surface discontinuities or incomplete markings may be easy to see. But the machined surfaces of welded flanges can only be detected through a volumetric form of NDE. The failure to meet heat treat, mechanical or chemical requirements of the specifications can only be verified through metallurgic examination.

NBBI will continue to publish updates as information is learned. This update is distributed in the interest of public safety.

Further questions or concerns should be directed to A.M. "Doc" Matthews, Jr. or R.D. Schueler, Jr. at National Board headquarters. □

Student Grant Recipients Named

The National Board has selected two students from 24 applications to receive 1992 National Board engineering education grants.

They are: Deborah Ann DeMania, University of Illinois at Urbana-Champaign, and William R. Johansen, University of Wyoming.

The grants will be presented to the students at the Annual General Meeting Awards Banquet in San Antonio. □

Alert Continues for Flanges from China

The Winter 1992 *National Board Bulletin* included an article regarding a serious problem found to exist on 14" slip-on, raised-face flanges.

Since publication, NBBI has learned the problem described is only one of many associated with flanges from the Peoples Republic of China.

NBBI has been provided with a lab report for a 4" weld neck flange SA-105N B16-5 with a BHN (Brinell Hardness Number) of up to 500. Also, normalizing and chemistry requirements do not meet SA-105 requirements.

These flanges have been reported to have cracks and other surface discontinuities that might make them unfit for service. In addition, there have been reports that some flanges do not meet thickness requirements. NBBI also has been advised through reinspection reports that some flanges may not bear the markings re-

quired by the ANSI B16 specification, although they do bear the B16 mark.

NBBI advises double-checking all flanges with the marking "China," especially before these flanges are placed in service.

Certainly, flanges that have visible surface discontinuities or incomplete markings may be easy to see. But the machined surfaces of welded flanges can only be detected through a volumetric form of NDE. The failure to meet heat treat, mechanical or chemical requirements of the specifications can only be verified through metallurgic examination.

This update is being distributed in the interest of public safety. Future updates will be published as more facts are learned.

Further questions or concerns should be directed to A.M. "Doc" Matthews, Jr. or R.D. Schueler, Jr. at National Board headquarters.

D.J. McDonald Meets With Hungarian President

National Board Executive Director D.J. McDonald met with Hungarian President Arpad Goncz on March 19 in Columbus, Ohio to discuss the need to train and certify Hungarian's boiler and pressure vessel inspectors.

President Goncz was in town to address the graduating class at The Ohio State University.

NBBI Infoletter Goes Monthly

You are now reading the last issue of the biweekly *NBBI Infoletter*. The reason: all future *NBBI Infoletters* will be distributed monthly. Monthly distribution is necessary to accommodate a new, expanded version that will better inform our readers. Look for the next *NBBI Infoletter* to be distributed the week of April 27.



a service of The National Board of
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