



## Tests of Corroded Steel Pipes Externally Wrapped with QuakeWrap®

**Client:** PERTAMINA Technical Services  
(Supply & Distribution S&D) & PT BMJP

**Testing Lab:** Polymer Technology Center  
Gedung 460, Kawasan Puspiptek  
Tangerang-Banten 15314 INDONESIA

### Test Description:

1. A steel pipe segments with diameter of 5 inch (127 mm) and thickness of 0.118 inch (3 mm) was selected by PERTAMINA to evaluate the repair technique for pipes that have lost wall thickness due to corrosion. A 20-mm (0.787-inch) diameter hole was drilled in the pipe to simulate corrosion damage.
2. The pipe surface was sand blasted to meet the Swedish Standards SA 1 (ISO SA 1) for surface preparation. This produced a near white surface.



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3. The finished pipe after sandblasting is shown here.



4. The hole was filled and patched with metal repair and QuakeBond™ epoxy mixed with silica fume. The patching area extended about 50 mm (2 inches) in each direction beyond the hole.



5. Cut a piece of VU20G glass fabric to cover the hole region. This band of fabric is 4 inch (100mm) wide x 16 inch (400 mm) long and allowed for an overlap of about 6 inch (150 mm) at the end of the fabric.



6. Saturate the glass fabric with QuakeBond™ J333SR (Underwater Saturating Resin).



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7. Wrap the saturated fabric around the pipe to cover the area where the hole. Note that the fabric overlaps around 6 inches (150 mm).



8. To prevent galvanic corrosion of the steel pipe, we have to prevent direct contact between the carbon fabric and the steel pipe. This was achieved by applying a layer of QuakeWrap® VU20G glass fabric saturated with QuakeBond™ J333SR around the pipe such that no steel was visible.



9. The strengthening of the pipe was achieved by applying two layers of QuakeWrap® VU18C unidirectional carbon fabric saturated with QuakeBond™ J333SR resin in the hoop direction. These layers covered the entire length of the pipe and they were each 16 inch (400 mm) long to provide the 6 inch (150 mm) overlap at the end.



10. If necessary, apply a top coat of QuakeBond™ J333SR to the carbon fabric to make sure the fabric is fully saturated.





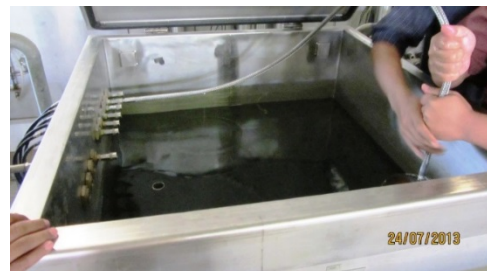
11. Wrap the pipe in plastic (shrink wrap). The wrapped pipe was allowed to cure in ambient temperature for 72 hours before it was sent to the Polymer Center for burst test.



12. The ends of the pipe were capped, sealed and filled water. An initial pressure test was performed to make sure there were no leaks in the system.



13. For added safety, the pipe test assembly was placed inside a tank containing water.



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14. The pipe test pressure was set at 95 bar (1378 psi). The maximum pressure reached in the repaired pipe was 93.1 bar (1351 psi). The complete data collected during the test is shown on the next page.

11 SET	50.00		
12 SET	58.00		
13 SET	85.90	ACT	85.01
14 SET	55.00	ACT	0.00
15 SET	50.00	ACT	0.09
16 SET	95.00	ACT	90.12
17 SET	40.00	ACT	0.00
18 SET	98.00	ACT	0.12

15. These photos show the test specimen at the conclusion of the test with the repair hole location marked. Failure of the specimen was through a small leak at the hole at a pressure of 93.1 bar (1351 psi).



16. Based on the successful tests demonstrated here, QuakeWrap® Carbon FRP system has been approved in 2013 by PERTAMINA Technical Services for external repair of pressure pipes in PERTAMINA and the Oil and Gas market sectors.

17. Since July 2013, QuakeWrap® Carbon FRP system has been used in 4 pipeline projects (onshore and submerged under the sea) repairing corrosion-damaged steel pipes that operate under high pressure.

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# Sentra Teknologi Polimer

Gedung 460 ,Kawasan Puspiptek  
Tangerang-Banten 15314  
Indonesia

## Product details

Test number	203
Description	komposit pipa2
Production no.	Pipa Komposit
Test type	customer standard
Customer	Bumi Mas Jaya Perkasa Karawaci

## Pressure Test Details

Operator	abd,
Station	16
Set Pressure	97,90 [bar]
Hysterisis	0,95 [bar]
Alarm limit	1,00 [bar]
Max. Pressure	93,15 [bar]
Leak rate	5

## Pressure Test Results

Total test time	1:00 hours
OK time	0:00 hours
Current test time	0:07 hours
Out of tolerance time	0:07 hours
Power failure time	0:00 hours

## Pressure Test Temperature

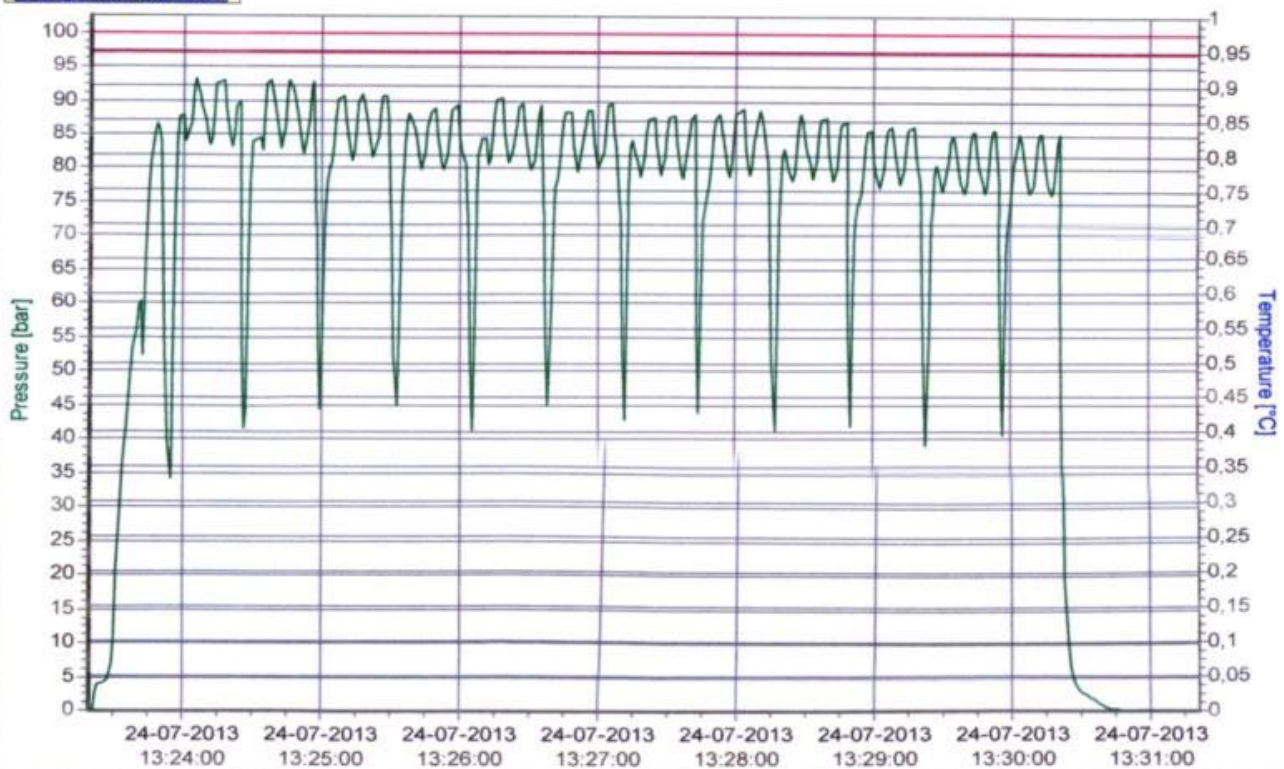
Tank no.	1
Max. temp.	0,00 [°C]
Min. temp.	0,00 [°C]

## Test comments

## Dates

Start date of test	24-07-2013 13:23
End date of test	24-07-2013 13:30
Date of print	24-07-2013 13:31:58

## Complete Test View



Pc version = 26 10 2011 8.40  
0 version = 18-04-2011

Test approved by

Date ..../..../..

ORIGINAL



# Testing Report

Report No : 1374650367      No Order : 1372912748      Date : 19 - 08 - 2013

Customer : PT. Bumi Mas Jaya Perkasa  
Ruko Barcelona  
Jln. Parasel, Palem Raja Raya Selatan No. 1  
Perum Palem Semi Karawaci Tangerang, Banten 15810

Contact Person : Ms. Nina

Sample Name : Pipa Carbon Steel

Incoming Sample : July 4, 2013

Testing Date : July 24, 2013

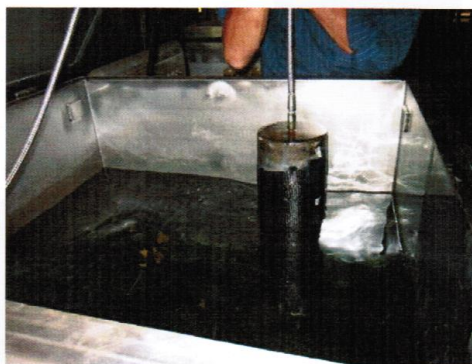
Type of Testing : Bursting Test (Customer Standard)

## I. TESTING CONDITION

The sample was prepared by customer. The bursting test was conducted at temperature of 20°C (in Tank) to one product using SQITEC Bursting Test Equipment until the product was burst. The test condition is shown in the figure 1 below:



Product



Product placed in Tank

Figure 1. Bursting Test Condition

This Report is valid only for sample tested; Prohibited to make a copy without permission of STP. All any complain related to our services shall be address to QA Manager.

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F-015;Ed.C;Rev:0

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## II. TESTING RESULT

The testing result of Pipa Carbon Steel is shown in table 1 below.

Table 1. The Result of Bursting Test

No.	Sample Name	Result
1.	<b>Pipa Carbon Steel</b> • Maximum Pressure • Test Duration	93.15 bar 7 minutes

Testing Manager

**STP**  
SENTRA TEKNOLOGI POLIMER  
Syuhada

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