KLINGER

B R I T I S H G A S P L C

SPADEADAM TEST SITE

KLINGER GASKET FIRE TESTS

KLINGERsil C 4430
KLINGERsil C 4210

Distribution

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INSPECTION AND TEST OF GASKETS

BS 5146: Part 1: 1974

To the Specification for the Petroleum, Petrochemical and Allied Industries

FIRE-SAFE TESTING

1. INTRODUCTION

Valves in general are required to maintain the ability to perform the functions of isolation and control with the minimum of leakage. In the event of a fire in the vicinity of a valve in the petroleum or petrochemical industries the requirement is specific for maintaining process integrity and safety. To meet this minimum requirement a test to BS 5146: Part 1: 1974 needs to be applied to valves of a given type, design and manufacture.

The procedure for carrying out this test is described here for the certification of 100 DN gaskets of the following specification.

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C4430 x 2 (1.5mm) non-asbestos gaskets DN 100
C4210 x 2 (1.5mm) non-asbestos gaskets DN 100

For the purpose of this test the gaskets were clamped between two raised face flanges, Figure 1. Initially, type B7 nuts and stud bolts were used with Class 150 carbon steel flanges. These are rated to only 450 deg. C. however, and the first test results were considered to be suspect. The flanges and stud bolts were replaced with 316 stainless steel flanges and bolts, rated to 600 deg. C. for tests two and three. The bolting torque used was 120 N-m. This is higher than that specified for cryogenic usage but was considered to be appropriate for the conditions in these tests.

2. PROCEDURE

2.1 Mount gasket between flanges and secure stud bolts to specified torque.

2.2 Fit thermo couple to an insertion hole in each flange.

2.3 Pump kerosene through the pipework and flanges and seal the system.

2.4 Sustain a pressure of 2 bar (minimum).

2.5 Check system for leaks and record temperature.

2.6 Ignite burners and close oven door.

2.7 Record temperature to 600 deg. C. at 5 minute intervals.

2.8 Maintain a minimum of 600 deg. C. for 30 minutes recording temperature every 5 minutes.

2.9 Check flanges for leaks throughout test and estimate flame lengths.

2.10 Turn off burners, let down pressure, drain kerosene and allow to cool.

2.11 Attach water supply and flush system through.

2.12 Maintain 1 bar water pressure on flanges and measure leakage over 10 minute period.

2.13 Apply 22 bar pressure to flanges and measure leakage over 10 minute period.

2.14 Dismantle and retrieve gasket.

3. RESULTS OF TEST

3.1 The following results show temperatures achieved during the three tests.

The first (commissioning) test was performed using B7 stud bolt materials. Comments on each of the tests are given in section 4.

KLINGER GASKET TEST RESULTS 7/12/97

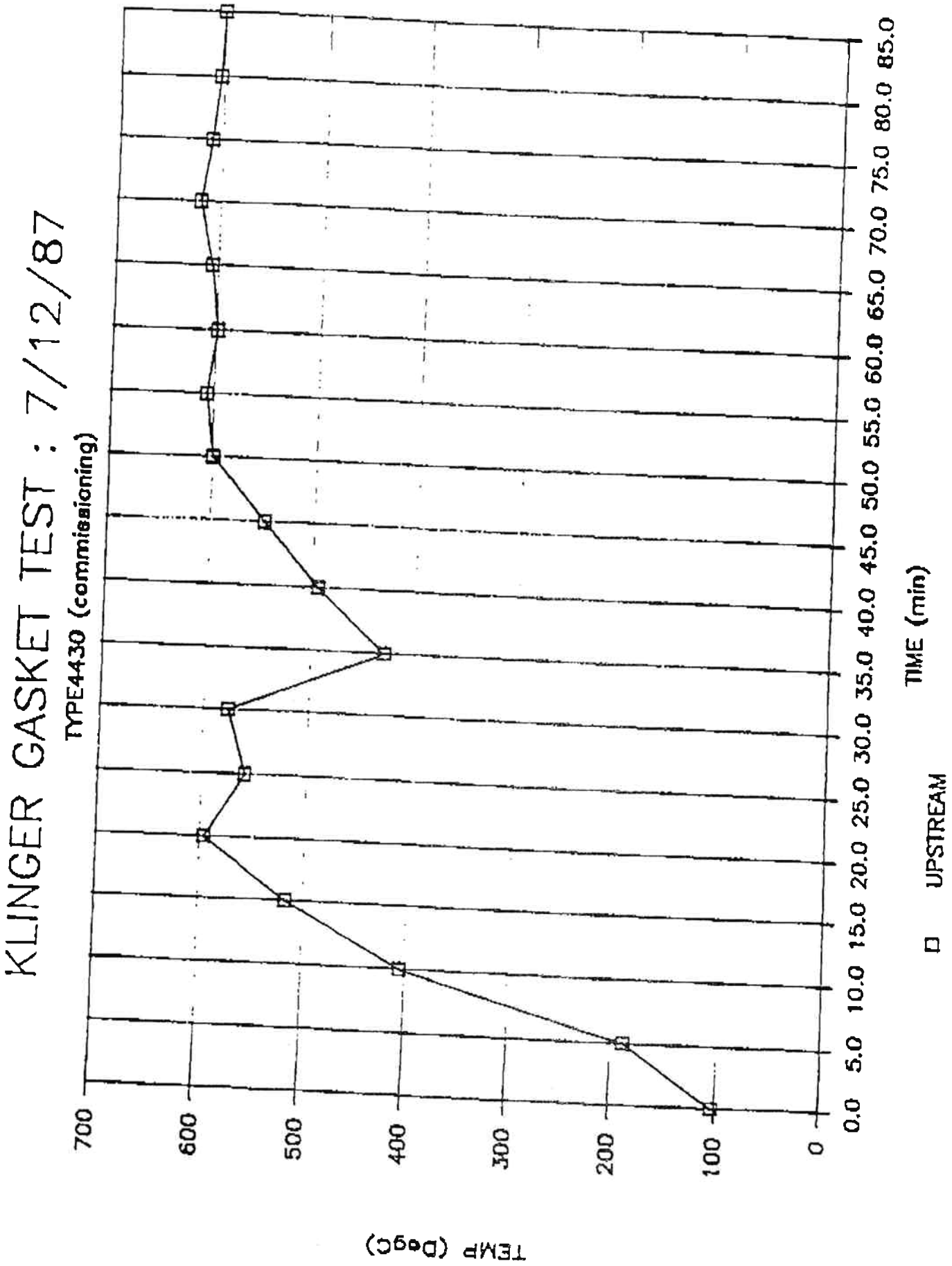
TEST NO. : 1 (commissioning)
GASKET TYPE : 4430
TEST LIQUID : KEROSENE
TEST PRESSURE : 2 bar

STUD BOLT TYPE B7
FLANGE CLASS 150 CARBON STEEL

TIME	FLANGE TEMPERATURE DegC		PRESS
min	UPSTREAM	DOWNSTREAM	bar
0.0	105.0	67.0	2.0
5.0	189.0	130.0	2.0
10.0	406.0	332.0	2.2
15.0	518.0	471.0	2.3
20.0	597.0	561.0	2.0
25.0	560.0	576.0	2.0
30.0	578.0	595.0	2.0
35.0	430.0	422.0	2.0
40.0	496.0	446.0	2.0
45.0	549.0	482.0	2.0
50.0	600.0	516.0	2.0
55.0	608.0	526.0	2.0
60.0	600.0	544.0	2.1
65.0	607.0	533.0	2.1
70.0	620.0	539.0	2.1
75.0	611.0	556.0	2.1
80.0	604.0	553.0	2.1
85.0	602.0	549.0	2.1

AMBIENT HYDRO TEST :

1 bar	10 minute leakage : 5 cc	0.5 cc/min	
22 bar	10 minute leakage : 50 cc	5.0 cc/min	


KLINGER GASKET TEST : 7/12/87
TYPE4430 (commissioning)
TEMP (Deg C)
700
600
500
400
300
200
100
0
0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0 55.0 60.0 65.0 70.0 75.0 80.0 85.0
TIME (min)
UPSTREAM

KLINGER GASKET TEST RESULTS 16/12/87

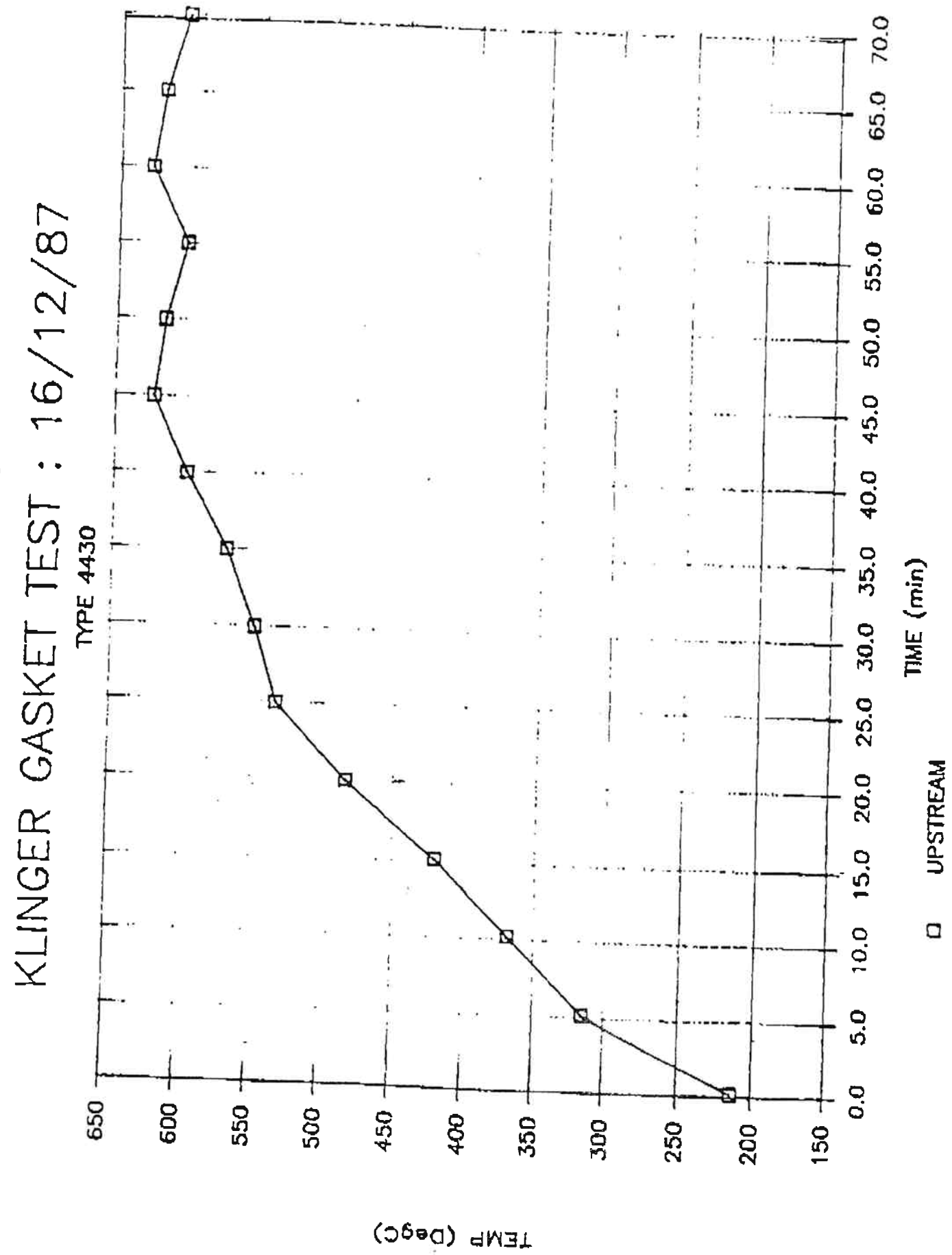
TEST NO. : 2
GASKET TYPE : 4430
TEST LIQUID : KEROSENE
TEST PRESSURE : 2 bar

STUD BOLT TYPE 316 STAINLESS
FLANGE CLASS 150 -316 STAINLESS

TIME	FLANGE TEMPERATURE Degc		PRESS
min	UPSTREAM	DOWNSTREAM	bar
0.0	215.0	197.0	2.0
5.0	316.0	261.0	2.0
10.0	369.0	344.0	2.0
15.0	421.0	396.0	2.1
20.0	484.0	446.0	2.1
25.0	534.0	504.0	2.1
30.0	550.0	530.0	2.1
35.0	571.0	561.0	2.1
40.0	600.0	584.0	2.1
45.0	624.0	613.0	2.1
50.0	617.0	607.0	2.1
55.0	603.0	600.0	2.1
60.0	628.0	595.0	2.1
65.0	620.0	592.0	2.1
70.0	605.0	594.0	2.1

AMBIENT HYDRO TEST :

1 bar 10 minute leakage : 0 cc 0.0 cc/min
22 bar 10 minute leakage : 25.0 cc 2.5 cc/min


KLINGER GASKET TEST : 16/12/87
TYPE 4430
TEMP (DegC)
650
600
550
500
450
400
350
300
250
200
150
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
55.0
60.0
65.0
70.0
TIME (min)
UPSTREAM

4. GENERAL OBSERVATIONS ON TEST

4.1 Test 1

A drop in temperature after 35 minutes occurred when the burners were switched off due to insufficient air input to the furnace. The remainder of the test was carried out with the furnace door open.

The downstream flange did not reach 600 deg. C. because all three burners were directed at the upstream flange. The furnace was modified for subsequent tests.

Although some pressure pulsations occurred the pressure was maintained at 2.1 bar ± 0.1 bar. Short flames were observed from around the flange, primarily over the 11 o'clock to 1 o'clock positions. Flame length was estimated at a maximum of 2 inches. For the last 5 minutes of the test a flame was observed at the 8 o'clock position. Some of the flames appeared to be due to ignition of kerosene vapour convecting to the top of the flange.

The gasket appeared to be cracked at one point on its surface (8 o'clock position)

4.2 Test 2

As stated in the results, the flanges and stud bolts were replaced with 316 stainless steel.

The temperatures of the flangaes remained fairly constant over the 30 minute period however the downstream flange temperature dropped to 592 deg. C.

During the warm-up period, flames between 2 and 3 inches long appeared around the flanges between the 10 and 2 o'clock positions These largely disappeared during the 30 minute test period.

On removal the gasket was retrieved in one piece; however, it was cracked at two points across its surface where stud bolts had rubbed.

4.3 Test 3

During this test the gasket again leaked during the warm-up period but this stopped during the test period. However, when the burners were adjusted during this time, leakage was observed around all of the circumference. This ceased when the temperature stabilised.

In this case no leakage was measured during the hydro test. However, on removal, the gasket was found to be fragmented and extremely brittle.

5. CONCLUSIONS

The type 4430 gaskets did not seem to have suffered as much as the type 4210 material. However, during the test of the type 4210 gasket (test 3) the temperatures were higher.

Flames were observed during the heating periods and during the test periods when the burners were adjusted. These appeared to be due to thermal expansion of the flange studs and flanges.

During the test period when the temperature was steady or varying slowly, no flames were observed. Although the type 4210 gasket was affected more by the high temperature than the type 4430 gasket material, it did not show any measurable leakage during the hydro test. However, the lower face of the downstream flange became wet to touch.

Cracking of the gaskets appeared to be due to impingement of the stud bolts during installation.

The amount of leakage past the type 4210 gasket under high temperatures appears to be due primarily to the response of the flange material and stud bolts. If the temperatures are steady and uniform, no leakage occurs.

The performance of the gaskets when in use with actual valves will depend primarily on the type, specification and torques used on the connecting stud bolts and flanges.

Signed: ..... Project Engineers: A Richardson

..... A Greener

Signed: ..... Site Manager: R Stephenson