

SHELL EO/EG PROCESS MEMORANDUM 106

SUBJECT : REACTOR TEMPERATURE INSTRUMENTATION

DATE OF ISSUE : MAY 2005

INTRODUCTION

It is essential that for good reaction performance the temperatures along the catalyst bed in the reactor tubes are known.

Engineering studies and actual operating experience were used in the development of recommendations for installation of temperature instruments.



DISCUSSION

Each water cooled EO reactor is provided with 6 catalyst-filled thermowell tubes and 3 coolant thermowells. Each of the coolant thermowells is located in a reactor tube that is perforated to allow entry of reactor coolant such that the coolant temperature will be measured directly. This coolant thermowell tube extends to the head of the reactor as shown in the drawings of the EO Reactor provided with the data sheets. The location of thermocouples for the catalyst-filled tubes should be selected to minimize differences in mass flow and heat flux between tubes containing thermocouples and tubes without thermocouples in order to permit meaningful and representative measurements.

The reactor thermocouple details are shown in the attached drawings 1,2 and 3.

Ease of charging and removing of the catalyst is to be observed in the selection of the type of thermocouples that will be installed.

Operating temperature information must be graphically displayed. The DCS system must:

1. Show all temperatures on a level by level basis, highlighting the minimum and maximum temperatures. The screen should display in a corner the minimum, average and maximum temperatures.
2. Using average temperatures for both the coolant and catalyst side, display a smooth temperature profile as a function of reactor tube length. At the points of reference, the minimum, maximum and average temperature should be displayed.
3. Display the temperature difference, on a proper scale, between the process and coolant side as a smooth curve along the length of the reactor. The numerical value at the peak point should be displayed along with the tube length where it occurs. This latter numerical display should also appear as part of display 2.



1. Number of thermocouples in the reactor:

Catalyst Bed	5 thermocouples in each of 6 catalyst tubes (3 of type A, 3 of type B) The catalyst thermowells will go through one nozzle in the reactor head.
Coolant	5 thermocouples in each of 3 perforated tubes. Coolant tubes must be sealed from the process side. One nozzle in the reactor head for each coolant thermowell is required.

In total 45 ($6 \times 5 + 3 \times 5$) temperature points are present per reactor, 30 of which (including all coolant thermocouples and type B catalyst thermocouples) will be recorded directly within the DCS.

The remaining 15 type A catalyst thermocouples will be connected directly as the trip initiator for the oxygen shut down system. The oxygen shut down system shall be activated when 2 out of 3 catalyst tubes have reached the trip temperature at some height in the catalyst bed.

From the oxygen shut down system the temperature of the 15 type A catalyst thermocouples shall be sent to the DCS for indication purposes using the communication link between the systems.

2. Thermocouple locations are shown on the EO reactor drawings with the EO reactor data sheet. Thermocouple heights, distance below top of top sheet in meters:

<u>Type A (3)</u>	<u>Type B (3)</u>	<u>Coolant Tubes (3)</u>
1.50	2.50	1.50
3.75	4.75	3.75
6.00	7.00	6.00
8.25	9.25	8.25
10.50	11.50	10.50



3. For location of other reactor temperature alarms and shutdown devices refer also to the process flow diagram.
 - a. Two reactor inlet thermocouples for the inlet TZA(HH) should be located in the inlet pipe, close to the head of the reactor.
 - b. One thermocouple for the inlet TIA(H) should be located directly in the top head approximately 30 cm from both the wall and tube sheet.
 - c. Two reactor exit thermocouples for the outlet TZA(HH) should be located in the exit pipe, close to the primary product cooler.
4. Chromel/Alumel thermocouples are suitable for the measurement of the temperatures in the catalyst tubes as well as in the coolant tubes. Use of resistance elements instead of thermocouples might be considered in view of increased accuracy and repeatability. It is recommended that the thermocouples are thin and bendable for ease of handling. For all the thermowells, the preferred material of construction is chloride resistant Inconel.
5. The thermowells in the reactor top head are to be tied to each other and supported to minimise vibration and possible damage.
6. Recommended manufacturers of EO - reactor thermowells and thermocouples are:
 1. Thermo-Electra,
Wetering weg 10,
PO Box 73,
2640 AB Pijnacker,
The Netherlands.
Tel +31 15 362 1200
Fax +31 15 369 4082
 2. Thermo-Electric Europe
Breguetlaan 53,
P.O. Box 292,
1430 AG Aalsmeer,
The Netherlands.
Tel +31 20 454 6000
Fax +31 20 454 6001



3. Japan Thermowell Co. Ltd.,
No. 104, Yaraicho, Shinjuku-ku,
Tokyo, Japan.
4. Okazaki Manufacturing Company,
1-3 Gokodori 3-chome
Chuo-ku, Kobe 651, Japan
5. RODAX N.V.
Karel Van Overmeirelaan 21-23
B-2100 Antwerpen, Belgium
Tel +32 3 360 90 00
Fax +32 3 326 44 74







