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An Evaluation of Loop Current Step Response Time Testing Equipment for Thermocouples

150

Plunge
Plunge
(Thermocouple)
LCSR(Loop Current Step
Response)
가
가
가
가
가
가

Abstract

In process instrumentation systems of such as nuclear plants, response time information is very important in most temperature transient measurements. Generally the response time of thermocouples is measured at a laboratory by using a plunge method. However, it is not easy to use the plunge testing method when a response time measurement of an installed thermocouple is required. A measurement system was developed to measure the response time of a thermocouple installed in a process by using the Loop Current Step Response(LCSR) testing method. This device heats a thermocouple by providing an electrical current, and then it measures the thermocouple output as the temperature of the thermocouple measurement junction returns to ambient temperature. The time constant of the thermocouple is determined from the transient curve of the thermocouple output indicating the temperature difference between the reference junction and measurement junction of the thermocouple. The device is designed to heat a middle point to reduce the temperature error caused by residual heat of thermocouple wire

1.

(Thermocouple)가
가
RTD(Resistance Temperature Detector)
[1-4].
가 Thermocouple

가 가 가

가 Thermocouple 가 Thermocouple [1,5]. Plunge 가

가 Thermocouple (LCSR : Loop Current Step Response)[1, 6-8] Transient 가 Plunge

Thermocouple LCSR Thermocouple LCSR 가

Thermocouple (Reference Junction) 가 Thermocouple 가 Thermocouple

2. 가

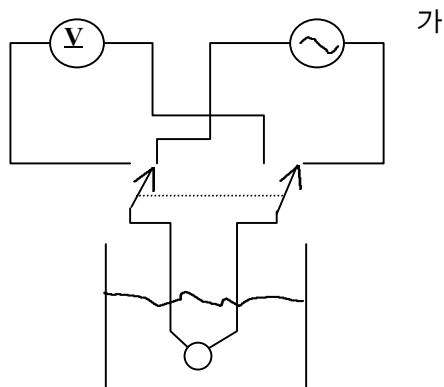
LCSR 가 (Measurement Junction)

가

가

가

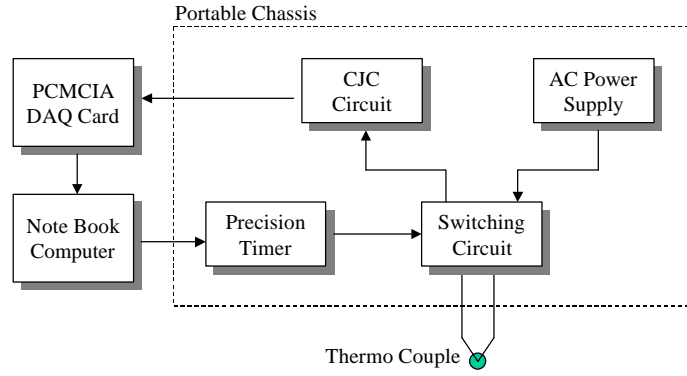
가



1. LCSR Thermocouple

2.1.

, Transformer , PCMCIA Data Acquisition Interface Card, Notebook Computer, ,



2.

2.2. 가
가
Junction

(Residual Heat) Measurement Junction
(Reference Junction) Reference

가

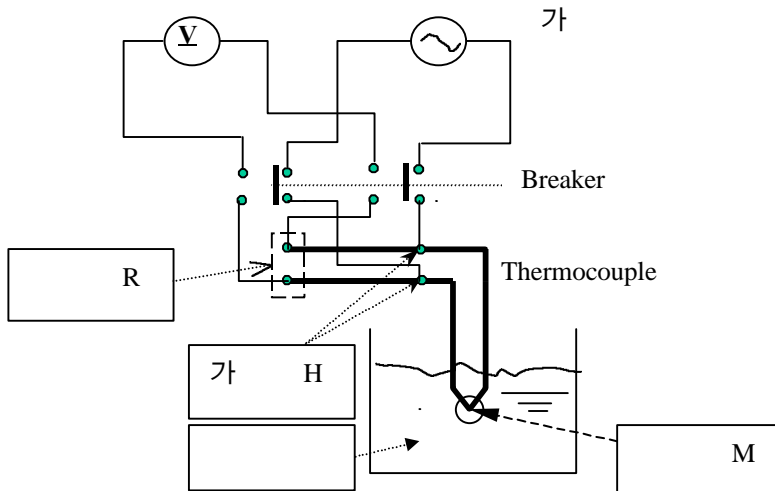
가

4

(Middle Point) 가

가 가

가 , 가



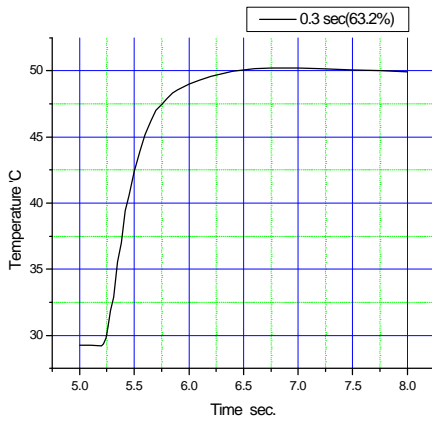
3. LCSR

3.

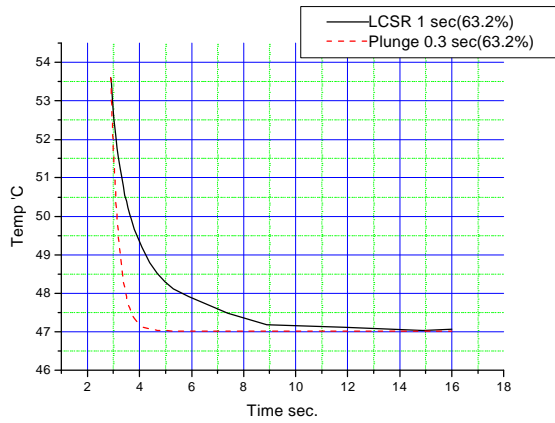
가 (LCSR) (Thermocouple) OMEGA Engineering
 K-type (Ungrounded)[2] Thermocouple ()
 LCSR Plunge
 Thermocouple LCSR Plunge
 LCSR

3.1. (Fast Thermocouple) (0.16cm(1/16"))

Thermo-well 가 Thermocouple
 Thermocouple Plunge 가 가 가 4
 63.2% 0.3 3 Step



4. Plunge



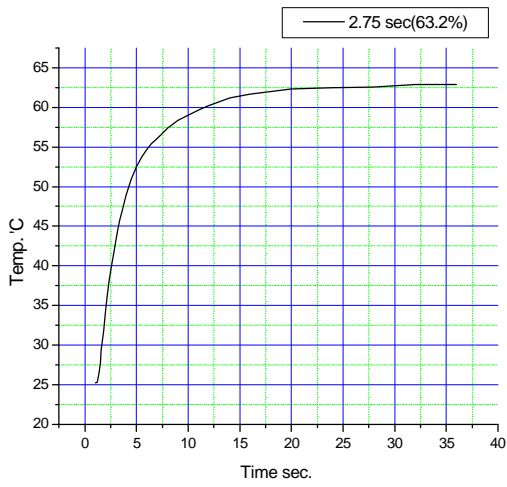
5. LCSR

5 LCSR Plunge

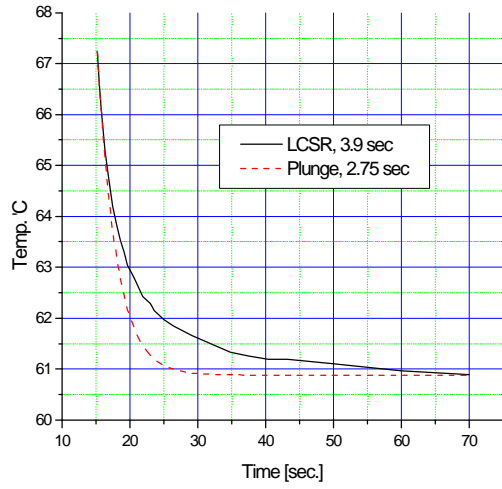
Plunge 가 Scale 5
 Plunge 가 1 가 가 4 5
 가 가 가 가 가 ()
 가 Loop, Thermocouple 가 가 5

3.2. (0.47cm(3/16"))

6 7 (0.47cm) Plunge LCSR
 Step 63.2%
 Plunge 2.75 , LCSR 3.9



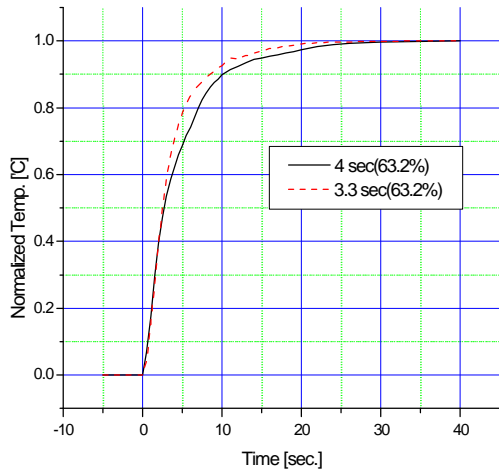
6. Plunge



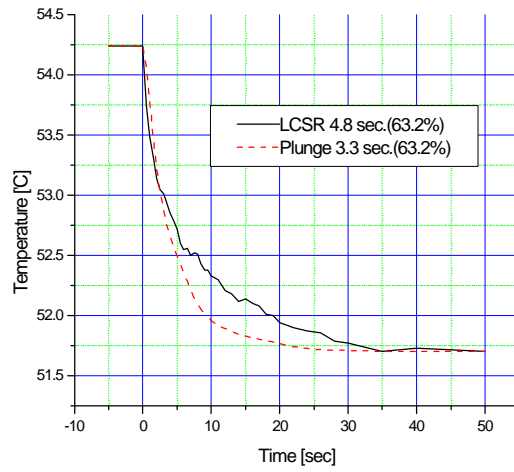
7. LCSR

3.3. (0.65cm(1/4")) 가

8 Thermocouple Plunge 가



8. Plunge



9. 가

9 Plunge

4. 가
 Thermocouple LCSR
 LCSR 가 가 가 RTD
 (Reference Junction) 가 2 [7]. 가
 가 , Thermocouple
 Relay Thermocouple
 Type,) 가 . Thermocouple (K, J, E-
 가

4.1. Thermocouple ()Reference Junction
 (Thermocouple) LCSR
 가 (Measurement Junction) Thermocouple
 Wire 가 가 가 (Reference
 Junction) 가 가 가
 가 가 3
 가 가

4.2. Peltier Tomson
 Joule
 Peltier 가 가 가
 가 가 가
 Joule [7].

4.3. Magnetic
 가 Thermocouple 가 Magnetic Effect 가
 Magnetic 50 msec. , Alumel 60' C
 [7].

4.4.
 LCSR , Connector, Relay Loop
 (Inhomogeneity) 가
 가

4.5.
 Loop 가 가
 가 Thermocouple 가
 Steady-State 가 Drift

5. LCSR

2.2 가 LCSR Thermocouple Reference Junction 가 Thermocouple Wire Connector Inhomogeneity factor 가 Plunge LCSR Plunge 가 (Saturation Point) 63.2% Plunge 4 1. ()

Thermocouple				
		Plunge	LCSR ()	LCSR(4)
(1/16 , OMEGA Co.US)	K-type	0.3	1	0.7
(3/16 , OMEAG Co. US)	K-Type	2.75	3.9	3.3
((1/4 , OMAGA Co. US)	K-type	3 - 4.	5.5	4.9
T/C 1 (1)	K-type	10.9	6.1	5.6
T/C 2 (,))	K-Type	11.3	11.9	11.25
T/C3 ()	K-Type	3.7	6.3 , 6	5.6 , 5.5

6. LCSR

6.1. (Limited Application) LCSR Thermocouple RTD 가 Thermocouple Plunge 가 Thermocouple 가 Plunge 가

6.2. 가 (reference junction) 가 Thermocouple 가
 , 가 (Heating Point) 가 Wire 가
 가 가 가 가

6.3. Thermocouple Thermocouple 가 가 가
 가 가 가 가 가 가
 가 가 가 가 (1 1) 가
 가 가 가 가 LCSR 가

6.4. Plunge Thermocouple , LCSR
 가 LCSR , Thermocouple
 (Reversed Connection), [6].

6.5. 가 가 1-2
 Noise 가 가

6.6. Data Base LCSR Thermocouple data

7. Thermocouple LCSR 가
 가 Plunge LCSR 가
 Plunge Thermocouple ,
 Plunge

Acknowledgement

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