

INTRODUCTION

The EXAOXY Series ZA8 In-Situ Type Zirconia Oxygen Analyzer Averaging Converter System performs multipoint oxygen concentration measurement in large-scale boiler and industrial furnace flues for combustion control optimization.

In this system, up to four or eight detectors are connected to a single AV8C averaging converter. Various other accessories may also be employed in order to obtain optimal measurements.

When the various devices that comprise this system are delivered to you, be sure to exercise care in their use to avoid impairing performance.

1. Cautions

This section describes general cautions that you should observe concerning the use of the averaging converter and detectors.

Notes and cautions relating specifically to installation, wiring and piping, operation and maintenance are described in the relevant sections of this manual.

[Averaging Converter]

- **Never touch the converter when carrying a static electrical charge.**

When humidity is low, your body can be carrying an especially large static charge. Before touching any of the converter's electronic circuits, always touch a grounded metal object first to discharge static electricity.

- **Never use an organic solvent to remove dirt.**

Organic solvents can discolor or cause deterioration of the materials. Use a neutral detergent or anhydrous alcohol to clean hard-to-remove dirt.

- **Never store in locations at high temperature or humidity.**

The converter should be used indoors at an ambient temperature of -5 to 50°C and humidity of 10% to 90% RH. Also avoid storing it in locations at high temperatures or high humidity.

The permissible storage temperature range is -20 to 75°C .

[Detectors]

- **Avoid subjecting the detector to mechanical shock.**

The zirconia used in the detectors is a kind of ceramic, and is fragile. Never subject the detectors to mechanical shock. Take extreme care when unpacking and transporting the detectors.

2. Contents of This Manual

The EXAOXY Series ZA8 In-Situ Type Zirconia Oxygen Analyzer Averaging Converter System has been developed for combustion control. This analyzer basically consists of a detector and a converter. The detector comes in one of four styles which can be selected based upon your application.

Optional accessories are also available to improve measurements and automate calibration. An optimal control system can be realized if the proper types of equipment are selected.

This instruction manual refers to almost all of the equipment related to the ZA8. You may skip the sections on the equipment which is not included in your system.

Product Line Included in This Manual and Described Content for Each

Model	Name	Description in the Manual				
		Specifi- cations	Install- ation	Opera- tion	Mainte- nance	CMPL
AV8C	Averaging Converter	○	○	○	○	○
—	Case for Outdoor Installation	○	○			
ZO21D-L	General Purpose Detector (Standard type)	○	○	○	○	○
ZO21DW-L	General Purpose Detector (Pressure balance type)	○	○	○	○	○
ZO21D-H	High-temperature Detector	○	○	○	○	○
ZO21V	Probe Supporter	○	○			
ZO21R-L	Probe Protector	○	○			
ZO21P-H	High-temperature Pprobe Adapter	○	○			○
—	High-temperature Auxiliary Ejector (Part No.: E7046EC, E7046EN-A0)	○	○			○
—	Dust Elimination Filter (Part No.: E7042UQ)	○	○		○	
AV8E	Manual Calibration Flow Setting Unit	○	○	○		
AV8F	Automatic Calibration Flow Setting Unit	○	○	○		
AV8H	Reference Gas Flow Setting Unit	○	○	○		
—	Calibration Gas Unit Case (Part No.: E7044KF)	○	○			

This manual is divided into twelve chapters as follows :

Chapter	Contents	Work Item		
		Installation	Operation	Maintenance
1. General	Gives examples of system configuration.	○	△	○
2. Specifications	Shows external views of equipment together with standard specifications and model codes or part numbers.	◎	○	○
3. Installation	Illustrates installation procedure for each type of equipment.	◎		△
4. Piping	Provides piping diagrams for four standard system configurations.	◎		△
5. Wiring	Wiring principles are explained according to the application.	◎		△
6. Names and Functions of Components	Describes the main components of the system.	△	○	○
7. Operation	Describes the operating procedure.		◎	△
8. Converter Key Operation	Details the converter key operation.		○	△
9. Calibration	Describes the calibration procedure required in the course of operation.		○	△
10. Check and Maintenance	Items to be checked are listed along with a description of the replacement procedure for damaged parts.		○	◎
11. Troubleshooting	This chapter describes measures to be taken when an abnormal condition occurs.		△	◎
CMPL (Parts List)	A list of replacement parts is given for each type of equipment.		△	○

◎ : Items which should be read through before starting operation.

○ : Items which should be read before operation and during operation as required.

△ : Items to be read as required.

CONTENTS

1. OVERVIEW	1-1
1.1 System Configuration Examples	1-1
1.1.1 System Configuration Example Using Flow Setting Units for Manual Calibration	1-2
1.1.2 System Configuration Example Using Flow Setting Units for Automatic Calibration	1-3
1.2 System Components	1-4
1.2.1 Device Types and Systems in Which Applicable	1-4
1.2.2 Detectors and Accessories	1-5
 2. SPECIFICATIONS	 2-1
2.1 General Specifications	2-1
2.1.1 Standard Specifications	2-1
2.1.2 Features	2-1
2.2 Standard Detector and Related Equipment	2-2
2.2.1 ZO21D-L Standard Detector	2-2
2.2.2 ZO21DW-L Standard Detector (Pressure Balance Type)	2-5
2.2.3 ZO21V Probe Supporter	2-8
2.2.4 ZO21R-L Probe Protector	2-10
2.3 High-Temperature Detector and Related Equipment	2-12
2.3.1 ZO21D-H High-Temperature Detector	2-12
2.3.2 ZO21P-H Adapter for the High-Temperature Probe	2-14
2.4 AV8C-□ Averaging Converter	2-16
2.5 Flow Setting Units	2-24
2.5.1 AV8E Manual Calibration Flow Setting Unit	2-24
2.5.2 AV8F Automatic Calibration Flow Setting Unit	2-26
2.5.3 AV8H Reference Gas Flow Setting Unit	2-28
2.6 Other Equipment	2-30
2.6.1 Dust Filter for the Detector (Part No.: E7042UQ)	2-30
2.6.2 Auxiliary Ejector for High-Temperature Use (Part No.: E7046EC or E7046EN-A0)	2-31
2.6.3 Needle (Stop) Valve (Part No.: G7011XH or G7013XH)	2-33
2.6.4 Solenoid Valve (Part No.: E7057G□ or G700□XP)	2-34
2.6.5 Air Set (Part No.: G7011XF or E7040EL)	2-35
2.6.6 Zero Gas Cylinder (Part No.: G7001ZC)	2-36
2.6.7 Cylinder Regulator Valve (Part No.: G7013XF or G7014XF)	2-36
2.6.8 Calibration Gas Unit Case (Part No.: E7044KF)	2-37
 3. INSTALLATION	 3-1
3.1 Installation of the Standard Detector	3-1
3.1.1 Installation Site	3-1
3.1.2 Probe Insertion Hole Fabrication	3-1
3.1.3 Detector Installation	3-2
3.1.4 Dust Filter Installation	3-4
3.2 Installation of the High-Temperature Detector	3-5
3.2.1 Installation Site	3-5

3.2.2	Probe Insertion Hole	3-5
3.2.3	Mounting the High-Temperature Detector	3-6
3.3	Averaging Converter Installation	3-7
3.3.1	Installation Location	3-7
3.3.2	Installing in Instrument Panel	3-7
3.3.3	Outdoor Installation	3-9
3.4	Flow Setting Unit Installation	3-10
3.4.1	Installation Location	3-10
3.4.2	Flow Setting Unit Installation	3-10
3.5	Installation of the Calibration Gas Unit Case	3-13
3.5.1	Installation Site	3-13
3.5.2	Mounting	3-13
4.	PIPING	4-1
4.1	Piping for System Using Manual Calibration Flow Setting Units	4-1
4.1.1	Piping Parts for a System that Uses Manual Calibration Flow Setting Units	4-2
4.1.2	Calibration Gas Piping	4-3
4.1.3	Reference Gas Piping	4-3
4.1.4	Piping to the High-Temperature Probe Adapter	4-4
4.1.5	Blowback Piping Installation	4-6
4.2	Piping for System Using Manual Calibration Flow Setting Units	4-7
4.2.1	Piping Parts for a System that Uses Automatic Calibration Flow Setting Units	4-8
4.2.2	Calibration Gas Piping	4-9
4.2.3	Reference Gas Piping	4-9
4.2.4	High Temperature Probe Adapter Piping	4-9
4.2.5	Blowback Piping Installation	4-10
4.2.6	Piping for Special Applications	4-10
4.3	Air Purge Piping in the Automatic Calibration Flow Setting Unit	4-11
4.3.1	Air Purge Air Source	4-11
4.3.2	Piping	4-11
5.	WIRING	5-1
5.1	General	5-1
5.1.1	Notes and Cautions to Be Observed During Wiring	5-1
5.1.2	Averaging Converter External Wiring Connection Terminals	5-2
5.1.3	Countering Noise	5-4
5.1.4	Wiring Material Specifications	5-7
5.1.5	Terminal Boards on the Averaging Converter	5-9
5.1.5	Types of Wiring (Subsystems)	5-10
5.2	Detector Output Wiring	5-11
5.2.1	Cable Specifications	5-11
5.2.2	Connections to the Detector	5-12
5.2.3	Connections to the Averaging Converter	5-12
5.3	Detector Heater Power Wiring	5-13
5.3.1	Cable Specifications	5-13
5.3.2	Connections to the Detector	5-14

5.3.3	Connections to the Averaging Converter	5-14
5.4	Analog Output Wiring	5-15
5.4.1	Cable Specifications	5-15
5.4.2	Wiring	5-15
5.5	Power and Ground Wiring	5-16
5.5.1	Power Wiring	5-16
5.5.2	Ground Wiring	5-16
5.6	Contact Output Wiring for Selectable Functions	5-17
5.6.1	Cable Specifications	5-17
5.6.2	Wiring	5-17
5.7	Solenoid Valve Contact Output Wiring (Optional)	5-18
5.7.1	Cable Specifications	5-18
5.7.2	Wiring	5-19
5.8	Contact Input Wiring	5-19
5.8.1	Cable Specifications	5-19
5.8.2	Wiring	5-19
5.9	Digital Communications Wiring	5-20
5.9.1	RS-422-A or RS-485 Communications Cable Wiring	5-20
5.9.2	Communications Specifications of the Averaging Converter	5-21
5.9.3	Command Types	5-24
5.9.4	Operation Command Data Structures	5-25
5.9.5	Data Structures of Data Read Commands	5-30
5.9.6	Communication Error Codes	5-37
6.	NAMES AND FUNCTIONS OF COMPONENTS	6-1
6.1	Detector	6-1
6.1.1	General-Purpose Detector (Standard)	6-1
6.1.2	General-Purpose Detector (Pressure Balance)	6-2
6.2	Averaging Converter	6-3
6.3	Calibration Flow Setting Unit	6-4
6.4	Reference Gas Flow Setting Unit	6-5
7.	OPERATION	7-1
7.1	Startup	7-1
7.1.1	Inspecting Installation	7-1
7.1.2	Inspecting Piping and Wiring	7-2
7.1.3	Valve Settings	7-2
7.1.4	Supplying Power to the Averaging Converter	7-2
7.1.5	Warmup	7-3
7.1.6	Parameter Data Entry (Parameters cannot be set unless the password "77" is input.)	7-3
7.1.7	Calibration	7-21
7.1.8	Checking Function Operations	7-23
7.2	Normal Operation	7-24
7.2.1	Acquiring Management Data	7-24
7.2.2	Troubleshooting	7-24
7.2.3	Checking Operating Conditions	7-25
7.2.4	Stopping and Restarting Operation	7-26

8. OPERATION KEYS AND DISPLAYS	8-1
8.1 Operation Keys	8-1
8.1.1 Types and Functions of Operation Keys	8-1
8.1.2 Operation Key Applications	8-2
8.2 Displays	8-8
8.2.1 Status Display	8-8
8.2.2 Channel Display	8-8
8.2.3 Data Display	8-9
8.2.4 Message Display	8-9
9. CALIBRATION	9-1
9.1 General	9-1
9.1.1 Principles of the Zirconia Oxygen Analyzer	9-1
9.1.2 Calibration Gas	9-2
9.1.3 Compensation	9-2
9.1.4 Characteristic Data from a Sensor Measured During Calibration	9-4
9.2 Calibration Procedures	9-5
9.2.1 Automatic Calibration	9-5
9.2.2 Semi-Automatic Calibration	9-7
9.2.3 One-Touch Calibration	9-9
9.3 Indication Check	9-12
9.3.1 Automatic Indication Check	9-13
9.3.2 Semi-Automatic Indication Check	9-14
9.3.3 One-Touch Indication Check	9-15
9.4 Operating the Valves of the AV8E Manual Calibration Flow Setting Unit	9-17
9.4.1 Preparing for Calibration	9-17
9.4.2 Span Gas Valve Operations	9-17
9.4.3 Zero Gas Valve Operations	9-18
9.4.4 Actions to Take When Calibration (Or Indication Check) Is Completed	9-18
10. INSPECTION AND MAINTENANCE	10-1
10.1 Inspection and Maintenance of the Detector	10-1
10.1.1 Precautions for Inspecting the Detector	10-1
10.1.2 Cleaning the Filter in the Sensor Assembly	10-1
10.1.3 Cleaning the Calibration Gas Tube	10-1
10.1.4 Replacing the Sensor Assembly	10-2
10.1.5 Cleaning the High-Temperature Probe Adapter	10-3
10.2 Inspection and Maintenance of the Averaging Converter	10-4
10.2.1 Periodic Inspection and Maintenance	10-4
10.2.2 Fuse Replacement	10-4
10.2.3 Replacing the Message Display	10-4

11. TROUBLESHOOTING	11-1
11.1 What to Do When an Error Code Is Displayed	11-1
11.1.1 Error Code Types	11-1
11.1.2 Causes of "E--1 Sensor (Cell) Failure", and Recovery Procedures	11-3
11.1.3 Causes of "E--2 Sensor Temperature Error (Low)" and Procedure for Restoration	11-4
11.1.4 Causes of "E--3 Sensor Temperature Error (High)", and Recovery Procedures	11-5
11.1.5 Causes of "E--4 A/D (Analog Circuit) Failure" and Procedure for Restoration	11-7
11.1.6 Causes of "E--5 Calibration Value Error (Zero)" and Procedure for Restoration	11-7
11.1.7 Causes of "E--6 Calibration Value Error (Span)" and Procedure for Restoration	11-8
11.1.8 Causes of "E--7 EMF Stabilization Time Over" and Procedure for Restoration	11-9
11.1.9 Causes of "E--8 ROM and RAM Failure" and Procedure for Restoration	11-9
11.1.10 Causes of Display Disappearance (Data Display) and Procedure for Restoration	11-10
11.2 Measures When Measured Value Shows an Error	11-11
11.2.1 Measured Value Higher Than True Value	11-11
11.2.2 Measured Value Lower Than True Value	11-12
11.2.3 Measured Value Sometimes Show Abnormal Values	11-12

1. OVERVIEW

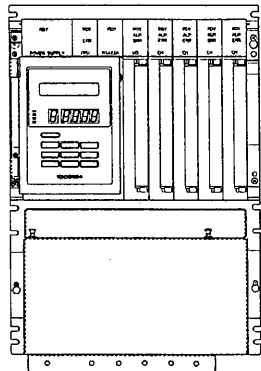
To improve combustion efficiency in large-scale electric power boilers and industrial boilers and furnaces (black liquor recovery boilers, petroleum refinery and iron and steel plant fired heaters, lime kilns, etc.) requires accurate and effective measurement of oxygen concentration in the flue gas. Since the oxygen concentration in a large boiler or industrial furnace flue may differ across the gas flow cross-section, measurements must be made at multiple points.

The best instrument in these applications is the EXAOXY Series ZA8 In-Situ Type Zirconia Oxygen Analyzer Averaging Converter System.

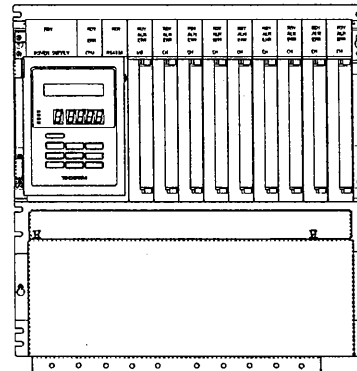
In a ZA8 In-Situ Type Zirconia Oxygen Analyzer Averaging Converter System, up to four or eight detectors can be connected to a single converter, enabling oxygen concentration to be obtained at multiple measurement points and averaged across those points.

This enables highly reliable low-O₂ combustion control with a minimum of equipment.

This section gives an overview of the system configuration, and discusses the specifications of various component devices.



AV8C-A, AV8C-C (4 channels)



AV8C-B, AV8C-D (8 channels)

Figure 1.1 Averaging Converter External Views

