IEC/TR 61831

Edition 2.0 2011-08

# TECHNICAL REPORT

## On-line analyser systems – Guide to design and installation

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE XB

ICS 13.040; 13.060; 17.020

ISBN 978-2-88912-633-0

® Registered trademark of the International Electrotechnical Commission

# CONTENTS

FOREWORD ..... 5
INTRODUCTION ..... 7
1 Scope ..... 8
2 Normative references ..... 8
3 Terms and definitions ..... 8
4 Remarks and considerations ..... 9
4.1 General remarks ..... 9
4.2 Further considerations ..... 9
4.3 Reliability ..... 10
4.4 Design ..... 10
4.5 Centralisation ..... 10
4.6 Local mounting ..... 10
4.7 Pre-assembled systems ..... 10
5 Health, safety and environmental considerations ..... 11
5.1 Overview ..... 11
5.2 Prevention of explosions and fires ..... 11
5.3 Prevention of toxic and asphyxiant hazards ..... 11
5.4 Radiation hazards ..... 12
5.5 Safety facilities ..... 12
5.6 Manual shut-down facilities ..... 12
5.7 Noise ..... 12
6 Housings ..... 12
6.1 Overview ..... 12
6.2 Selection of housing ..... 13
6.2.1 Analyser case ..... 13
6.2.2 Analyser cabinet ..... 13
6.2.3 Analyser shelter ..... 13
6.2.4 Analyser house ..... 14
6.3 Area classification and toxic danger ..... 14
6.3.1 Electrical area classification ..... 14
6.3.2 Toxic and asphyxiate danger ..... 14
6.4 Construction and mounting ..... 14
6.4.1 General ..... 14
6.4.2 Analyser housings ..... 15
6.4.3 Analyser houses ..... 15
6.4.4 Analyser shelters ..... 15
6.5 Analyser housings with natural ventilation ..... 16
6.5.1 General ..... 16
6.5.2 Ventilation requirements ..... 16
6.5.3 Heating requirements ..... 16
6.5.4 Analyser shelters ..... 17
6.5.5 Analyser cases ..... 17
6.6 Analyser housings with forced ventilation ..... 17
6.6.1 General ..... 17
6.6.2 Ventilation requirements ..... 17
6.6.3 Air intake system ..... 17

6.6.4 Ventilation fan requirements ..... 17
6.6.5 Airflow requirements ..... 18
6.6.6 Heating requirements ..... 18
6.6.7 Safety monitors and alarms ..... 18
7 Sampling systems ..... 21
7.1 Overview ..... 21
7.2 Sample system terminology ..... 22
7.3 General requirements ..... 22
7.4 Sample point location ..... 23
7.5 Fast circulating systems (fast loops) ..... 24
7.6 By-pass systems ..... 24
7.7 Sample recovery systems ..... 24
7.8 Special considerations ..... 25
7.9 Multi-stream systems ..... 25
7.10 Construction ..... 26
7.10.1 General ..... 26
7.10.2 Material selection ..... 26
7.10.3 Flushing facilities ..... 27
7.10.4 Blockage removal ..... 27
7.10.5 Heat tracing and insulation ..... 27
7.10.6 Minimising risks from leakage ..... 28
7.10.7 Location of equipment ..... 28
7.10.8 Instrumentation ..... 28
7.10.9 Identification ..... 28
7.11 Effluent disposal ..... 29
7.11.1 General ..... 29
7.11.2 Vapour ..... 29
7.11.3 Liquid ..... 29
7.12 Calibration facilities ..... 30
7.13 Automatic calibration ..... 30
8 Analyser communications ..... 31
8.1 Overview ..... 31
8.2 Signal transmission ..... 31
8.3 Safety ..... 32
8.4 Cables ..... 33
8.5 Use of signal ..... 33
8.6 Alarms ..... 33
Annex A (informative) Typical analyser process line sampling probe for line sizes NPS 2" and above ..... 34
Annex B (informative) Determination of sample probe lengths ..... 35
Annex C (informative) Sample system calculations ..... 43
Annex D (informative) Natural ventilation calculations ..... 56
Annex E (informative) Forced ventilation calculations ..... 62
Annex F (informative) Example of verification/calibration sequence of data to computer ..... 63
Annex G (informative) Analyser house with forced ventilation – Summary of recommended control shut-down actions for flammable hazard operation ..... 64

Annex H (informative) Analyser houses with forced ventilation – Ventilation failure and flammable gas detection trip logic ..... 65
Annex I (informative) Typical analyser system schematics ..... 67
Annex J (informative) Example schematic showing a typical wall penetration using a transit ..... 69
Bibliography ..... 70

Figure A.1 – Typical analyser sample probe design ..... 34
Figure C.1 – Sample system configuration ..... 49
Figure D.1 – Schematic showing wind induced free ventilation principles with worked example ventilation louvre layout and suggested warm air distribution ..... 56
Figure F.1 – Typical signal sequence during verification ..... 63
Figure H.1 – Typical analyser shelter logic diagram ..... 66
Figure I.1 – Multi-stream sampling for processes of similar pressure and components (e.g. atmospheric sampling) ..... 67
Figure I.2 – Multi-stream sampling for processes of differing pressure and/or components showing typical double block and bleed arrangement ..... 67
Figure I.3 – Minimum pollution sampling configuration ..... 68
Figure I.4 – Typical double block and bleed arrangement ..... 68
Figure J.1 – Typical wall penetration using a transit ..... 69

Table B.1 – Vibrational Mode Constants ..... 36
Table B.2 – Example calculations for maximum fluid velocity ..... 40
Table C.1 – Nomenclature Used In Calculations ..... 43
Table C.2 – Equivalent lengths of valves and fittings ..... 46
Table C.3 – Sample system component pressure drop allowances ..... 48
Table G.1 – Shelter safety cause and effect matrix ..... 64

INTERNATIONAL ELECTROTECHNICAL COMMISSION

# ON-LINE ANALYSER SYSTEMS – GUIDE TO DESIGN AND INSTALLATION

## FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC 61831, which is a technical report, has been prepared by subcommittee 65B: Devices and integration in enterprise systems, of IEC technical committee 65: Industrial-process measurement, control and automation.

With the kind permission of the Engineering Equipment and Materials Users Association this report is based on and includes extracts from EEMUA Publication 138.

This second edition cancels and replaces the first edition published in 1999. This edition constitutes a technical revision.

The main changes with respect to the previous edition are listed below.

- Updated references;

- Made consistent with current practices and regulations;
- Incorporating new technologies where applicable.

The text of this technical report is based on the following documents:

| Enquiry draft | Report on voting |
|---|---|
| 65B/744/DTR | 65B/793/RVC |

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

# INTRODUCTION

This Technical Report provides guidance on the design and installation of on-line analyser systems. There are many International standards and documents which are referenced below relating to specific parts of the design and safety of on-line analyser systems. However, there is limited practical guidance available on the overall design concepts, approaches, tools and methodology for the design and installation of on-line analyser systems to ensure they perform with the required reliability and precision which this publication addresses.

The document is divided into eight clauses

1. General
2. Normative references
3. Terms and definitions
4. Remarks and considerations
5. Health, safety and environmental considerations
6. Housings
7. Sampling systems
8. Analyser communications

Individual users of on-line analysers have varying practices but the fundamental approach is generally similar. It is therefore hoped that this document will encourage standardisation within industry and lead to reduction in design and construction costs and to improved safety.

The word "analyser" has been used throughout this document to refer to instruments variously known as on-line analysers, process stream analysers, quality analysers, quality measuring instruments and process quality monitors.

Where reference is made to International standards it should be noted that National authorities may have statutory requirements that are mandatory.

# ON-LINE ANALYSER SYSTEMS – GUIDE TO DESIGN AND INSTALLATION

## 1 Scope

This technical report is a guide applicable to on-line analyser systems. It provides the necessary guidance for the system supplier and user to specify or design a complete analyser system from sample point in the process to the final output for display or control purposes.

## 2 Normative references

IEC 61285:2004, *Industrial-process control – Safety of analyzer houses*

ISO/IEC 8802-3:2000, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*

BS 5925:1991, *Code of practice for ventilation principles and designing for natural ventilation*

API (ANSI/ASTM D4177), *Manual of Petroleum Measurement Standards – Part 8: Chapter 8.2 Automatic Sampling of Petroleum Products ()*

EEMUA 175, *Code of Practice for Calibration and Checking Process Analysers (Formerly IP 340)*