SS 664 : 2020
(ICS 27.015; 71.100.20)

SINGAPORE STANDARD

Code of practice for long-term measurement of compressed air system energy efficiency

Singapore Standards Council

SS 664 : 2020
(ICS 27.015; 71.100.20)

SINGAPORE STANDARD

Code of practice for long-term measurement of compressed air system energy efficiency

Published by Enterprise Singapore

ISBN 978-981-49-2528-0

The content of this Singapore Standard was approved on 27 October 2020 by the Environment and Resources Standards Committee (ERSC) under the purview of the Singapore Standards Council.

First published, 2021

ERSC consists of the following members:

		Name	Representation
Chairman	:	Mr Wim Roels	*Individual Capacity*
Deputy Chairpersons	:	Mr Dalson Chung	*National Environment Agency*
		Ms Neo Gim Huay	*Individual Capacity*
Advisor	:	Prof Reginald Tan	*Individual Capacity*
Secretary	:	Ms Elane Ng	*Standards Development Organisation @ Singapore Chemical Industry Council*
Members	:	A/Prof Winston Chow	*Singapore Management University*
		Dr Adil Dhalla	*Nanyang Environment and Water Research Institute*
		Ms Kavita Gandhi	*Sustainable Energy Association of Singapore*
		Mr Michael Ho	*Waste Management and Recycling Association of Singapore*
		Mr Terence Koh	*Singapore Chemical Industry Council*
		Dr Karthik Kumar	*Agency for Science, Technology and Research*
		Mr Mikkel Larsen	*DBS Bank Ltd*
		Mr Lim Yeow Keong	*Sembcorp Utilities*
		Ms Marika Lindstrom	*Unilever Asia Ltd*
		Dr Pang Chee Meng	*PUB, the National Water Agency*
		Dr Thomas Reindl	*Solar Energy Research Institute of Singapore*
		Mr Steve Seah	*SP Group*
		Mr Dinesh Sharma	*Singapore Water Association*
		Mr Kenneth Sim	*Ministry of Sustainability and the Environment*
		Dr Victor Sim Siang Tze	*Surbana Jurong Consultants Pte Ltd*
		Ms Yvonne Soh	*Singapore Green Building Council*
		Mr Tan Li Khiam	*ExxonMobil Asia Pacific Pte Ltd*
		Ms Jen Teo Pui Heng	*Singapore Environment Council*
		Mr Toh Eng Shyan	*Building and Construction Authority*
		Ms Rose Tong	*Singapore Retailers Association*
		Mr Yap Ong Heng	*Ministry of Transport*
		Mr Simon Yeo	*Ernst and Young LLP*
		Mr Yeoh Choon Jin	*Enterprise Singapore*

ERSC set up the Technical Committee on Energy to oversee the preparation of this standard. The Technical Committee consists of the following members:

		Name	Representation
Chairman	:	Mr Norman Lee	*Individual Capacity*
Secretary	:	Mr Timothy Fong	*Enterprise Singapore*
Members	:	Assoc Prof Chai Kah Hin	*National University of Singapore*
		Er. Goh Chee Tiong	*National Environment Agency*
		Prof Ho Hiang Kwee	*National Climate Change Secretariat*
		Dr Lal Jayamaha	*LJ Energy Pte Ltd*
		Ms Lee Ham Eng	*Singapore Accreditation Council*
		Mr Lem Yang Lim	*Singapore Green Building Council*
		Er. Desmond Ng	*DNV GL*
		Mr Toh Eng Shyan	*Building and Construction Authority*
		Assoc Prof Wan Man Pun	*Nanyang Technological University*

The Technical Committee set up the Working Group on Long-term Measurement of Compressed Air System Energy Efficiency to prepare this standard. The Working Group consists of the following experts who contribute in their *individual capacity*:

		Name
Co-Convenors	:	Dr Lal Jayamaha
		Mr Roland Tan
Members	:	Mr Bijaya Jena
		Mr Dominador Catayas
		Mr Choong Chow Neng
		Mr Tim Chua
		Mr Goh Yoong Quan
		Mr Heng Cheng Li
		Dr Jahangeer K Abdul Halim
		Mr Lim Chi Nee
		Dr Md Raisul Islam
		Mr Remus Ong
		Mr Suresh Kumar
		Assoc Prof Wan Man Pun

The organisations in which the experts of the Working Group are involved are:

Atlas Copco (Southeast Asia) Pte Ltd
Emerson Automation Solutions
G-Energy Global Pte Ltd
Ingersoll Rand Singapore Enterprises Pte Ltd
MSD International GmbH
Nanyang Technological University

National Environment Agency
National University of Singapore
The Institution of Engineers, Singapore
Ronsor Engineering Pte Ltd

Contents

Foreword

This Singapore Standard was prepared by the Working Group on Long-term Measurement of Compressed Air System Energy Efficiency set up by the Technical Committee on Energy under the purview of ERSC.

The standard aims to promote a systematic approach in measuring the energy efficiency of compressed air systems. Establishing a standardised measurement methodology will encourage the adoption and development of more energy efficient industrial equipment and systems in Singapore.

In preparing this standard, reference was made to the following publications:

ISO 5725-1:1994	Accuracy (trueness and precision) of measurement methods and results – Part 1: General principles and definitions
ISO 11011:2013	Compressed air – Energy efficiency – Assessment
ISO 50001:2018	Energy management systems – Requirements with guidance for use
SS 591:2013	Code of practice for long term measurement of central chilled water system energy efficiency (incorporating Corrigendum No.1)

Permission has been sought from ISO to reproduce the definition for “Accuracy” from ISO 5725-1:1994, “Compressed air system” from ISO 11011:2013, and “Energy consumption” and “Energy performance” (without notes to entry) from ISO 50001:2018.

Acknowledgement is made for the use of information from the above publications.

This standard is expected to be used by industrial facilities with compressed air systems, contractors, energy services companies, equipment manufacturers and suppliers, and system designers.

Attention is drawn to the possibility that some of the elements of this Singapore Standard may be the subject of patent rights. Enterprise Singapore shall not be held responsible for identifying any or all of such patent rights.

NOTE

1. *Singapore Standards (SSs) and Technical References (TRs) are reviewed periodically to keep abreast of technical changes, technological developments and industry practices. The changes are documented through the issue of either amendments or revisions. Where SSs are deemed to be stable, i.e. no foreseeable changes in them, they will be classified as “Mature Standards”. Mature Standards will not be subject to further review, unless there are requests to review such standards.*

2. *An SS or TR is voluntary in nature except when it is made mandatory by a regulatory authority. It can also be cited in contracts making its application a business necessity. Users are advised to assess and determine whether the SS or TR is suitable for their intended use or purpose. If required, they should refer to the relevant professionals or experts for advice on the use of the document. Enterprise Singapore and the Singapore Standards Council shall not be liable for any damages whether directly or indirectly suffered by anyone or any organisation as a result of the use of any SS or TR. Although care has been taken to draft this standard, users are also advised to ensure that they apply the information after due diligence.*

3. *Compliance with a SS or TR does not exempt users from any legal obligations.*

Code of practice for long-term measurement of compressed air system energy efficiency

1 Scope

This standard specifies the requirements and recommendations for instrumentation to capture relevant process parameters, their installation, commissioning, operational monitoring and maintenance in order to perform continuous and long-term measurement of compressed air system energy efficiency.

This standard also:

a) specifies the acceptable uncertainty levels for continuous measurements for the proper efficiency rating of the compressed air system and equipment;

b) specifies the parameters and performance indicators for continuous measurements; and

c) gives guidelines on the development of useful formats for data collection and presentation.

2 Normative references

The following referenced documents are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61869-2	Instrument transformers – Part 2: Additional requirements for current transformers
IEC 61869-3	Instrument transformers – Part 3: Additional requirements for inductive voltage transformers
IEC 61869-5	Instrument transformers – Part 5 Additional requirements for capacitor voltage transformers
IEC 62053-22	Electricity metering equipment - Particular requirements - Part 22: Static meters for AC active energy (classes 0,1S, 0,2S and 0,5S)
ISO 10790:2015	Measurement of fluid flow in closed conduits – Guidance to the selection, installation and use of Coriolis flowmeters (mass flow, density and volume flow measurements)
ISO 14511:2019	Measurement of fluid flow in closed conduits – Thermal mass flowmeters