

BS EN ISO 11011:2015



BSI Standards Publication

Compressed air — Energy efficiency — Assessment

bsi.

...making excellence a habit.
AVA Documents™
Document Sharing Hub

National foreword

This British Standard is the UK implementation of EN ISO 11011:2015. It is identical to ISO 11011:2013. It supersedes BS ISO 11011:2013 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MCE/8, Compressors, pneumatic tools, pneumatic machines and vacuum technology.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2015.
Published by BSI Standards Limited 2015

ISBN 978 0 580 90397 7
ICS 23.140

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 September 2013.

Amendments/corrigenda issued since publication

Date	Text affected
31 May 2015	This corrigendum renumbers BS ISO 11011:2013 as BS EN ISO 11011:2015

English Version

Compressed air - Energy efficiency - Assessment (ISO 11011:2013)

Air comprimé - Efficacité énergétique - Évaluation (ISO 11011:2013)

Druckluft - Energieeffizienz - Bewertung (ISO 11011:2013)

This European Standard was approved by CEN on 19 March 2015.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Foreword

The text of ISO 11011:2013 has been prepared by Technical Committee ISO/TC 118 “Compressors and pneumatic tools, machines and equipment” of the International Organization for Standardization (ISO) and has been taken over as EN ISO 11011:2015 by Technical Committee CEN/TC 232 “Compressors, vacuum pumps and their systems” the secretariat of which is held by SIS.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2015, and conflicting national standards shall be withdrawn at the latest by September 2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Endorsement notice

The text of ISO 11011:2013 has been approved by CEN as EN ISO 11011:2015 without any modification.

Contents

Page

Foreword	v
Introduction	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
3.1 General	2
3.2 Flow	3
3.3 Pressure	4
3.4 Storage	5
3.5 Volume	5
4 Roles and responsibilities	6
4.1 Identification of assessment team members	6
4.2 Site management support	7
4.3 Communications	7
4.4 Access to equipment, resources, and information	7
4.5 Assessment objectives and scope	7
4.6 Identification of other assessment team members	7
4.7 Objective check	7
5 Assessment methodology	8
5.1 General	8
5.2 Systems engineering methods	8
5.3 Systems engineering process	8
5.4 System assessment process	9
6 Parameters and their determination	10
6.1 General	10
6.2 Measurement	10
6.3 Pressure	10
6.4 Flow rate	11
6.5 Power	12
7 Initial data collection and evaluation	13
7.1 General	13
7.2 Plant background	13
7.3 Plant function	13
7.4 Compressed air system definition	13
7.5 Inventory of key end-use air demands	13
7.6 Heat recovery	13
7.7 Baseline period and duration of data logging	14
7.8 Energy use	14
7.9 Compressed air system supply efficiency	14
7.10 System volume	14
7.11 Pressure	15
7.12 Flowrate	15
7.13 Critical air demands	15
7.14 Compressed air waste	15
7.15 Air treatment	15
7.16 Compressor control	16
7.17 Storage	16
7.18 Maintenance	16
7.19 Ambient intake conditions	16
8 Analysis of data from assessment	16
8.1 General	16

8.2	Baseline profiles	17
8.3	System volume	19
8.4	Pressure profile	19
8.5	Perceived high-pressure demand	21
8.6	Demand profile	22
8.7	Critical air demands	23
8.8	Compressed air waste	24
8.9	Optimized air treatment	25
8.10	Reduced system operating pressure	26
8.11	Balance of supply and demand	27
8.12	Maintenance opportunities	27
8.13	Heat recovery opportunities	28
9	Reporting and documentation of assessment findings	28
9.1	Assessment report	28
9.2	Confidentiality	29
9.3	Energy-saving opportunities	29
9.4	Data for third-party review	29
Annex A (informative) Introduction to energy assessment		30
Annex B (informative) Assessment activities — General		32
Annex C (informative) Assessment activities — Supply		37
Annex D (informative) Assessment activities — Transmission		43
Annex E (informative) Assessment activities — Demand		47
Annex F (informative) Competencies		50
Bibliography		51

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received. www.iso.org/patents

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

The committee responsible for this document is ISO/TC 118, *Compressors and pneumatic tools, machines and equipment*, Subcommittee SC 6, *Air compressors and compressed air systems*.

Introduction

This International Standard has been developed with reference to available documentation¹⁾ (see Bibliography) relating to energy assessment of compressed air systems.

This International Standard is produced to support the objectives of energy management for those organisations utilizing compressed air and wishing to improve the energy efficiency of such systems. Remembering the words of Lord Kelvin who said in 1883, “If you cannot measure it, you cannot improve it”, this International Standard aims to assist with measurement and provide the knowledge to enable improvement.

The prime consideration for any compressed air system is the ability to generate air with the least amount of energy. Having done this, the next consideration is to transmit energy from the point of generation to the point of use with the least loss. The final consideration is to eliminate waste and use the least amount of air for the production process.

This International Standard uses speciality terms which relate the needs of assessment activities to those of compressed air systems. Many terms will appear new to the users of this International Standard who are familiar with general compressed air terms.

A general introduction to energy assessment is given in [Annex A](#).

1) Extracts from ASME EA-4-2010 were used with permission from ASME. The core elements used are from Scope and Introduction, Organizing the Assessment, Analysis of Data From the Assessment, Reporting and Documentation, and Mandatory Appendices — I, Preliminary Data Collection Matrix.

Compressed air — Energy efficiency — Assessment

WARNING — Users of this International Standard are advised that energy-related judgements should not compromise safety issues.

1 Scope

This International Standard sets requirements for conducting and reporting the results of a compressed air system assessment (hereafter referenced as an “assessment”) that considers the entire system, from energy inputs to the work performed as the result of these inputs.

This International Standard considers compressed air systems as three functional subsystems:

- supply which includes the conversion of primary energy resource to compressed air energy;
- transmission which includes movement of compressed air energy from where it is generated to where it is used;
- demand which includes the total of all compressed air consumers, including productive end-use applications and various forms of compressed air waste.

This International Standard sets requirements for

- analysing the data from the assessment,
- reporting and documentation of assessment findings, and
- identification of an estimate of energy saving resulting from the assessment process.

This International Standard identifies the roles and responsibilities of those involved in the assessment activity.

This International Standard provides indicative information in [Annexes B, C, D](#), and E of the type of data to be collected to assist in a successful assessment. The information provided is not exhaustive and therefore is not intended to restrict the inclusion of other data. The form and presentation of the information given in the annexes is also not intended to restrict the manner of presentation of the reporting to the client.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1217, *Displacement compressors — Acceptance tests*

ISO 5598, *Fluid power systems and components — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1217 and ISO 5598 and the following apply.

3.1 General

3.1.1

air treatment

any process provided for the purpose of separation and purification of the compressed air

3.1.2

artificial demand

excess air consumed by a system's unregulated or poorly regulated uses due to operating at a pressure in excess of actual requirements

3.1.3

assessment team

authority to fulfil roles and responsibility of the assessment having appropriate functions and knowledge

3.1.4

baseline

set of typical operating period, work conditions, and performance parameters revealed by assessment and used for comparison of efficiency of measures recommended as a result of energy efficiency assessment procedures

3.1.5

compressed air point of use

components using the pneumatic energy for physical or chemical actions

3.1.6

compressed air systems

group of subsystems comprising integrated sets of components, including air compressors, treatment equipment, controls, piping, pneumatic tools, pneumatically powered machinery, and process applications utilizing compressed air

3.1.7

compressed air system assessment

activity which considers all components and functions, from energy inputs (SUPPLY SIDE) to the work performed (DEMAND SIDE) as the result of these inputs; undertaken to observe, measure, and document energy reduction and performance improvement opportunities in a compressed air system

3.1.8

data logging

measurement of physical parameters while tabulating a periodic log (record) of their numerical value using time-aligned data frames for the plurality of recorded parameters

Note 1 to entry: Two types of data logging are:

- a) dynamics: data logging while creating a sufficiently high frequency periodic log (record) so as to investigate the time-based variation of measured physical parameters
- b) trending: data logging during an extended duration of time for the purpose of investigating regularities, irregularities, or both in the measured physical parameters throughout time

3.1.9

demand

total of all compressed air consumers, including productive end-use applications and various forms of compressed air waste

3.1.10

drawdown

circumstance observed in a compressed air system that is characterized by continual pressure decay arising from a compressed air system event whereby air demand exceeds the capacity of supply

3.1.11

operating period

group of typical time periods that share similar compressed air energy and compressed air demand profiles

Note 1 to entry: See [3.1.15](#).

3.1.12

spot check measurement

measurement of physical parameters creating a log (record) of their numerical value that is carried out at random time intervals or limited to a few instances

3.1.13

supply

conversion of primary energy resource to compressed air energy

3.1.14

transmission

movement of compressed air energy from where it is generated to where it is used

3.1.15

typical operating period

time period that represents a period of typical plant operation

3.2 Flow

3.2.1

demand flow rate

total airflow rate of demand-side consumption

Note 1 to entry: Demand-side consumption includes productive consumers, inappropriate usage, artificial demand, and demand-side waste. This takes into account supply flow plus or minus the compressed air supplied to system demand from secondary storage as system pressure decreases. This can also account for the airflow entering secondary storage as system pressure increases.

3.2.2

flow dynamic application

end use wherein the peak airflow rate and minimum pressure occur simultaneously

3.2.3

flow static application

end uses characterized when peak airflow rate and minimum pressure required do not occur simultaneously

3.2.4

generation flow rate

airflow rate of compressed air generated by the air compressor(s) before any air treatment equipment air use and supply-side waste

3.2.5

peak airflow

maximum value of the airflow during the daily or other periodic operating cycle

3.2.6

storage flow rate

airflow rate entering the storage volume as pressure increases or the airflow rate exiting the storage volume as pressure decreases

Note 1 to entry: The airflow can be either entering or exiting the system or the primary or secondary storage.

3.2.7

supply flow rate

net airflow rate leaving the supply side of the system

3.3 Pressure

3.3.1

compressor inlet pressure

pressure of the aspirated air at the standard inlet point of the compressor which varies with compressor design and type

Note 1 to entry: The pressure is at the inlet flange for bare compressors or ambient air entry point into the package for packaged compressors.

3.3.2

drawdown pressure

total pressure decay in compressed air system pressure that occurs during a particular drawdown event

3.3.3

pressure loss

reduction in compressed air pressure resulting from the interaction of airflow through the fixed resistance associated with a component of the air system

Note 1 to entry: See [3.3.8](#).

3.3.4

pressure signature

pressure profile of a repeated event that is correlated with a specific end-use or production activity

3.3.5

minimum system pressure

lowest possible air pressure a system can reach before adversely affecting the process

3.3.6 Operating pressure

3.3.6.1

user operating pressure

prescribed air pressure at the inlet point of the particular compressed air user equipment according to its specifications

3.3.6.2

system operating pressure

air pressure at the entry point into the network of the compressed air users

3.3.7

pressure gradient

rate of pressure change with respect to distance in the direction of maximum change

Note 1 to entry: In fluid mechanics, the change in pressure, P , along the length and distance, d , of a fluid conduit. It is represented by $\Delta P/\Delta d$.

Note 2 to entry: The air velocity in a pipeline depends on the magnitude of the gradient and resistance of the pipeline.

Note 3 to entry: Without gradient, there is no airflow. In a compressed air system, air moves from high-pressure toward low-pressure areas.

3.3.8 Pressure profile

3.3.8.1

cyclic pressure profile

timely function of the compressed air pressure variations in daily or other periodical operation cycles at a particular point of the compressed air system caused by combination of different air consumption cycles of several end users

3.3.8.2

distance pressure profile

function of pressure degradation along the compressed air transmission and distribution system at a certain typical period of operation cycle caused by pressure loss in its components

Note 1 to entry: Components such as air treatment facilities, fittings, air transmission pipes, branch pressure take-offs, etc.

3.3.9 Pressure differential

3.3.9.1

available pressure differential

compressed air pressure difference between the inlet and outlet of a component, which represents a variable resistance to airflow

Note 1 to entry: The available compressed air energy represented by the upstream volume and greater pressure that is available to the system.

Note 2 to entry: See [3.3.3](#).

3.3.9.2

storage pressure differential

difference between pressure in a storage volume and the desired target pressure of the connected system or sector

3.3.10

target pressure

compressed air pressure that is desired to be consistently supplied to a compressed air system or sector of a compressed air system at a specific point

EXAMPLE A specific point may include the main header downstream of supply, air treatment equipment, upstream of a system control valve, downstream of a system control valve, etc.

Note 1 to entry: See [3.3.5](#).

3.4 Storage

3.4.1

primary storage

compressed air storage system that is located on the generation side (supply) of a compressed air system

3.4.2

secondary storage

auxiliary storage vessel installed close to the end-user equipment by heavy intermittent air consumption and use of long and small transmission lines with the purpose of elimination of overloading the main air transmission line and excessive pressure losses

3.5 Volume

3.5.1

effective volume

internal volume of a single storage component or sector of a compressed air system reflecting its capability to store compressed air energy

3.5.2

geometrical volume **mechanical volume**

calculated by adding all of the geometric volumes in the system based on the observed sizes of those volumes

3.5.3

system volume

internal volume of the compressed air system reflecting its capability to store compressed air energy and to suppress air pressure pulsations

4 Roles and responsibilities

4.1 Identification of assessment team members

The functions and knowledge required to accomplish an assessment are listed in [4.1.1](#). The assessment team shall have members that have responsibility and authority to carry out these functions.

4.1.1 Required functions and personnel

4.1.1.1 Resource allocation

- a) Determine availability of on-site, as well as other off-site participants.
- b) Allocation of funding and resources necessary to plan and execute the assessment.
- c) Exercise final decision-making authority on resources.
- d) Oversee participation of outside personnel, including items such as contracts, scheduling, confidentiality agreements, statement of work, and/or other items.

4.1.1.2 Coordination, logistics, and communications

- a) Obtain necessary support from plant personnel and other individuals and organizations during the assessment.
- b) Participate in organizing the assessment team and coordinate access to relevant personnel, systems, and equipment.
- c) Organize and schedule assessment activities.

4.1.1.3 Compressed air systems knowledge

- a) Have background, experience, and recognized abilities to perform the assessment activities, data analysis, and report preparation.
- b) Be familiar with operating and maintenance practices for compressed air systems.
- c) Have experience applying the systems approach in assessments.

4.1.1.4 Competency

Assessment personnel shall have the knowledge and skills necessary to perform assessments. Those personnel can also require formal documentation in order to meet some national requirements.

In the absence of national requirements, those leading the assessment shall provide evidence of familiarity with and understanding of, compressed air technology basics through recognized qualifications, as well as a relevant period of experience in assessment activities. See [Annex F](#) for further information.

Information on other assessment team members is identified in [4.6](#).

4.2 Site management support

Site management support is essential for the successful outcome of the assessment. Site management understanding and support of the purpose of the assessment shall be secured. The site personnel shall be engaged in the assessment to the extent necessary. The support of site management shall be gained prior to conducting the assessment as follows:

- a) Commit the necessary funding, personnel, and resources to support the assessment.
- b) Communicate to site personnel the assessment's importance to the organization.

4.3 Communications

Lines of communication required for the assessment shall be established. Clear guidance shall be provided to facilitate communications among members of the assessment team so all necessary information and data can be communicated in a timely manner. This includes administrative data and logistics information, as well as operational and maintenance data.

4.4 Access to equipment, resources, and information

For the performance of a complete and comprehensive assessment of a facility's compressed air system, it is necessary to physically inspect and make selected measurements on the system components. Therefore, access shall be required to

- a) plant areas and compressed air system components required to conduct the assessment,
- b) plant personnel (engineering, operations, maintenance, etc.), their equipment vendors, contractors, and others to collect information pertinent and useful to the assessment activities and analysis of data used for the preparation of the report, and
- c) other information sources such as drawings, manuals, test reports, historical utility bill information, computer monitoring and control data, electrical equipment panels, and calibration records necessary to conduct the assessment.

4.5 Assessment objectives and scope

The overall goals and scope of the assessment shall be discussed and agreed upon at an early stage by the assessment team. The overall objectives of the assessment shall include identification of performance improvement opportunities in the compressed air system being assessed using a systems approach. The scope of the assessment shall define the area(s) of the facility to be assessed.

4.6 Identification of other assessment team members

The assessment considers the entire system from energy inputs to the work performed as a result of those inputs. As a result of facility specialists interviews, certain manufacturing equipment or processes that use compressed air may be identified for detailed study requiring the participation of individuals with specialized knowledge related to these applications.

4.7 Objective check

Prior to conducting the assessment, the plan of action shall be reviewed to establish that it meets the stated assessment objectives. The assessment plan of action shall be reviewed for relevance, cost effectiveness, and capacity to produce the desired results.

5 Assessment methodology

5.1 General

Assessments involve collecting and analysing system design, operation, energy inputs, energy use, and performance data and identifying energy performance improvement opportunities for system optimization. An assessment can also include additional information, such as recommendations for improving resource utilization, reducing per unit production cost, reducing lifecycle costs, and improving environmental performance related to the assessed system(s).

The methodologies to be applied in performing the assessment shall include one or more of the following techniques:

- a) observation and research;
- b) spot-check measurements;
- c) data logging, including dynamics and trend.

5.2 Systems engineering methods

This International Standard utilizes systems engineering methods applied to a compressed air system assessment. It is necessary to:

- a) Understand compressed air point of use as it supports critical plant production functions.
- b) Correct existing poor performing applications and those that upset system operation.
- c) Eliminate wasteful practices, leaks, artificial demand, and inappropriate use.
- d) Create and maintain an energy balance between supply and demand.
- e) Optimize compressed air energy storage and air compressor control.

Application of a systems approach to a compressed air system assessment directs the focus toward total system performance rather than individual component efficiency.

NOTE Systems engineering focuses on defining client needs and required system functionality early in the development cycle, documenting system requirements, and then proceeding with system design while considering the entire system.

5.3 Systems engineering process

The systems engineering process is described in 10 steps:

- a) Identify what needs to be accomplished.
- b) Identify what needs to be evaluated.
- c) Get organized, identify the assessment team, and get plant background information.
- d) Define the present system.
- e) State site-specific system assessment goals.
- f) Design the system assessment (what, how, when).
- g) Test the assessment's design for relevance, completeness, and cost effectiveness.
- h) Do the assessment and gather facts and data.
- i) Analyse the facts and data to develop solutions and estimate cost and savings.

j) Report and document recommendations and findings.

NOTE 1 Compressed air systems engineering is an iterative process including requirements definition, the assessment process, and evaluation of outcomes and results. It is a fluid process whereby outcomes and results can achieve defined goals or can result in new or revised requirements definition.

NOTE 2 There are many compressed air system integration factors where decisions related to one component or subsystem impact other components or subsystems. Concept alternatives should be proposed and analysed before final conclusions are reached.

5.4 System assessment process

5.4.1 General

The assessment should document issues and concerns about compressed air use, critical production functions, and poor compressed air system performance. The assessment should identify and quantify energy waste, compressed air supply-and-demand balance, energy use, and total compressed air demand. These generalizations should be used to guide the selection of objectives and action items for preliminary data collection.

5.4.2 Relationships in the system assessment process

The relationships of those involved in the assessment and the assessment process are shown in [Figure 1](#).

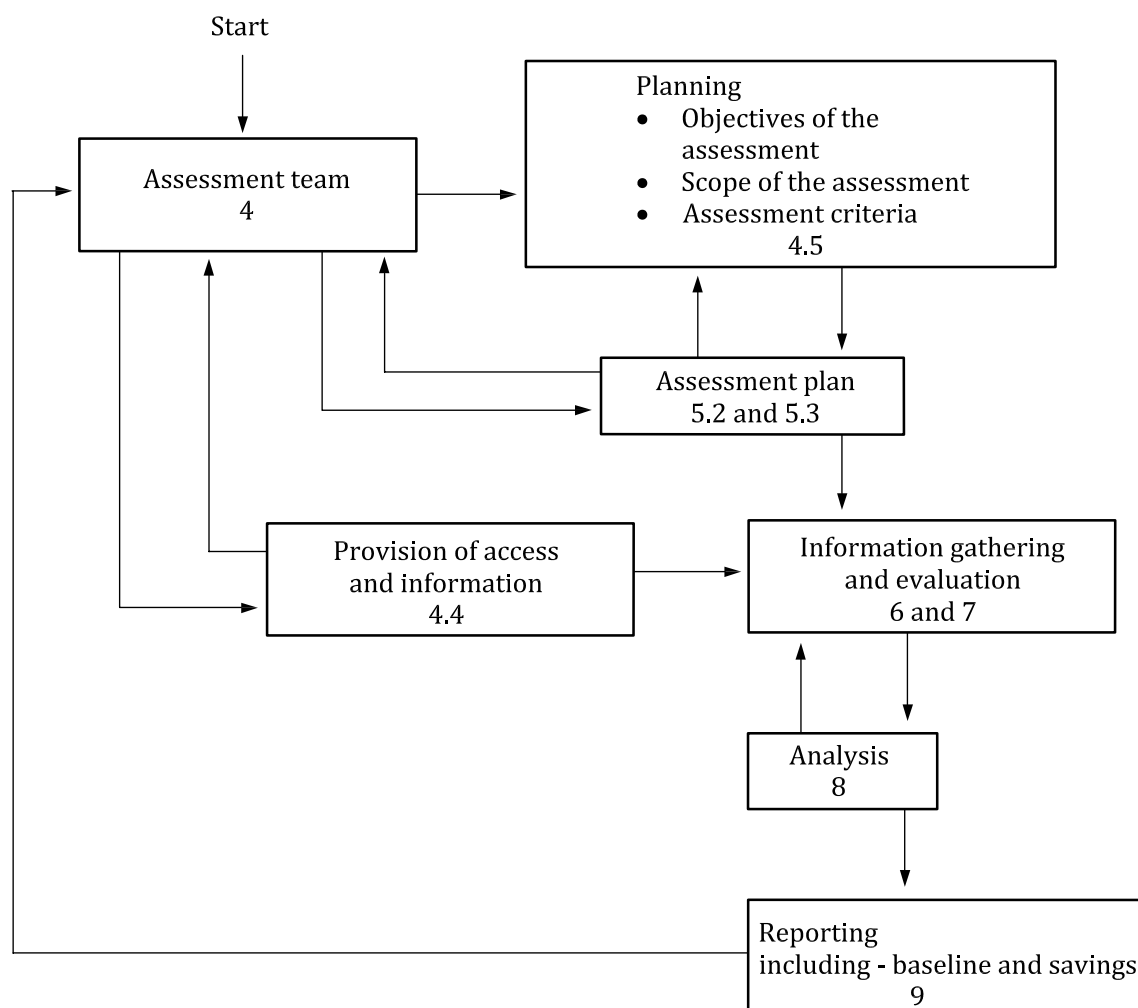


Figure 1 — Process for conducting an energy assessment of a compressed air system

6 Parameters and their determination

6.1 General

Pressure, flow rate, and power are the key parameters required to provide essential details for the determination of the energy balance in the compressed air system under review. In addition, each of these parameters is affected by the installed control system.

6.2 Measurement

6.2.1 Units

The preferred measurement units used when applying this International Standard shall be SI units. If due to common use or understanding imperial units are applied, then the SI units should also be given. The use of units shall be agreed upon when establishing the parameters of the assessment and identified in the assessment report.

6.2.2 Accuracy

Where necessary to ensure valid results, measuring equipment shall be calibrated, verified, or both at specified intervals or prior to use against measurement standards traceable to international or national measurement standards; where no such standards exist, the basis used for calibration or verification shall be recorded.

All instruments used for measurement including those permanently installed shall have a record of the most recent calibration information of which the accuracy and calibration details for all devices should be mentioned in the report.

The measurement accuracy level for a particular parameter can vary depending on the sensitivity of the assessment conclusions and recommendations to the value of the particular parameter as identified in [6.3](#), [6.4](#), and [6.5](#).

6.2.3 Data interval

The data interval is the time between recorded data required to capture the dynamic nature of an event in a compressed air system. Where dynamic events are to be recorded, a data interval of at least one order of magnitude less than the duration of the event being measured shall be applied.

Dynamic events are, by nature, of short duration. Average air consumption during the day or shift is not a dynamic event.

NOTE If, for example, a dynamic event in the system has a duration of one second, the data interval would have to be no greater than one tenth of a second or less, or 10 recorded data points per second, to characterize that event.

6.3 Pressure

6.3.1 Pressure profile

A pressure profile is an important tool for assessing end-user requirements over time, allowing identification of any pressure losses and helps identify potential improvements. Transient and dynamic behaviour within the profile can also be analysed from the collected data.

6.3.2 Pressure test points

Pressure test points are identified in [Table C.1](#), [Table D.1](#), and [Table E.1](#) and should be included in the assessment. Not all points are valid for all systems and additional points can be required; therefore, the actual points used shall be identified in the assessment plan.

6.3.3 Pressure identity

Pressure is commonly considered in only one way and that is supply pressure. Other pressure variations should also be considered.

The assessment of a functional system should take into consideration the following pressure variations:

- a) minimum system pressure;
- b) actual operating pressure;
- c) target pressure;
- d) pressure gradient;
- e) drawdown pressure;
- f) pressure loss;
- g) available pressure differential;
- h) storage pressure differential;
- i) compressor inlet pressure.

NOTE Pressure in a compressed air system is seen as a key driver for end-use applications.

6.4 Flow rate

6.4.1 Flow rate profile

The system flow rate profile is important to properly support end-use requirements, allowing identification of any flow restrictions and opportunities to improve system design. Transient and dynamic behaviour of the system can also be analysed from collected data.

6.4.2 Flow rate test points

Flow test points are identified in [Table C.1](#), [Table D.1](#), and [Table E.1](#) and should be included in the assessment. Not all points are valid for all systems and additional points can be required; therefore, the points used shall be identified in the assessment plan.

6.4.3 Flow rate identity

Flow rate is commonly considered in only one way and that is generation flow rate. Other flow rate variations should also be considered.

The assessment of a functional system should take into consideration the following airflow rate variations:

- a) supply flow rate;
- b) storage flow (system, primary, or secondary);
- c) demand flow rate;
- d) peak airflow;
- e) flow dynamic;
- f) flow static;
- g) generated flow rate.