International Standard

ISO 17104

Rotary tools for threaded fasteners — Impulse and impulsing tools — Performance test method

Outils rotatifs pour fixations filetées — Outils à impulsion — Méthode d'essai des caractéristiques de fonctionnement

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Contents

Page

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 document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 118, *Compressors and pneumatic tools, machines and equipment*, Subcommittee SC 3, *Pneumatic tools and machines*.

This first edition of ISO 17104 cancels and replaces the first edition of ISO/TS 17104:2006, which has been technically revised and upgraded to an International Standard.

The main changes are as follows:

— Title and Scope have been modified to reflect changes in the tool types that have become available since 2006.

— Starting point of the joint rate measurement is taken from 50 % of the target rather than 10 %.

— Several requirements are explained more in detail to increase user understanding and tool test consistency.

— The opportunity for users to test performance at a preferred test torque level is added as an informative annex.

— New annexes have been added to educate users in the background to the requirements.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is intended to

— enable the manufacturers of power tools to offer their products under standardized technical specifications, and

— give users of threaded fasteners a method for evaluating and specifying the performance of power assembly tools.

This document is a fundamental test procedure, with no attempt to set acceptance criteria. Any minimum performance requirements are the responsibility of the user to meet the demands of the particular application for which the tool is intended for use.

Unlike the previous Technical Specification, this document is applicable to tightening tools of any power source within its scope. However, the test does require that the tool under test is capable of being set to a specific shut-off point.

Additional statements have been introduced to point out the differences between correlated torque derived from clamp force and inbuilt indication or control systems that now exist in a number of tools.

Annex A explains the basis for the use of clamp force rather than torque for testing the performance of fastener assembly tools that apply torque in a discontinuous method.

Annex B explains the principle of electric impulsing tools which operate in a different way to hydraulic impulse tools.

Annex C includes preferred torque values that may be used for testing.

Annex D gives an example format for the test report.

Annex E provides background to the testing performed during the creation of this document.

This document includes some changes to the specifications for the test joints and for the test method. These changes reflect the practical experience gained through the use of the previous version of the document and are intended to improve the reproducibility of the test method.

Testing of the tools within the scope of this document present a number of challenges. New equipment and methods are being developed and the subcommittee members responsible for its publication believe that this document is a step closer to understanding the true performance of impulse and impulsing tools. Further development will continue, and the experiences of users are welcomed by the subcommittee.

Results obtained using this document may differ from results obtained using the previous technical specification.

Some of the changes in this document have been guided by the work of the VDI/VDE Committee Gesellschaft Mess- und Automatisierungstechnik and are used with their permission.

Rotary tools for threaded fasteners — Impulse and impulsing tools — Performance test method

1 Scope

This document specifies a laboratory performance test method for hydraulic impulse and electric impulsing tools for installing threaded fasteners in a laboratory environment, and for power assembly tools (referred throughout the document as “tools”) for installing threaded fasteners. It gives instructions on the procedure, performance parameters to test and how to evaluate and present the test data.

It also provides a method for the measurement of torque repeatability (scatter)

— over a range of torque rates as specified in this document, and

— over a range of torque adjustment as defined by the manufacturer.

It gives instructions on equipment parameters, what to test for and how to evaluate and present the test data.

It is applicable to tools

— of any power source, such as pneumatic or electric, including battery-powered,

— which apply torque in discontinuous increments, and

— within the torque range 0,5 N·m to 800 N·m. Outside this range, it is acceptable to modify the test method providing that the modification is documented in the test report.

It is not applicable to

— impact wrenches, and

— ratchet wrenches or wrenches with ratcheting clutches.

The relationship between torque measurements and clamp force-based tests is commented on in Annex A.

The use of tools using discontinuous operation of the motor to provide torque impulses is discussed in Annex B.

It requires manufacturers to perform tests over their defined torque range of the tool; however, it allows users to perform single point tests in order to minimize the number of test joints necessary for a wide range of test torque levels. A list of preferred test torque levels is provided in Annex C.

2 Normative references

No normative references are referred to in this document.

3 Terms, definitions and symbols

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
rotary tool for threaded fasteners
powered tool, the output spindle of which rotates to turn a threaded fastener

Note 1 to entry: Either a pneumatic or an electric motor can be used.

Note 2 to entry: The final movement of the spindle can be rotational and continuous or rotational and discontinuous, depending on the type of rotary machine considered.

3.2
continuous rotation fastening tool
powered assembly tool for tightening threaded fasteners, which applies torque to a fastener in a continuous motion

Note 1 to entry: The term is used in this document when establishing the relationship between torque and clamp force.

3.3
hydraulic impulse tool
powered assembly tool for tightening threaded fasteners, which applies torque to a fastener in discontinuous increments through a hydraulic impulse unit between the motor and the output drive

3.4
electric impulsing tool
powered assembly tool for tightening threaded fasteners, which applies torque to a fastener in discontinuous increments by pulsing the input to the electric motor which then delivers pulses of kinetic energy to the output drive

Note 1 to entry: A number of variations on this tool exists. Their common distinguishing action is that the pulsing comes from controlling the motor, rather than subsequently controlling the output of the motor.

3.5
automatic shut-off tool

powered assembly tool for tightening threaded fasteners, provided with a torque control mechanism which shuts off or disconnects the power to the tool when the predetermined set output torque level is attained

Note 1 to entry: A number of variations on the mechanisms for achieving this feature exists.

3.6
parameter adjustable tool
hydraulic impulse tool (3.3) or *electric impulsing tool* (3.4) capable of customising the tightening profile, by changing parameters such as speed, pulse rate, pulse intensity

3.7
pulse mode
settings employed in an *electric impulsing tool* (3.4) to establish pulse frequency, duration and intensity

Note 1 to entry: The settings will influence the reaction force experienced by the operator.

3.8
number of pulses
number of pulses generated by the tool from the start of rundown to completion of the defined joint

3.9
operating cycle
one complete fastener tightening from start of rotation until end of rotation

3.10
joint condition
combination of *torque rate* (3.14) and *test torque* (3.26)

Note 1 to entry: The effect of lubrication viscosity, thread deformation or galling can alter the joint condition.

3.11
standard deviation
s
statistical parameter to describe a scatter range

$$s=\sqrt{\frac{1}{N-1}\sum_{i=1}^{N}\left(x_i-\bar{X}\right)^2}$$

[SOURCE: ISO 3534-1:2006, 2.37]

3.12
diameter
D
nominal diameter of a bolt

Note 1 to entry: The diameter is expressed in millimetres.

3.13
angle
θ
measure of the rotation through which a fastener is turned

Note 1 to entry: The angle is expressed in degrees.

3.14
torque rate
rate of increase of torque relative to rotation while tightening a fastener in a threaded joint.

Note 1 to entry: The torque rate is expressed in newton-metres per revolution.

3.15
rundown
period of angular rotation without corresponding torque increase

Note 1 to entry: This allows the tool to reach operating speed.

3.16
clamp force
F_c
axial tension acting on the bolt shank or compression acting on the clamped member

Note 1 to entry: The clamp force is expressed in newtons.

3.17
peak clamp force
F_{cp}
peak value of the *clamp force* (3.16) measured during an *operating cycle* (3.9)

Note 1 to entry: The peak clamp force is expressed in newtons.

3.18
target clamp force
F_{ct}
clamp force (3.16) required to achieve the *test torque* (3.26) when testing a tool on a test joint

Note 1 to entry: This is based on the following formula:

$$F_{ct}=T_t/\left(\bar{K}\times D\right)$$

where T_T is defined in 3.26, $\bar{K}$ is defined in 3.31 and D is defined in 3.12.

3.19
torque
T
product of the force turning the fastener and the perpendicular distance between the line of force and the centre of the fastener

Note 1 to entry: Torque is expressed in newton-metres.

3.20
dynamic torque
torque (3.19) recorded during the determination of *K* for a test joint condition as described in 4.3.2

Note 1 to entry: For test joint analysis, dynamic torque is measured with an in-line, rotary torque and angle transducer, placed between a continuous drive spindle and the socket/driver bit.

Note 2 to entry: Dynamic torque is expressed in newton-metres.

3.21
peak dynamic torque
T_{dp}
peak value of the *dynamic torque* (3.20) recorded during an *operating cycle* (3.9) performed during the procedure described in 4.3.2

3.22
correlated torque
T_c
torque (3.19) derived from a *peak clamp force* (3.17) measurement

Note 1 to entry: This is based on the following formula:

$$T_c = \bar{K} \times D \times F_{cp}$$

where *K* is defined in 3.30, F_{cp} is defined in 3.17 and *D* is defined in 3.12.

Note 2 to entry: The correlated torque is expressed in newton-metres.

3.23
mean correlated torque
$\bar{T}_c$
arithmetic mean of a number of *correlated torque* (3.22) readings on a specific joint

3.24
range of correlated torque scatter
S
range within which the actual values lie

Note 1 to entry: For a normally distributed statistical population, 99,73 % of all members of that population are encompassed within the scatter range 6 times the standard deviation, *s*, (6*s*).

Note 2 to entry: Scatter range is expressed in the quantity measured e.g. in kilonewtons or newton-metres.

3.25
correlated torque scatter as a percentage of the mean correlated torque
S_p
single numerical percentage value designating the *correlated torque* (3.22) capability of a tool run on a single joint condition under controlled conditions

3.26
test torque
T_t
torque level at which the tool's correlated torque scatter capability is determined, e.g. the torque level at which the test is carried out

Note 1 to entry: Although nominally determined by the values of the torque adjustment range, the exact test torque is set by the value achieved by the continuous rotation nutrunners in 4.3.2.

3.27
torque adjustment range
range over which a tool can be adjusted as defined by the manufacturer

3.28
upper test torque
T_u
test torque (3.26) equal to the upper limit of the defined *torque adjustment range* (3.27)

3.29
lower test torque
T_l
test torque (3.26) equal to the lower limit of the defined *torque adjustment range* (3.27)

3.30
torque factor
K
constant relating *clamp force* (3.16) and *dynamic torque* (3.20) in a test joint

3.31
mean torque factor
$\overline{K}$
mean of the 25 torque factor values obtained in the measurement process for each test joint at each test torque level

3.32
tightening time
time required for a tool to tighten a specific joint, excluding the rundown

4 Method for measurement of performance

4.1 General rules for performance tests

4.1.1 Measurements

All measurements carried out in conformity with this document shall be performed by personnel trained in the use of the equipment utilizing instrumentation, which is calibrated against existing standard methods.

4.1.2 Ambient conditions

Unless otherwise noted, the ambient conditions shall be kept within the following limits during the test:

— ambient temperature: 22 °C ± 5 °C;

— change of ambient temperature during one complete test shall be within ±2 °C;

— relative humidity: below 90 %.

4.1.3 Test installation

The test performance of a tool can be affected by improper alignment with the axis of the test joint. The tool shall, therefore, be guided by a device and shall be aligned to the test joint to minimise operator influence.

An example of a test stand used to support the tool and align it with the test joint is shown in Figure 1 and Figure 2.

4.1.4 Test tool

The tool under test shall be an automatic shut-off tool, equipped with a mechanism for automatically shutting off the drive of the tool once the set point has been reached.

The test tool shall be adjusted to each joint condition specified in 4.3.2 in accordance with the manufacturer's instructions. The adjustment shall be such that the shut-off mechanism operates each time.

Once the tool has been adjusted for the joint-rate and test torque level, all control settings shall be constant throughout the test.

4.1.5 Test tool condition

The test tool shall be in good working condition and lubricated in accordance with the manufacturer's specification. Before the start of the test, it shall be ensured that the tool under test is at ambient temperature.

The tool shall be tested under the manufacturer's specified input conditions and used in accordance with the manufacturer's instructions.

4.1.6 Power media

4.1.6.1 Pneumatic power

The air pressure shall be documented in the test report. The air supply shall include lubrication in accordance with the manufacturer's instructions.

The performance of pneumatic tools is affected by the ambient conditions such as atmospheric pressure and temperature. For this reason, unless otherwise specified, the following conditions shall be maintained:

— atmospheric pressure: 1 013 hPa ± 50 hPa;

— compressed air temperature: 20 °C ± 5 °C.

Actual values shall be recorded if they are outside of these limits.

During performance tests of pneumatic tools, it is necessary to state the inlet air pressure. If not stated, the inlet air pressure is 0,6 MPa. The air supply shall be free from fluctuations that would influence the result.

During performance tests of pneumatic tools, a 3 m hose of the tool manufacturer's specification shall be attached to the tool inlet. The air pressure at the inlet of this hose shall be kept within the following limits:

— free-running conditions: between the static value and 2 % below;

— approaching the test torque level: ±2 % of the static value.

NOTE A lubricator with insufficient flow properties can affect these values.

No pressure adjustments shall be made to the pilot regulator during the course of a given test.