TECHNICAL SPECIFICATION

ISO/TS 17104

First edition
2006-04-15

Rotary tool for threaded fasteners — Hydraulic impulse tools — Performance test method

Outils rotatifs pour éléments de fixation filetés — Outils hydraulique à impulsion — Méthode d'essai des caractéristiques de fonctionnement

Reference number
ISO/TS 17104:2006(E)

Contents

Page

Foreword iv
Introduction v
1 Scope 1
2 Normative references 1
3 Terms, definitions and symbols 1
4 Method for measurement of performance 5
5 Evaluation of test results 11
6 Presentation of data 12
Annex A (informative) **Explanation and justification of the method** 13
Annex B (informative) **Clamp force tester** 15
Annex C (informative) **Torque coefficient (K) dependence on speed** 21
Annex D (informative) **Example of form for hydraulic impulse tool performance test** 25
Bibliography 27

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

— an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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.

ISO/TS 17104 was prepared by Technical Committee ISO/TC 118, *Compressors and pneumatic tools, machines and equipment*, Subcommittee SC 3, *Pneumatic tools and machines*.

Introduction

The test method specified in this Technical Specification is designed to measure the overall performance and capability of hydraulic impulse tools.

This ISO/Technical Specification is intended to give users of impulse tools a means for measuring and comparing the performance of hydraulic impulse tools under controlled conditions.

Every effort has been made to specify all critical characteristics of the test fixtures conforming to this Technical Specification. However, test results from different test fixtures can be affected by differences in dynamic characteristics, thereby making direct comparisons difficult.

The ISO/TS can be used for comparing the torque capabilities of impulse tools. It has not so far been possible to achieve acceptable reproducibility of the correlated torque scatter and it is hoped that data accumulated through experience of using the ISO/TS enables improvements to be made when it is reviewed three years after publication. In the meantime, when comparing the performances of different tools, quoted differences in correlated torque scatter (as a percentage of mean correlated torque) of fewer than ten percentage points should be viewed with caution/treated as insignificant, until verified by the potential user or purchaser of the tools.

Rotary tool for threaded fasteners — Hydraulic impulse tools — Performance test method

1 Scope

This Technical Specification specifies a laboratory performance test method for hydraulic impulse tools for installing threaded fasteners. It gives instructions on the procedure, performance parameters to test and how to evaluate and present the test data.

Justification for the test method is found in Annex A.

The test method is not intended as a routine in-plant inspection method.

2 Normative references

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

ISO 2787, *Rotary and percussive pneumatic tools — Performance tests*

ISO 5393, *Rotary tools for threaded fasteners — Performance test method*

3 Terms, definitions and symbols

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

3.1
hydraulic impulse tool
powered assembly tool for tightening threaded fasteners, which applies torque to a fastener in discontinuous increments through a hydraulic impulse unit

3.1.1
automatic shut-off tool
powered assembly tool for tightening threaded fasteners, which is provided with a control mechanism or system that shuts off or disconnects the power to the motor when a predetermined output level is attained

3.1.2
non shut-off tool
powered assembly tool for tightening threaded fasteners, which continues to apply torque impulses as long as the throttle remains in the “on” position

3.2
standard deviation
s
measure of the dispersion (scatter) based on the mean-squared deviation from the arithmetic mean derived from a sample of a statistical population

3.3
six sigma
$6s$
range of probability, plus and minus three standard deviations from the mean, derived from a sample of a statistical population

NOTE For a normally distributed statistical population, 99,73 % of all members of that population are encompassed.

3.4
diameter
D
nominal diameter of a bolt

NOTE The diameter is expressed in millimetres.

3.5
angle
measure of the angular displacement through which a fastener is turned

NOTE The angle is expressed in degrees.

3.6
clamp force
F_{C}
result of the force achieved by turning a bolt in the tightening direction after the bolt head makes contact with the joint bearing surface

NOTE The clamp force is expressed in newtons.

3.6.1
peak clamp force
F_{CP}
peak value of the clamp force measured during a tightening cycle

NOTE The peak clamp force is expressed in newtons.

3.6.2
target clamp force
F_{CT}
clamp force required to achieve the test torque when testing a hydraulic impulse tool on a test joint based on Equation (1):

$$F_{CT} = T_{T} / \left(\overline{K} \times D\right) \quad (1)$$

where T_{T} is defined in 3.7.10, $\overline{K}$ is defined in 3.9.1, and D is defined in 3.4.

3.7
torque
product of the force turning the fastener and the perpendicular distance between the line of force and the centre of the fastener

3.7.1
dynamic torque
T_{D}
torque recorded during the calibration of the test joint as described in 4.2.2 and 4.2.6

NOTE 1 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 Dynamic torque is expressed in newton-metres.

3.7.2
peak dynamic torque
T_{DP}
peak value of the dynamic torque recorded during a tightening cycle performed during the test joint calibration procedure described in 4.2.6

3.7.3
correlated torque
T_C
torque derived from a peak clamp force measurement based on Equation (2):

$$T_C = K \times D \times F_{CP} \tag{2}$$

where K is defined in 3.9, F_{CP} is defined in 3.6.1 and D is defined in 3.4

NOTE The correlated torque is expressed in newton-metres.

3.7.4
mean correlated torque
$\overline{T_C}$
arithmetic mean of a number of correlated torque readings on a specific joint as defined in 3.7.3

3.7.5
6*s*-correlated torque scatter
S_{6s}
predictable range of correlated torque over which a tool performs at a given setting using a single torque-rate joint under controlled conditions

NOTE 1 For the practical purposes of this Technical Specification, 6*s* correlated torque scatter of a tool is the total probable range of torque of a tool run on a single joint at the same setting of the tool torque adjustment.

NOTE 2 6*s*-correlated torque scatter is calculated according to 5.1.

3.7.6
6*s*-correlated torque scatter as a percentage of the mean correlated torque
$S_{6s,p}$
single numerical percentage value designating the correlated torque capability of a tool run on a single torque rate joint under controlled conditions

NOTE 6*s*-correlated torque scatter as a percentage of the mean correlated torque is calculated according to 5.1.

3.7.7
combined mean correlated torque
$\overline{T_C}_{comb}$
midpoint between the lowest and highest predictable correlated torque readings of a tool at a given setting when tested on both test joints

NOTE The combined mean correlated torque is calculated according to 5.2.

3.7.8
combined correlated torque scatter
$\Delta T_{C\,comb}$
predictable range of correlated torque over which a tool performs, encompassing 99,73 % or more of all possible correlated torque readings, taken on a range of joints of varying torque rates from a defined high torque rate through a defined low torque rate

NOTE For the practical purposes of this Technical Specification, combined correlated torque scatter of a tool is the total probable range of torque of a tool run on all joints used in practice at the same setting of the tool torque adjustment. It is calculated according to 5.2.

3.7.9
correlated torque scatter as a percentage of combined mean correlated torque
single numerical value designating the correlated torque capability of a tool run on joints of varying torque rate, from a defined high torque rate through a defined low torque rate at the same setting of the tool torque adjustment

NOTE The correlated torque scatter as a percentage of combined mean correlated torque is calculated according to 5.2.

3.7.10
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

3.7.11
upper test torque
test torque equal to the upper limit of the defined torque adjustment range over which a tool's correlated torque scatter capability is determined as described in 4.3.3.2

3.7.12
lower test torque
test torque equal to the lower limit of the defined torque adjustment range over which a tool's correlated torque scatter capability is determined as described in 4.3.3.2

3.8
torque rate
rate of increase of torque relative to angular displacement while tightening a fastener in a threaded joint.

NOTE The torque rate is expressed in newton-metres per revolution.

3.9
torque coefficient
K
constant relating clamp force and dynamic torque in a test joint, based on Equation (3):

$$K = T_{DP} / \left(F_{CP} \times D\right) \tag{3}$$

using peak dynamic torque (T_{DP}) and corresponding peak clamp force (F_{CP}) measurements on the test joint at the test torque level as described in 4.2.6

NOTE T_{DP} is defined in 3.7.2, F_{CP} is defined in 3.6.1 and D is defined in 3.4. See also Annex C.

3.9.1
mean torque coefficient
$\overline{K}$
mean of the 25 torque coefficient values obtained in the calibration process for each test joint at each test torque level

3.10
mean shift
difference in mean correlated torque of a tool run on threaded joints of two different torque rates at the same setting of the tool torque adjustment

NOTE The mean shift is calculated according to 5.2.

3.11
pulse count
number of pulses produced by a hydraulic impulse tool to tighten a specific joint

NOTE For automatic shutoff tools, it is the number of pulses to achieve shutoff. For non-shutoff tools, it is the number of pulses to tighten a specific joint until the fastener stops rotating. The pulse count can be affected by the adjustment of the tool.

3.12
tightening time
time required for a hydraulic impulse tool to tighten a specific joint, excluding the free run down

NOTE 1 For automatic shutoff tools, it is the time required to achieve shutoff.

NOTE 2 For non-shutoff tools, it is the time required to tighten a specific joint until the fastener stops rotating, measured in seconds. The tightening time can be affected by the adjustment of the tool.

3.13
symbols

Symbol	Description	Unit
D	diameter	mm
F_{C}	clamp force	N
F_{CP}	peak clamp force	N
F_{CT}	target clamp force	N
K	torque coefficient	
$\overline{K}$	mean torque coefficient	
s	standard deviation	
$6s$	six sigma	
$\mathrm{S}_{6\mathrm{s}}$	$6s$-correlated torque scatter	
$\mathrm{S}_{6\mathrm{s,p}}$	$6s$-correlated torque scatter as a percentage	
T_{C}	correlated torque	Nm
T_{D}	dynamic torque	Nm
T_{DP}	peak dynamic torque	Nm
T_{T}	test torque	
$\overline{T_{\mathrm{C}}}$	mean correlated torque	Nm
$\overline{T_{\mathrm{C}}}_{\mathrm{comb}}$	combined mean correlated torque	Nm
$\Delta T_{\mathrm{C\,comb}}$	combined correlated torque scatter	Nm

4 Method for measurement of performance

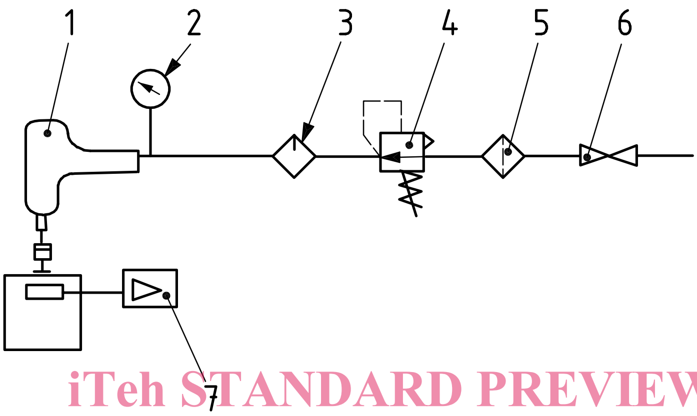
4.1 General rules for performance tests

4.1.1 All measurements carried out in conformity with this Technical Specification shall be performed by competent persons and with accurate instrumentation, which is calibrated against existing standard methods.

4.1.2 The performance of pneumatic tools is affected by the ambient conditions such as atmospheric pressure and temperature. For this reason, the ambient conditions shall be kept within the limits specified in ISO 2787.

4.1.3 During the test, the tool shall be in good working order. The lubrication shall be in accordance with the manufacturer's specifications. Electric impulse tools shall be tested under their rated conditions.

4.1.4 During performance tests of pneumatic impulse tools, a special pressure gauge with glycerine filling should be used to stabilize the gauge pointer. The air pressure at the inlet of the tool shall not vary more than 2 %. An example of a suitable test installation is shown in Figure 1. A pressure regulator with a small hysteresis provides a more constant pressure to the impulse tool and is not so much affected by a pressure change in the system.



Key

1 impulse tool under test
2 pressure gauge
3 lubricator
4 pilot-operated pressure regulator
5 filter
6 shutoff valve
7 clamp force measuring device with amplifier with peak-hold circuit and visual display or printout capability

Figure 1 — Example of a suitable test installation

4.1.5 The performance of hydraulic impulse tools can be affected by misalignment with the fastener. The tool shall be fixed in a test stand and aligned to reduce influence by the operator. Figure 2 shows an example of a test stand used to support the tool and align it with the test joint; more information can be found in Annex B. The axial load on the tool shall not exceed two times the weight of the tool.

