INTERNATIONAL STANDARD

ISO 11148-6

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Hand-held non-electric power tools — Safety requirements —

Part 6: Assembly power tools for threaded fasteners

Machines portatives à moteur non électrique — Exigences de sécurité —

Partie 6: Machines d'assemblage pour éléments de fixation filetés

Reference number
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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.

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 11148-6 was prepared by Technical Committee ISO/TC 118, *Compressors and pneumatic tools, machines and equipment*, Subcommittee SC 3, *Pneumatic tools and machines*.

This second edition cancels and replaces the first edition (ISO 11148-6:2010), of which it constitutes a minor revision.

ISO 11148 consists of the following parts, under the general title *Hand-held non-electric power tools — Safety requirements*:

— *Part 1: Assembly power tools for non-threaded mechanical fasteners*

— *Part 2: Cutting-off and crimping power tools*

— *Part 3: Drills and tappers*

— *Part 4: Non-rotary percussive power tools*

— *Part 5: Rotary percussive drills*

— *Part 6: Assembly power tools for threaded fasteners*

— *Part 7: Grinders*

— *Part 8: Sanders and polishers*

— *Part 9: Die grinders*

— *Part 10: Compression power tools*

— *Part 11: Nibblers and shears*

— *Part 12: Circular, oscillating and reciprocating saws*

A part 13, dealing with fastener driving tools, is under preparation.

Introduction

This document is a type C standard as stated in ISO 12100.

The machinery concerned and the extent to which hazards, hazardous situations and events are covered are defined in the Scope of this part of ISO 11148.

When provisions of this type C standard are different from those that are stated in type A or B standards, the requirements of this type C standard take precedence over the requirements of other standards for machines that have been designed and built according to the requirements of this type C standard.

ISO 11148 consists of a number of independent parts for individual types of hand-held, non-electric power tools.

Certain elements of this part of ISO 11148 cover hand-held, non-electric power tools driven by internal combustion engines powered by gaseous or liquid fuel. In these parts, the safety aspects relating to internal combustion engines are found in a normative annex.

The parts are type C standards and refer to pertinent standards of types A and B where such standards are applicable.

Hand-held non-electric power tools — Safety requirements —

Part 6:
Assembly power tools for threaded fasteners

IMPORTANT — The electronic file of this document contains colours that are considered useful for the correct understanding of the document. Users should consider printing this document using a colour printer. ISO 3864-4 provides colourimetric and photometric properties together with, as a guideline, references from colour order systems.

1 Scope

This part of ISO 11148 applies to hand-held non-electric power tools (hereinafter "assembly power tools for threaded fasteners") intended for tightening or installing of threaded fasteners. The assembly power tools for threaded fasteners can be powered by compressed air, hydraulic fluid or internal combustion engines and are intended for use by one operator and supported by the operator's hand or hands, with or without a suspension, e.g. a balancer.

This part of ISO 11148 covers

— air-hydraulic impulse wrenches;

— impact wrenches;

— fastener installation tools;

— nutrunners;

— open-ended spanners (crow-foot with open-ended socket or tube nut wrench);

— ratchet wrenches;

— screwdrivers.

NOTE 1 For examples of assembly power tools for threaded fasteners, see Annex B.

This part of ISO 11148 does not cover special requirements and modifications of assembly power tools for threaded fasteners for the purpose of mounting them in fixtures.

This part of ISO 11148 deals with all significant hazards, hazardous situations or hazardous events when the tools are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer, with the exception of the use of assembly power tools for threaded fasteners in potentially explosive atmospheres.

NOTE 2 EN 13463-1 gives requirements for non-electrical equipment for potentially explosive atmospheres.

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 3857-3, *Compressors, pneumatic tools and machines — Vocabulary — Part 3: Pneumatic tools and machines*

ISO 3864-2, *Graphical symbols — Safety colours and safety signs — Part 2: Design principles for product safety labels*

ISO 5391, *Pneumatic tools and machines — Vocabulary*

ISO 7000, *Graphical symbols for use on equipment — Registered symbols*[1)]

ISO 7010, *Graphical symbols — Safety colours and safety signs — Registered safety signs*[1)]

ISO 9158, *Road vehicles — Nozzle spouts for unleaded gasoline*

ISO 9159, *Road vehicles — Nozzle spouts for leaded gasoline and diesel fuel*

ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 13732-1, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces*

ISO 13732-3, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 3: Cold surfaces*

ISO 15744, *Hand-held non-electric power tools — Noise measurement code — Engineering method (grade 2)*

ISO 17066, *Hydraulic tools — Vocabulary*

ISO 20643, *Mechanical vibration — Hand-held and hand-guided machinery — Principles for evaluation of vibration emission*

ISO 28927-2, *Hand-held portable power tools — Test methods for evaluation of vibration emission — Part 2: Wrenches, nutrunners and screwdrivers*

EN 12096, *Mechanical vibration — Declaration and verification of vibration emission values*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3857-3, ISO 5391, ISO 12100 and ISO 17066 (for hydraulic tools), and the following apply.

3.1 General definitions

3.1.1
hand-held power tool
machine operated by one or two hands and driven by rotary or linear motors powered by compressed air, hydraulic fluid, gaseous or liquid fuel, electricity or stored energy (e.g. by a spring) to do mechanical work and so designed that the motor and the mechanism form an assembly that can easily be brought to its place of operation

NOTE Hand-held power tools driven by compressed air or gas are called pneumatic tools (or air tools). Hand-held power tools driven by hydraulic liquid are called hydraulic tools.

3.1.2
inserted tool
tool inserted in the assembly power tool for threaded fasteners to perform the intended work

3.1.3
service tool
tool intended for performing maintenance or service on the assembly power tool for threaded fasteners

3.1.4
control device
device to start and stop the assembly power tool for threaded fasteners or to change the direction of the rotation or to control the functional characteristics such as speed and power

1) The graphical symbol collections of ISO 7000, ISO 7001 and ISO 7010 are also available online in the ISO web store. For more information, consult http://www.iso.org/iso/fr/publications_and_e-products/databases.htm.

3.1.5
start-and-stop device
throttle
manually operated control on the assembly power tool for threaded fasteners by which the energy supply to the motor can be turned on and off

3.1.6
hold-to-run start-and-stop device
constant-pressure throttle
start-and-stop device that automatically returns to the OFF position when force on the start-and-stop device actuator is released

3.1.7
lock-on start-and-stop device
constant-pressure throttle with instant release lock
hold-to-run start-and-stop device that can be locked in the ON position and designed so that it permits the assembly power tool for threaded fasteners to be turned off by a single motion of the same finger or fingers used to turn it on

3.1.8
lock-off start-and-stop device
lock-off throttle
start-and-stop device that automatically latches in the OFF position when the actuator is released and where two motions are required to energize the assembly power tool for threaded fasteners

3.1.9
positive on-off start-and-stop device
positive on-off throttle
start-and-stop device that remains in an ON position until it is manually changed

3.1.10
maximum operating pressure
maximum pressure at which an assembly power tool for threaded fasteners may be operated

3.1.11
whip hose
air hose, connecting the main air hose with an air tool for the purpose of providing more flexibility

3.1.12
rated air pressure
air pressure, required at an air tool inlet port to assure rated performance of the tool, also considered the maximum pressure at which the tool may be operated

3.1.13 Rated speed

3.1.13.1
rated speed
⟨pneumatic tool⟩ speed of an air tool at no load and rated air pressure at the tool inlet port

NOTE The rated speed is expressed in revolutions per minute.

3.1.13.2
rated speed
⟨hydraulic tool⟩ nominal speed of a hydraulic tool at no load and rated flow at the tool inlet port

NOTE The rated speed is expressed in revolutions per minute.

3.1.14
maximum attainable speed
maximum speed which the tool can achieve under the most adverse condition of possible maladjustment or malfunction of its speed control devices, when supplied with compressed air at the pressure marked on the assembly power tool for threaded fasteners

3.1.15
suspension device
device, which is attached to the tool, whose primary purpose is to reduce the strain on the operator caused by the weight of the tool

NOTE The device may also have a secondary purpose of transmitting a reaction torque.

3.2 Definitions related to assembly power tools for threaded fasteners

3.2.1
screwdriver
rotary, reversible or non-reversible, power tool driving a spindle fitted with a screwdriver bit

NOTE Screwdrivers can be straight, pistol-grip or angle types, and might or might not have a clutch; these terms are defined in ISO 5391.

3.2.2
nutrunner
rotary, reversible or non-reversible, power tool, incorporating a socket adapter for the tightening of nuts and bolts

NOTE Nutrunners can be pistol-grip or angle-drive types, and might or might not have a clutch. This category includes two-speed and crow-foot nutrunners; these terms are defined in ISO 5391.

3.2.3
impact wrench
percussive rotary power tool fitted with a multi-vane or oscillating motor driving a hammer that periodically strikes an anvil to tighten nuts and bolts without producing any considerable reaction torque on the tool

NOTE These terms are defined in ISO 5391.

3.2.4
air-hydraulic impulse wrench
power assembly tool fitted with a motor driving a hydraulic impulse mechanism for tightening threaded fasteners, which applies torque through a hydraulic impulse unit to a fastener in discontinuous increments

NOTE Air-hydraulic impulse wrenches have the same types as impact wrenches; these terms are defined in ISO 5391.

3.2.5
fastener installation tool
screwdriver, having a manual or automatic reverse mechanism and a threaded drive spindle for installing threaded captive fasteners, which may be straight, pistol-grip or angle-drive type

3.2.6
open-ended spanner
crow-foot with open-ended socket
tube nut wrench
nutrunner or a ratchet wrench with an open-ended socket

3.2.7
ratchet wrench
angle-drive wrench progressively rotating a socket by means of a ratchet and pawl coupling

3.2.8
reaction bar
implement fitted to the hand-held tool to place against a fixed structure of sufficient strength to accept the load of the reaction torque

3.2.9
sleeve fitting
device for aligning the inserted tool or drive adapter with the axis of rotation of the power tool spindle that can reduce the vibration caused by misalignment

3.2.10
drive adapter
implement fitted to the hand-held power tool to drive the threaded fastener

EXAMPLE Drive bits and sockets.

4 Safety requirements and/or protective measures

4.1 General

The machine shall comply with the following safety requirements and/or protective measures and be verified in accordance with Clause 5. In addition, the machine shall be designed in accordance with the principles of ISO 12100 for the relevant, but not necessarily significant, hazards, which are not dealt with by this part of ISO 11148.

The measures adopted to comply with the requirements of Clause 4 shall take account of the state-of-the-art.

It is recognized that optimizing the design with respect to some safety measures can result in a degradation of performance against other safety requirements. In such cases, it is required to strike a balance between the various requirements in order to achieve an assembly power tool design that satisfies each requirement, so far as is reasonably practicable, and remains fit for purpose.

4.2 Mechanical safety

4.2.1 Surfaces, edges and corners

Accessible parts of assembly power tools for threaded fasteners, except the inserted tool, shall not have sharp edges or angles or rough or abrasive surfaces; see ISO 12100:2010, 6.2.2.1.

4.2.2 Supporting surface and stability

Assembly power tools for threaded fasteners shall be so designed that they can be laid aside and remain in a stable position on a plane surface.

4.2.3 Hydraulic fluid ejection

Hydraulic systems of the assembly power tool shall be enclosed so as to give protection against high-pressure fluid ejection.

4.2.4 Guards

Guards covering the drive adaptor and the inserted tool are not required.

4.2.5 Access openings

Openings provided in the assembly power tool for threaded fasteners to allow access to adjusting means shall be designed to protect the operator from pinching his/her fingers while operating the tool; see ISO 13857.

4.2.6 Socket retainer

The socket retainer shall be designed and used so that it retains the socket on the output shaft while the assembly power tool for threaded fasteners is operating. Loose pin retainers shall have a positive means of retaining the pin.

4.2.7 Power tool construction

The assembly power tool for threaded fasteners shall be designed and constructed so as to prevent the loosening or loss of components during expected use, including rough handling and occasional dropping, which can compromise its safety functions. Verification shall be made in accordance with 5.5.

4.3 Thermal safety

Surface temperatures of parts of the assembly power tools for threaded fasteners that are held during use or that can be inadvertently touched shall follow the provisions of ISO 13732-1 and ISO 13732-3.

Pneumatic tools shall be designed to avoid the cooling effects of exhaust air on the handles and other gripping zones.

4.4 Noise reduction

The assembly power tool for threaded fasteners shall be designed and constructed so that the emission of noise is reduced to the lowest level, taking account of technical progress and the availability of means of reducing noise, in particular at the source. Principles for designing assembly power tools for threaded fasteners with reduced noise emission are contained in ISO/TR 11688-1 and ISO/TR 11688-2.

The noise emission from using assembly power tools for threaded fasteners has three main sources:

— the assembly power tool for threaded fasteners itself;

— the inserted tool;

— the workpiece.

NOTE Generally, the noise emitted due to the characteristics of the workpiece cannot be controlled directly by the manufacturer of the assembly power tool for threaded fasteners.

Typical sources of noise emitted by the assembly power tool for threaded fasteners itself are

a) the motor and drive mechanism;

b) the exhaust air or gases;

c) vibration- or impact-induced noise.

Where the exhaust air or gases are the major contributor to the noise, means to reduce the noise, for example a silencer or equivalent means, shall be included in the design.

Alternatively, where practicable, the exhaust air or gases can be piped away from the operator in a hose.

Vibration-induced noise can often be reduced by vibration isolation and damping.

This list is not exhaustive; where alternative technical measures for noise reduction, with greater efficiency, are available, they should be used by the manufacturer.

4.5 Vibration

The assembly power tool for threaded fasteners shall be designed and constructed so that the vibration is reduced to the lowest level at the handles and at any other parts of the tool in contact with the operator's hands, taking account of technical progress and the availability of means of reducing vibration, in particular at source. Principles for designing assembly power tools for threaded fasteners with reduced vibration emission are contained in CR 1030-1.

Typical sources of vibration emitted by an assembly power tool for threaded fasteners are

— unbalance of rotating parts;

— poorly designed motors and gears;

— resonances in the structure of the machine, particularly the handles and their mounts.

The following design features have been found effective and should be considered by manufacturers when designing assembly power tools for threaded fasteners:

a) autobalancers;

b) increasing inertia;

c) isolated casing or handles;

d) in the case of impulse wrenches, the socket interface should be dimensioned as recommended by ISO/TS 21108.

This list is not exhaustive; where alternative technical measures for vibration reduction, with greater efficiency, are available, they should be used by the manufacturer.

4.6 Materials and substances processed, used or exhausted

4.6.1 Exhaust air or gas

Assembly power tools for threaded fasteners driven with compressed air or gas or an internal combustion engine shall be designed in such a way that exhaust air or gases are directed so as not to cause a hazard to the operator and so that any other effects, such as blowing the dust and reflected air or gas from the workpiece onto the operator, are minimized.

4.6.2 Lubricants

When specifying lubricants, the manufacturer shall take environmental and occupational health aspects into account.

4.7 Ergonomics

4.7.1 Design of the handle

Gripping areas of the assembly power tools for threaded fasteners shall be designed to provide a convenient, effective means for the operator to exercise full control over the assembly power tool for threaded fasteners.

Handles and other parts used for gripping the assembly power tool for threaded fasteners shall be designed to ensure that the operator is able to grip the assembly power tool for threaded fasteners correctly and to perform the expected work. Handles shall suit the functional anatomy of the hand and the dimensions of the hands of the operator population.

NOTE Further guidance on ergonomic design principles can be found in EN 614-1.

Assembly power tools for threaded fasteners having a mass greater than 2 kg (including the inserted tool) shall be capable of being supported by two hands while being lifted or operated.

The grip shall be such that normal feed force and reaction torque can be transmitted in an ergonomic way from the hand of the operator to the assembly power tool for threaded fasteners.

The strength of a removable handle and the method of fixing it shall be appropriate to the intended principal use.

4.7.2 Suspension device

Provision shall be made, where appropriate, to enable the attachment to the assembly power tool for threaded fasteners of a suspension device in order to reduce, where practicable, the physical strain placed on the operator by the weight of the assembly power tool for threaded fasteners. The fitting of a suspension device shall not introduce an additional hazard.

4.7.3 Reaction torque absorption

Screwdrivers and nutrunners shall be designed to reduce the effect of the reaction torque as much as possible. The reaction torque can be absorbed by mechanical means, such as support handles, reaction bars or suspension arms.

Where it is possible to envision that screwdrivers and nutrunners can be used in such a manner that the operator is required to absorb a harmful reaction torque, provisions shall be made for the attachment of

absorbing devices (support handles, reaction bars). Reaction bars shall be designed to withstand the strain that can be exerted upon them.

Straight rotary tools shall have provisions for mounting a second handle when the reaction torque absorbed by the operator can exceed 4 N□m.

Pistol-grip tools shall have a provision for mounting a second handle when the reaction torque absorbed by the operator can exceed 10 N□m.

Angle nutrunners shall have provision for mounting a reaction bar when the reaction torque absorbed by the operator can exceed 60 N□m.

NOTE 1 Provision for mounting second handles or reaction bars can be required at values of reaction torque lower than those indicated above, depending upon factors such as the expected frequency and daily duration of operation, the physique and posture of the operator, the type of joint and use of accessories, such as extensions.

NOTE 2 Recommended force limits for machinery operation are given in EN 1005.

Figures 1 to 3 show examples of methods (indicated by the arrows in Figures 1 and 2) for absorbing reaction torque.

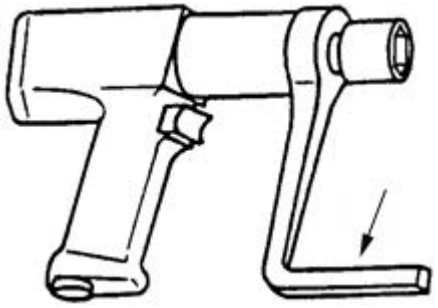


Figure 1 — Reaction bar

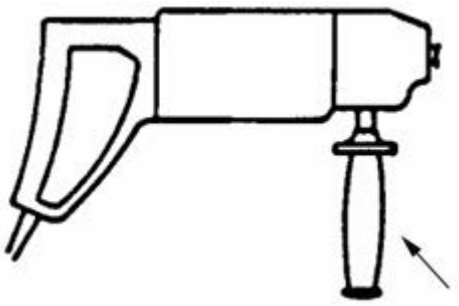


Figure 2 — Support handle

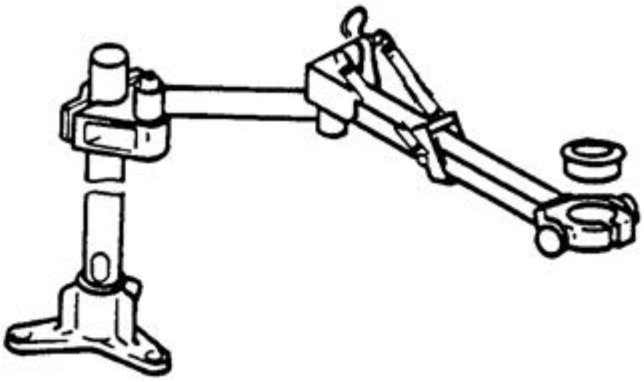


Figure 3 — Suspension arm

4.8 Controls

4.8.1 Start-and-stop device

Assembly power tools for threaded fasteners shall be equipped with a single control device to start or stop them. It shall be adapted to the handle or to the part of the assembly power tool for threaded fasteners being gripped, so that the operator can activate it without releasing the grip on the handles.

Start-and-stop devices shall be so designed that the inserted tool ceases to be powered when the start-and-stop device is released. Without manual effort and when completely released, the device shall move to the stop position, i.e. shall be of the hold-to-run type.

Start-and-stop devices shall be in the stop position or immediately move to the stop position when the assembly power tool for threaded fasteners is connected to the energy supply.

It shall not be possible to lock the start-and-stop device in the running position.

There is an exception for assembly power tools for threaded fasteners with a capacity to tighten fasteners having a thread size of 8 mm or less, which may have a lock-on start-and-stop device.

Start-and-stop devices shall be so positioned or guarded that release cannot be unintentionally or inadvertently prevented. An example of a suitable position for the control device for angle nutrunners is shown in Figure 4.

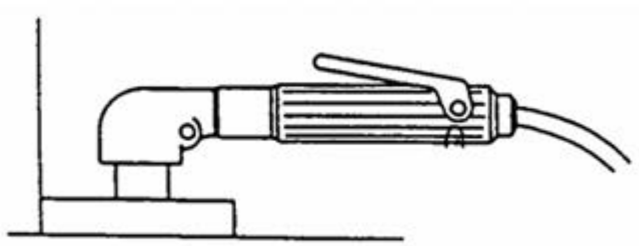


Figure 4 — Suitable position for the control device on the upper side of the handle

4.8.2 Unintentional start

The start-and-stop device for open-ended spanners shall be so designed, positioned or guarded that the risk of unintentional start is minimized. Verification shall be made according to 5.4.

Open-ended spanners shall have a lock-off throttle.

4.8.3 Actuating forces

For assembly power tools for threaded fasteners that are intended for frequent starts or for use with precision work, the actuating force shall be small.

For assembly power tools for threaded fasteners that are normally used in operations of long duration, the force to keep the start device in the run position should be small.

NOTE For further information on trigger forces for control devices, see EN 894-3.

4.8.4 Directional control devices

An assembly power tool for threaded fasteners starting in an unintended direction can be hazardous due to the unexpected direction of the assembly power tool's movement. If it is possible for the assembly power tool for threaded fasteners to start in the reverse direction, the positions of the control device that control the forward and the reverse movements shall be clearly marked by arrows showing the rotational direction of the spindle.

Forward is defined as the direction of rotation of the inserted tool that tightens a right-hand threaded fastener.

Examples of indicating the mode of operation are found in Annex C.

5 Verification

5.1 General conditions for tests

Tests according to this part of ISO 11148 are type tests.

5.2 Noise

The noise-emission values shall be measured and declared in accordance with ISO 15744.

Compliance with 4.4 may be verified through the comparison of the noise emission values with those for other machines of the same family or with machines of similar size and performance characteristics.

5.3 Vibration

The vibration total value shall be measured and reported in accordance with ISO 28927-2.

The vibration-emission value and its uncertainty shall be declared in accordance with EN 12096.

Compliance with 4.5 may be verified through the comparison of the vibration emission values with those for other machines of the same family or with machines of similar size and performance characteristics.

5.4 Unintentional start

Compliance with 4.8.2 shall be verified as follows.

Visually check that open-ended spanners require two separate and dissimilar actions to start them.

Open-ended spanners shall be subjected to a test in which the open-ended spanner shall be connected to the energy supply and placed in any possible position and pulled over the horizontal plane by its hose and the tool shall then not start.

5.5 Power tool construction

Compliance with 4.2.7 shall be verified by dropping a sample assembly power tool for threaded fasteners without inserted tool or accessory three times onto a concrete surface from a height of 1 m without affecting its operational and safety functions. The sample shall be positioned to vary the point of impact.

5.6 Structure of verification of safety requirements

Table 1 — Structure of verification

Safety requirement	Visual check	Functional check	Measurement	Reference [to the subclause(s) of this part of ISO 11148 or other standard]
4.2.1 Surfaces, edges and corners	X	—	—	—
4.2.2 Supporting surface and stability	X	X	—	—
4.2.3 Hydraulic fluid ejection	X	—	—	—
4.2.5 Access openings	X	—	—	—
4.2.6 Socket retainer	X	—	—	—
4.2.7 Power tool construction	—	X	—	5.5
4.3 Thermal safety	—	X	X	ISO 13732-1 ISO 13732-3
4.4 Noise reduction	—	—	X	ISO 15744 5.2
4.5 Vibration	—	—	X	ISO 28927-2 5.3
4.6.1 Exhaust air or gas	—	X	—	—
4.7.1 Design of the handle	X	—	—	—
4.7.2 Suspension device	X	X	—	—
4.7.3 Reaction torque absorption	X	X	—	—
4.8.1 Start-and-stop device	—	X	—	—
4.8.2 Unintentional start	X	X	—	5.4
4.8.3 Actuating forces	X	X	—	—
4.8.4 Directional control device	X	X	—	—

6 Information for use

6.1 Marking, signs and written warnings

Assembly power tools for threaded fasteners shall be marked visibly, legibly and indelibly with the following information:

— name and full address of the manufacturer and, where applicable, his/her authorized representative;

NOTE 1 The address can be simplified if there is not really enough room on small machines, as long as the manufacturer (and, where applicable, his/her authorized representative) can always be identified so that mail is able to reach the company.

— designation of series or type;

NOTE 2 The designation of the tool can be achieved by a combination of letters and numbers.

— serial number or batch number;

— year of construction, that is the year in which the manufacturing process is completed;

— rated speed, in revolutions per minute:

  — for pneumatic assembly power tools for threaded fasteners:

    — the rated air pressure marked as (max.);

  — for hydraulic assembly power tools for threaded fasteners:

    — the nominal pressure and flow,

    — the maximum allowable setting for the pressure relief valve.

Assembly power tools for threaded fasteners shall be permanently marked with a graphical symbol in accordance with Annex C showing that the operator's instructions shall be read before work starts.

The direction of rotation, as required in 4.8.4, shall be permanently marked in accordance with Annex C.

Open-ended spanners shall have a warning sign in accordance with Annex C affixed to the head, warning against the risk of crushing.

Tools with fixed torque reaction bars shall be provided with labels as shown in Annex C indicating the proper position of the reaction device.

Other graphical symbols that can be used are shown in Annex C.

6.2 Instructions handbook

6.2.1 General

For the information provided to the user, the content of Clause 6 together with ISO 12100:2010, 6.4.5.2 and 6.4.5.3, apply.

The information provided by the manufacturer is an important, but not exclusive, basis for the safe use of the assembly power tool for threaded fasteners. It shall provide sufficient information for the end user to perform an initial risk assessment.

The hazards identified in 6.2.2.4 to 6.2.2.12 are foreseeable in the general use of hand-held assembly power tools for threaded fasteners. The information provided with the tool shall state that the user or the user's employer shall assess the specific risks that can be present as a result of each use.

The instructions handbook shall contain information relating to at least the following:

— name and address of the manufacturer or supplier or any other agent responsible for placing the assembly power tool for threaded fasteners on the market;

— designation of the series or type;

— operating instructions; see 6.3;

— information on noise emission; see 6.4.2;

— information on vibration transmitted to the hands of the operator; see 6.4.3;

— maintenance instructions; see 6.5;

— explanations of any symbols marked on the assembly power tool for threaded fasteners; see Annex C;

— information about residual risks and how to control them.

6.2.2 Operator's instructions

6.2.2.1 General

The instructions and warnings stated in 6.2.2 to 6.2.4 shall be given with all assembly power tools for threaded fasteners unless the risk assessment shows that they are not relevant to a particular assembly power tool for threaded fasteners. Words of equivalent meaning may be used.

6.2.2.2 Statement of use

The operator's instructions shall include a description of the correct use of the assembly power tool for threaded fasteners and make reference to the appropriate inserted tools. The operator's instructions shall state that any other use is forbidden. Foreseeable misuse of the assembly power tool for threaded fasteners, which experience has shown to occur, shall be warned against.

6.2.2.3 Allowance for user

The operator's instructions shall be written primarily for professional users. Where a tool can be used by non-professional users, additional information for use shall be provided.

6.2.2.4 General safety rules

— For multiple hazards, read and understand the safety instructions before installing, operating, repairing, maintaining, changing accessories on, or working near the assembly power tool for threaded fasteners. Failure to do so can result in serious bodily injury.

— Only qualified and trained operators should install, adjust or use the assembly power tool for threaded fasteners.

— Do not modify this assembly power tool for threaded fasteners. Modifications can reduce the effectiveness of safety measures and increase the risks to the operator.

— Do not discard the safety instructions; give them to the operator.

— Do not use the assembly power tool for threaded fasteners if it has been damaged.

— Tools shall be inspected periodically to verify that the ratings and markings required by this part of ISO 11148 are legibly marked on the tool. The employer/user shall contact the manufacturer to obtain replacement marking labels when necessary.

6.2.2.5 Projectile hazards

— Failure of the workpiece, of accessories or even of the inserted tool itself can generate high-velocity projectiles.

— Always wear impact-resistant eye protection during the operation of the assembly power tool for threaded fasteners. The grade of protection required should be assessed for each use.

— Ensure that the workpiece is securely fixed.

6.2.2.6 Entanglement hazards

— Entanglement hazards can result in choking, scalping and/or lacerations if loose clothing, personal jewellery, neckware, hair or gloves are not kept away from the tool and accessories.

— Gloves can become entangled with the rotating drive, causing severed or broken fingers.

— Rotating drive sockets and drive extensions can easily entangle rubber-coated or metal-reinforced gloves.

— Do not wear loose-fitting gloves or gloves with cut or frayed fingers.

— Never hold the drive, socket or drive extension.

— Keep hands away from rotating drives.

6.2.2.7 Operating hazards

— The use of the tool can expose the operator’s hands to hazards including crushing, impacts, cuts and abrasions and heat. Wear suitable gloves to protect hands.

— Operators and maintenance personnel shall be physically able to handle the bulk, weight and power of the tool.

— Hold the tool correctly; be ready to counteract normal or sudden movements and have both hands available.

— Maintain a balanced body position and secure footing.

— In cases where the means to absorb the reaction torque are requested, it is recommended to use a suspension arm whenever possible. If that is not possible, side handles are recommended for straight-case and pistol-grip tools. Reaction bars are recommended for angle nutrunners. In any case, it is recommended to use a means to absorb the reaction torque above 4 N·m for straight tools, above 10 N·m for pistol-grip tools, and above 60 N·m for angle nutrunners.

— Release the start-and-stop device in the case of an interruption of the energy supply.

— Use only lubricants recommended by the manufacturer.

— Fingers can be crushed in open-ended crow-foot nutrunners.

— Do not use in confined spaces and beware of crushing hands between tool and workpiece, especially when unscrewing.

6.2.2.8 Repetitive motions hazards

— When using a power tool for, the operator can experience discomfort in the hands, arms, shoulders, neck, or other parts of the body.

— While using an assembly power tool for threaded fasteners, the operator should adopt a comfortable posture while maintaining secure footing and avoiding awkward or off-balanced postures. The operator should change posture during extended tasks, which can help avoid discomfort and fatigue.

— If the operator experiences symptoms such as persistent or recurring discomfort, pain, throbbing, aching, tingling, numbness, burning sensations or stiffness, these warning signs should not be ignored. The operator should tell the employer and consult a qualified health professional.

6.2.2.9 Accessory hazards

— Disconnect the assembly power tool for threaded fasteners from the energy supply before changing the inserted tool or accessory.

— Do not touch sockets or accessories during impacting, as this increases the risk of cuts, burns or vibration injuries.

— Use only sizes and types of accessories and consumables that are recommended by the assembly power tool for threaded fasteners manufacturer; do not use other types or sizes of accessories and consumables.

— Use only impact-wrench-rated sockets in good condition, as poor condition or hand sockets and accessories used with impact wrenches can shatter and become a projectile.

6.2.2.10 Workplace hazards

— Slips, trips and falls are major causes of workplace injury. Be aware of slippery surfaces caused by the use of the tool and also of trip hazards caused by the air line or hydraulic hose.

— Proceed with care in unfamiliar surroundings. Hidden hazards, such as electricity or other utility lines, can exist.

— The assembly power tool for threaded fasteners is not intended for use in potentially explosive atmospheres and is not insulated against coming into contact with electric power.

— Make sure there are no electrical cables, gas pipes, etc., that can cause a hazard if damaged by use of the tool.

6.2.2.11 Dust and fume hazards

— Dust and fumes generated when using assembly power tools for threaded fasteners can cause ill health (for example cancer, birth defects, asthma and/or dermatitis); risk assessment and implementation of appropriate controls for these hazards are essential.

— Risk assessment should include dust created by the use of the tool and the potential for disturbing existing dust.

— Direct the exhaust so as to minimize disturbance of dust in a dust-filled environment.

— Where dust or fumes are created, the priority shall be to control them at the point of emission.

— All integral features or accessories for the collection, extraction or suppression of airborne dust or fumes should be correctly used and maintained in accordance with the manufacturer's instructions.

— Use respiratory protection in accordance with employer's instructions and as required by occupational health and safety regulations.

6.2.2.12 Noise hazards

— Exposure to high noise levels can cause permanent, disabling hearing loss and other problems, such as tinnitus (ringing, buzzing, whistling or humming in the ears). Therefore a risk assessment and implementation of appropriate controls for these hazards are essential.

— Appropriate controls to reduce the risk may include actions such as damping materials to prevent workpieces from "ringing".

— Use hearing protection in accordance with employer's instructions and as required by occupational health and safety regulations.

— Operate and maintain the assembly power tool for threaded fasteners as recommended in the instructions handbook, to prevent an unnecessary increase in noise levels.

— If the assembly power tool for threaded fasteners has a silencer, always ensure it is in place and in good working order when the assembly power tool for threaded fasteners is operating.

— Select, maintain and replace the consumable/inserted tool as recommended in the instructions handbook, to prevent an unnecessary increase in noise.

6.2.2.13 Vibration hazards

The information for use shall draw attention to vibration hazards that have not been eliminated by design and construction and remain as residual vibration risks. It shall enable employers to identify the circumstances in which the operator is likely to be at risk from vibration exposure. If the vibration emission value obtained using ISO 28927-2 does not adequately represent the vibration emission in the intended uses (and foreseeable misuses) of the machine, additional information shall be supplied to enable the risks arising from vibration to be assessed and managed.

For recommended interface dimensions for spindles and drive adapters to help reduce vibrations, see ISO/TS 21108.

— Exposure to vibration can cause disabling damage to the nerves and blood supply of the hands and arms.

— Keep the hands away from the nutrunner sockets.

— Wear warm clothing when working in cold conditions and keep your hands warm and dry.

— If you experience numbness, tingling, pain or whitening of the skin in your fingers or hands, stop using the assembly power tool for threaded fasteners, tell your employer and consult a physician.

— Operate and maintain the assembly power tool for threaded fasteners as recommended in the instructions handbook, to prevent an unnecessary increase in vibration levels.

— Do not use worn or ill-fitting sockets or extensions, as this is likely to cause a substantial increase in vibration.

— Select, maintain and replace the consumable/inserted tool as recommended in the instructions handbook, to prevent an unnecessary increase in vibration levels.

— Sleeve fittings should be used where practicable.

— Support the weight of the tool in a stand, tensioner or balancer, if possible.

— Hold the tool with a light but safe grip, taking account of the required hand reaction forces, because the risk from vibration is generally greater when the grip force is higher.

6.2.3 Additional safety instructions for pneumatic power tools

— Air under pressure can cause severe injury:

  — always shut off air supply, drain hose of air pressure and disconnect tool from air supply when not in use, before changing accessories or when making repairs;

  — never direct air at yourself or anyone else.

— Whipping hoses can cause severe injury. Always check for damaged or loose hoses and fittings.

— Cold air shall be directed away from the hands.

— Do not use quick-disconnect couplings at tool inlet for impact and air-hydraulic impulse wrenches. Use hardened steel (or material with comparable shock resistance) threaded hose fittings.

— Whenever universal twist couplings (claw couplings) are used, lock pins shall be installed and whipcheck safety cables shall be used to safeguard against possible hose-to-tool and hose-and-hose connection failure.

— Do not exceed the maximum air pressure stated on the tool.

— For torque-control and continuous-rotation tools, the air pressure has a safety critical effect on performance. Therefore, requirements for length and diameter of the hose shall be specified.

— Never carry an air tool by the hose.

6.2.4 Additional safety instructions for hydraulic power tools

— Do not exceed the maximum relief-valve setting stated on the tool.

— Carry out a daily check for damaged or worn hoses or hydraulic connections and replace if necessary.

— Use only clean oil and filling equipment.

— Power units require a free flow of air for cooling purposes and should, therefore, be positioned in a well ventilated area free from hazardous fumes.

— Ensure that couplings are clean and correctly engaged before operation.

— Do not inspect or clean the tool while the hydraulic power source is connected. Accidental engagement of the tool can cause serious injury.

— Do not install or remove the tool while the hydraulic power source is connected. Accidental engagement of the tool can cause serious injury.

— Be sure all hose connections are tight.

— Wipe all couplers clean before connecting. Failure to do so can result in damage to the quick couplers and cause overheating.

Instructions shall be given that only hydraulic fluid recommended by the manufacturer shall be used.

NOTE It is advisable to equire of the manufacturer whether or not non-flammable fluids can be used.

6.2.5 Specific safety instructions

Warnings shall be given about any specific or unusual hazards associated with the use of the assembly power tool for threaded fasteners. Such warnings shall indicate the nature of the hazard, the risk of injury and the avoidance action to take.

6.3 Operating instructions

The instructions shall include, where appropriate,

— instructions for setting up or fixing the assembly power tool for threaded fasteners in a stable position, appropriate for assembly power tools for threaded fasteners that can be mounted in a support;

— assembly instructions, accessories and inserted tools;

— illustrated description of functions;

— limitation on tool use due to environmental conditions;

— instructions for setting and testing;

— general instructions for use, including changing inserted tools and limits on the size and type of workpiece.

6.4 Data

6.4.1 General

The instructions shall include the information on the data plate and the following:

— mass of the assembly power tool for threaded fasteners;

— for hydraulic assembly power tools for threaded fasteners:

  — specification of the coupling,

  — specification of hoses with regard to pressure and flow,

  — maximum inlet temperature of the inlet fluid.

6.4.2 Noise

6.4.2.1 Declaration of emission

The instructions shall include a noise-emission declaration in accordance with ISO 15744.

6.4.2.2 Additional information

If the values for noise emissions obtained using the appropriate tests defined in 5.2 do not adequately represent the emissions during the intended uses of the machine, additional information and/or warnings shall be supplied to enable an assessment and the management of the associated risks.

Information on noise emission shall also be provided in the sales literature describing the performance characteristics of machinery.

6.4.3 Vibration

6.4.3.1 Declaration of emission

The instructions handbook shall include the vibration-emission value and uncertainty as specified in 5.3 and the reference number of the test code, ISO 28927-2.

6.4.3.2 Additional information

If the values for vibration emissions obtained using the appropriate tests defined in 5.3 do not adequately represent the emissions during the intended uses of the machine, additional information and/or warnings shall be supplied to enable the potential risks to be assessed and managed.

Information on vibration emission should also be provided in the sales literature.

6.5 Maintenance instructions

The maintenance instructions shall contain

— instructions to keep the assembly power tools for threaded fasteners safe by regular preventative maintenance;

— information on when the regular preventative maintenance shall be carried out, for instance, after a specified time of operation, a specified number of cycles/operations or a stated number of times per year;

— instructions for disposal so as not to expose personnel and the environment to hazards;

— list of the service operations that the user should carry out;

— instructions for lubrication, if required;

— instructions to check the speed and make a simple check of the vibration level after each service;

— instructions to check the speed regularly;

— specifications of the spare parts for use when these affect the health and safety of operators.

Maintenance instructions shall include the precautions to take to avoid exposure to hazardous substances deposited (due to work processes) on the tool.

NOTE Skin exposure to hazardous dust can cause severe dermatitis. If dust is generated or disturbed during the maintenance procedure, it can be inhaled.

Annex A
(informative)

List of significant hazards

This annex contains all the significant hazards, hazardous situations and events, as far as they are dealt with in this part of ISO 11148, identified by risk assessment as significant for this type of machinery and that require action to eliminate or reduce the risk. The following significant hazards are associated with the use of assembly power tools for threaded fasteners. For additional hazards that can occur in assembly power tools for threaded fasteners driven by an internal combustion engine, see Annex D.

Table A.1 — List of significant hazards

Hazard type		Reference to safety requirement	
		By design or guarding	Information for use
1	Mechanical hazards:		
—	crushing	4.2.5, 4.8.1, 4.8.2, 4.8.4	6.2.2.5, 6.2.2.6
—	cutting	4.2.1, 4.8.1, 4.8.2, 4.8.3	6.2.2.5, 6.2.2.6, 6.2.2.8
—	drawing in or trapping (caused by hair, clothing, etc., getting entangled in a rotating assembly power tool for threaded fasteners)	4.8.1, 4.8.2, 4.8.3	6.2.2.5, 6.2.2.8
—	friction or abrasion hazard	4.2.1, 4.8.1, 4.8.2	6.2.2.6, 6.2.2.8
—	loss of stability	4.2.2	
—	whipping hose		6.2.3, 6.2.4
—	ejection from high-pressure hydraulic systems	4.2.3	
—	ejection of parts	4.2.4, 4.2.6, 4.2.7	6.2.2.4, 6.2.2.8
—	hose and hose coupling specifications		6.2.3, 6.2.4
2	Electrical hazards		6.2.2.9
3	Thermal hazards:	4.3	
—	explosions		6.2.2.9
—	health damage due to hot or cold surfaces	4.3	6.2.2.8
4	Hazards caused by noise	4.4	6.2.2.11
5	Hazards generated by vibration	4.5	6.2.2.12
—	hazards caused by the operator putting hands on the nut-running socket		6.2.2.5, 6.2.2.8
6	Hazards generated by materials and substances processed, used or exhausted:		
—	exhaust air or gas	4.6.1	6.2.3, 6.2.2.10
—	lubricants	4.6.2	6.2.2.6
—	hydraulic fluid	4.2.3	6.2.4
7	Hazards caused by neglecting ergonomic principles:		
—	repetitive strain injuries	4.7.1, 4.7.2, 4.7.3, 4.8.3	6.2.2.6, 6.2.2.7
—	unsuitable postures		6.2.2.6, 6.2.2.7
—	inadequate grip design and tool balance		6.2.2.6
—	effects of reaction forces upon operator	4.7.3	6.2.2.6
—	neglected use of personal protection equipment		6.2.2.4, 6.2.2.5, 6.2.2.6, 6.2.2.10
8	Hazards caused by the energy supply:		

Table A.1 *(continued)*

Hazard type		Reference to safety requirement	
		By design or guarding	Information for use
—	unexpected return of energy supply after a breakdown		6.2.4, 6.2.2.6
—	discharge of high-pressure air or hydraulic fluid		6.2.4
—	incorrect hydraulic fluid flow and outlet pressure		6.2.4
9	Hazards caused by missing and/or incorrectly positioned safety-related means:		
—	start-and-stop device	4.8.1	6.2.2.6
—	unintentional start	4.8.2	

Annex B
(informative)

Examples of assembly power tools for threaded fasteners covered by this part of ISO 11148

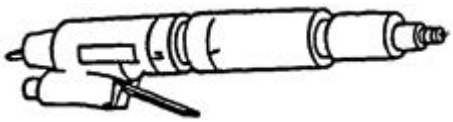


Figure B.1 — Fastener installation tool (straight)

Figure B.2 — Screwdriver (straight)

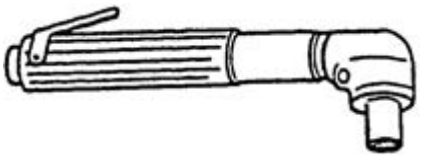


Figure B.3 — Nutrunner (angle)

Figure B.4 — Ratchet wrench

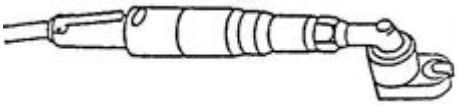


Figure B.5 — Open-ended spanner

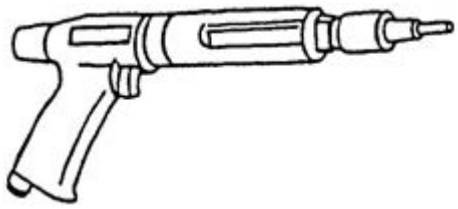


Figure B.6 — Fastener installation tool (pistol-grip)

Figure B.7 — Screwdriver (pistol-grip)

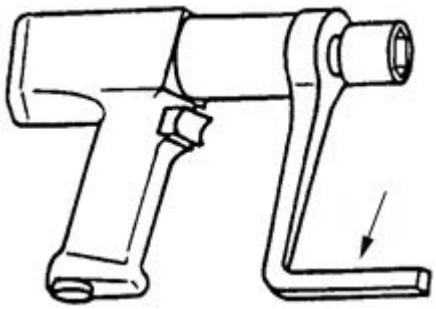


Figure B.8 — Nutrunner (pistol-grip)

Figure B.9 — Impact or air-hydraulic impulse wrench (pistol-grip)

Annex C
(normative)

Symbols for labels and signs

C.1 Normative symbols for labels and signs

Table C.1 — Symbols for labels and signs

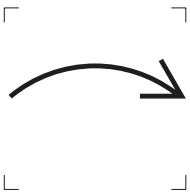
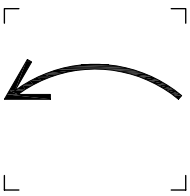
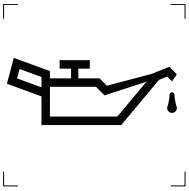
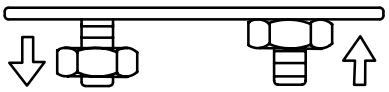
No.	Symbol	Significance	Colours	Symbol registration number or source
C.1.1		Warning Minimum requirement. This symbol is normative. Additional symbols and/or text are informative.	Background in the circle: blue Symbol: white Background for warning: orange	ISO 3864-2 ISO 7010-M002
C.1.2		Warning Risk of crushing (intended for open-ended spanners)	Background: yellow Triangular band: black Symbol: black	
C.1.3		Warning Risk of crushing (between the reaction bar and the workpiece)	Background: yellow Triangular band: black Symbol: black	
C.1.4		Direction of rotation	Background: optional Symbol: black	Application of ISO 7000-0004
C.1.5		Direction of rotation	Background: optional Symbol: black	Application of ISO 7000-0004

Table C.1 *(continued)*

No.	Symbol	Significance	Colours	Symbol registration number or source
C.1.6		Tools with fixed torque reaction devices shall be provided with labels indicating the proper position of the reaction device.		ANSI B186.1
C.1.7		Engine oil	Background: optional Symbol: black	ISO 7000-0248
C.1.8		Fuel	Background: optional Symbol: black	ISO 7000-0245

C.2 Informative symbols for labels and signs

Table C.2 — Alternative symbol(s)

No.	Symbol	Significance	Colours	Corresponding standard
C.2.9		Alternative direction of rotation		

Annex D
(normative)

Additional safety requirements related to internal combustion engine power tools

D.1 General

This annex covers the additional safety requirements related to the internal combustion engines (ICEs) of assembly power tools for threaded fasteners, both rotary and linear and powered by liquid or gaseous fuel.

D.2 List of hazards

Table D.1 lists the hazards that are specific to cases when the energy source is an internal combustion engine.

Table D.1 — List of hazards for tolls with an internal combustion engine as energy source

Hazard type	Reference to safety requirement	
	By design or guarding	Information for use
D.2.1 Mechanical hazards: — incorrect carburettor adjustment	D.3.1	—
D.2.2 Electrical hazards	D.3.2	—
D.2.3 Thermal hazards: — radiation of heat sources	D.3.3	—
D.2.4 Hazards generated by materials and substances processed, used or exhausted: — resulting from contact with or inhalation of harmful fluids, gases, mists and fumes — fires or explosion hazards — incorrect fuel	D.3.4	6.2
D.2.5 Hazards caused by functional disorders: — resulting from unexpected ejection of fluid — breakdown of pressurized gas container	D.3.6	—
D.2.6 Hazards caused by missing or incorrectly positioned safety related measures and means	D.3.5	—

D.3 Safety requirements and measures

D.3.1 Mechanical safety

If carburettors or other fuel-management-system devices are adjustable, it shall be possible to adjust them from the outside without removal of casing parts; the control devices shall be easily and safely accessible.

D.3.2 Electrical safety

The electrical equipment in the internal combustion engine shall be insulated and covered so that the risk of electric shock or arcing is removed.

D.3.3 Thermal safety

Radiation of heat from hot surfaces and exhaust gases shall not cause a hazard to the operator under normal working conditions.

D.3.4 Materials and substances processed, used or exhausted

Refillable tanks for fuel and oil shall fulfil the following requirements.

— The openings for both fuel and oil shall be positioned so that filling can be carried out without obstacles and so that spillage is avoided.

— The openings shall be positioned so that no spills fall on hot surfaces.

— The tank caps shall have retainers to prevent them from being lost.

— The opening of the fuel tank shall be large enough to enable the filling with a standard canister with a nozzle spout in accordance with ISO 9158 or ISO 9159.

No apparent leakage of fuel from the fuel tank is allowed under normal operating conditions. Leakage from the venting hole in the cap is accepted.

D.3.5 Missing or incorrectly positioned safety-related measures and means

When releasing the start-and-stop device, the movement of the inserted tool is allowed to continue at idling speed, if it cannot cause any hazard.

D.3.6 Pressurized gas container

Containers for liquefied petrol gas (LPG) shall fulfil national regulations.

D.4 Information for use

D.4.1 Markings, signs and warnings

The openings for fuel and oil shall be clearly and indelibly marked. Marking on the fuel tank and lubrication tank openings shall be a symbol in accordance with Annex C.

Devices for adjustment of the carburettor or other fuel metering devices shall be clearly and indelibly marked and indicated on the ICE-driven assembly power tool for threaded fasteners.

Symbols used shall be clear, unambiguous and shall be explained in the instructions handbook.

D.4.2 Instructions handbook

D.4.2.1 Additional safety instructions for ICE power tools

The following warnings (or equivalent) shall be given with all ICE assembly power tools for threaded fasteners, in addition to those specified in Clause 6:

D.4.2.1.1 Fuel hazards

The following are fuel hazards.

— Fuel is highly flammable:

  — never smoke near the machine;

— never smoke when filling fuel.

— Spillage of fuel can cause a fire:

— operate the machine with the fuel cap securely in place;

— when opening the fuel cap, always loosen the cap slowly to relieve any pressure in the tank;

— never remove the fuel cap or add fuel when the engine is hot. Stop the engine and allow it to cool before adding fuel;

— do not overfill the tank;

— do not use a machine that is leaking fuel;

— ensure that the machine is upright during transportation.

— Include instructions on how to transport the assembly power tool for threaded fasteners so as to minimize the risk of fuel leakage.

— Include instructions on how to adjust the carburettor or other fuel-metering device.

— Specify that empty LPG containers shall be taken care of and sent back to the retailer.

D.4.2.1.2 Inhalation hazards

Inhalation of exhaust fumes can cause death by asphyxiation. Do not operate the machine in an unventilated environment or in closed pits where the surroundings hinder or prevent air circulation.

D.4.2.1.3 High-temperature hazards

The following are high-temperature hazards.

— The exhaust pipe and other machine parts can get very hot during operation, and can remain hot during a period of time after the machine has been shut off:

— never touch the exhaust pipe or any other part of the machine before it has cooled down;

— wait until the inserted tool has cooled down before performing maintenance on the machine.

— Hot parts and hot exhaust gases can cause materials in contact or nearby to burn or explode. Do not use or leave the machine near flammable material, gases or dust particles.

D.4.2.1.4 Consumable hazards

The following are consumable hazards.

— Fuel and oil can penetrate the skin and cause permanent damage:

— wear safety gloves resistant to fluids used;

— do not use your fingers to check for fluid leaks;

— consult a physician if fuel or oil has penetrated the skin.

D.4.2.2 Operating instructions

The operating instructions for ICE assembly power tools for threaded fasteners shall, in addition to the information listed in Clause 6, also

— include instructions on how to transport the assembly power tool for threaded fasteners so as to minimize the risk of fuel leakage;

— instruct how to adjust the carburettor or other fuel-metering device;

— specify that empty LPG containers shall be taken care of and sent back to the retailer.

D.4.2.3 Data

In addition to the information specified in 6.4, data on the fuel quality, i.e. for petrol, the lead content and octane number, and for LPG, the specified class, shall also be included.

D.4.2.4 Maintenance instructions

The maintenance instruction shall contain instructions for checking electrical cables and electric insulation.

Bibliography

NOTE The documents listed are not referred to as normative in the text of this part of ISO 11148, however they have a bearing on the specifications and are listed for information. This is not an exhaustive list.

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

[2] ISO 3857-1, *Compressors, pneumatic tools and machines — Vocabulary — Part 1: General*

[3] ISO 3864-1, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs and safety markings*

[4] ISO 4871, *Acoustics — Declaration and verification of noise emission values of machinery and equipment*

[5] ISO/TR 11688-1, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning*

[6] ISO/TR 11688-2, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 2: Introduction to the physics of low-noise design*

[7] ISO 11690 (all parts), *Acoustics — Recommended practice for the design of low-noise workplaces containing machinery*

[8] ISO 13857, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

[9] ISO/TS 21108, *Hand-held power tools — Impulse wrenches — Dimensions and tolerances of interface to power socket*

[10] EN 614-1, *Safety of machinery — Ergonomic design principles — Part 1: Terminology and general principles*

[11] EN 626 (all parts), *Safety of machinery — Reduction of risks to health from hazardous substances emitted by machinery*

[12] EN 894-3, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 3: Control actuators*

[13] EN 982, *Safety of machinery — Safety requirements for fluid power systems and their components — Hydraulics*

[14] EN 983, *Safety of machinery — Safety requirements for fluid power systems and their components — Pneumatics*

[15] EN 1005 (all parts), *Safety of machinery — Human physical performance*

[16] EN 13463-1, *Non-electrical equipment for use in potentially explosive atmospheres — Part 1: Basic method and requirements*

[17] IEC 60745-1, *Hand-held motor-operated tools — Part 1: General requirements*

[18] IEC 61310-1, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, acoustic and tactile signals*

[19] IEC 61310-2, *Safety of machinery — Indication, marking and actuation — Part 2: Requirements for marking*

[20] E.H.T.M.A., *Recommendations for the correct use of hand-held or portable hydraulic tools and associated portable power sources*, June 1991[2)]

[21] CR 1030-1, *Hand-arm vibration — Guidelines for vibration hazards reduction — Part 1: Engineering methods by design of machinery*

[22] ANSI B186, *Safety Code for Portable Air Tools*

2) EHTMA publications can be obtained from: http://www.ehtma.com or mailto:secretary@ehtma.com.

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