TECHNICAL SPECIFICATION

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Acceptance tests for CO_2-laser beam machines for welding and cutting using 2D moving optics type

Essais de réception des machines de soudage et de coupage par faisceau laser CO_2, à l'aide d'optiques mobiles 2D

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Foreword

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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.

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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 17477 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 10, *Unification of requirements in the field of metal welding*.

Introduction

Requests for official interpretations of any aspect of this Technical Specification should be directed to the Secretariat of ISO/TC 44/SC 10, *Unification of requirements in the field of metal welding* via your national standards body, a complete listing of which can be found at www.iso.org.

Acceptance tests for CO_2-laser beam machines for welding and cutting using 2D moving optics type

1 Scope

The purpose of this Technical Specification is to provide a guideline on minimum requirements for acceptance tests by using practical test methods for the two-dimensional CO_2-laser beam machines for welding and cutting, fixing a workpiece on the platen, by using moving optics. This Technical Specification is not applicable to machines that use an articulated robot.

This Technical Specification does not cover hazard protection devices that shall be used with laser machining equipment such as the devices for discharging chips and particles that are generated during welding and cutting.

2 Terms and definitions

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

2.1
deviation from intersection
longest distance between any two points that is made by three or more straight intersects

2.2
marking
tracing the trajectory of the machining head and marking it on the paper with a ballpoint pen, an equivalent marking pen installed on the tip of the machining head, or scribe the trajectory with a low-power laser beam, or an equivalent instrument agreed between the parties concerned, when the laser machine is being operated

3 Classification of machine type

Judgement criteria/allowance value are classified into two machine types as follows:

— Class A: laser beam source is built into moving machine;

— Class B: laser beam source is not built into moving machine.

4 Acceptance test conditions

4.1 Installation environment

The laser machine to be subjected to the acceptance test shall be installed in such a way that the welding and cutting operation will not significantly be disturbed by vibrations and temperature variations.

4.2 Power supply

The power source for the laser machine and its cooling system shall conform to the manufacturer's specifications for the equipment. Output voltage fluctuations shall be within ± 10 % of the nominal voltage.

4.3 Cooling system

If the cooling system is not supplied with the welding and cutting equipment, it shall conform to the welding and cutting equipment manufacturer's specifications (for the water flow, temperature control range, cooling capacity, etc.).

The quality of the cooling water (purity, conductivity, pH, etc.) shall be as specified by the welding and cutting equipment manufacturer.

4.4 Gas supply and gas supply system

The flow rate and quality of the laser gases, assist gases or shield gas (plasma removing, cutting and welding gases), and purging gases shall be as specified by the welding and cutting equipment manufacturer.

4.5 Operating instruction for users

Technical information necessary for operation, maintenance and control of the equipment and at least the minimum information related to the safety of welding and cutting processing equipment, shall be provided by the supplier.

5 Acceptance test items

5.1 Check of parts

A check shall be made that all specified parts of the equipment are available and properly installed.

5.2 Machine accuracy verification testing

5.2.1 Accuracy test variables

The following variables shall be checked for accuracy in accordance with 5.2.3 and 5.2.4:

a) trajectory accuracy;

b) straightness of the motion in X-axis direction;

c) straightness of the motion in Y-axis direction;

d) squareness between X and Y axes;

e) positioning accuracy of the motion in X-axis direction;

f) positioning accuracy of the motion in Y-axis direction;

g) machining speed accuracy.

NOTE See also Table 1.

5.2.2 Measuring instruments

Measurements for the accuracy tests shall be carried out with calibrated measuring instruments, such as standard scale, tape measure, dial gauge and/or steel wire, or other measuring instruments as agreed between the parties concerned.

5.2.3 Test methods

5.2.3.1 General

The accuracy of the variables listed in 5.2.1 shall be verified using the following methods.

5.2.3.2 Trajectory accuracy

The laser machine shall be used to draw the diagram, shown in Figure 1 with external dimensions 800 mm × 800 mm. The starting position shall be A and follow the sequence as listed under Figure 1, i.e. A, B, C, D, A, C, H, etc. For laser machines with an effective machining range less than 800 mm × 800 mm, the largest square covering the effective machining range shall be drawn. The pattern shall be drawn at 1 000 mm/min using the machine's numerical control system. Deviations from the intersections, meandering of trajectories and deviations of arc trajectories shall be monitored in accordance with the following procedures. For laser machines with a single-sided drive, the test shall be carried out on the driving side. The pattern shown in Figure 1 shall be drawn as follows:

1) one side of the external square shall be drawn parallel to the X-axis;

2) all straight lines shall be drawn continuously;

3) the circle shall be drawn continuously;

4) the circle shall be overwritten once in both the clockwise and anti-clockwise directions;

5) dwell time shall be determined by the parties concerned.

The deviation of any line at an intersection where three or more straight lines come together (A to H) or intersect (J to R) shall be measured.

Meandering of the trajectory shall be checked by measuring the maximum deviation of the actual trajectory from each straight ruled line shown in Figure 1.

Deviation of the arc trajectory shall be checked by measuring the maximum deviation of the circle that has been overwritten in both the clockwise and anti-clockwise directions.

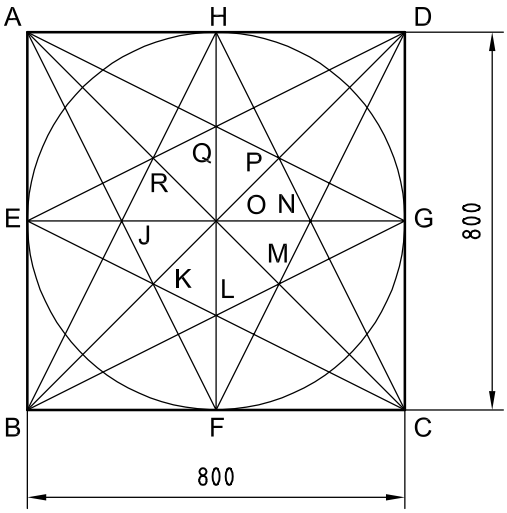
5.2.3.3 Straightness of the motion in X-axis direction

Draw a straight line on the paper placed on a flat plate, such as a steel plate, fitting a ballpoint pen on to the machining head, or scribe the straight line using the low-power laser beam, moving the laser machine in the X-axis direction.

Stretch a steel wire between both ends of this straight line, and measure the maximum deviation of the straight line from the steel wire by measurement scope, at every 1 000 mm in the X-axis direction.

This test should be performed over the whole range of the effective machining length of the laser machine.

Dimension in millimetres



Sequence of trajectory: A → B → C → D → A → C → H → B → D → F → A → G → E → C → G → B → E → D → H → F → E → H → G → F → G → H →E → F

Figure 1 — Marking figure inspected

5.2.3.4 Straightness of motion in Y-axis direction

Draw a straight line on the paper placed on a flat plate, such as a steel plate, fitting a ballpoint pen on to the machining head, or scribe the straight line using the low-power laser beam, moving the laser machine in the Y-axis direction.

Stretch a steel wire between both ends of this straight line, and measure the maximum deviation of the straight line from the steel wire by measurement scope at every 1 000 mm in the Y-axis direction.

This test should be performed over the effective machining range of one machining head.

5.2.3.5 Squareness between X-axis and Y-axis

Mark a square parallel to the X-axis and having a side of 2 000 mm (for a laser machine having an effective machining range of less than 2 000 mm × 2 000 mm, the largest square covering the effective machining range), measure the lengths of the two diagonals with a tape measure and determine the difference in length between them.

5.2.3.6 Positioning accuracy of the motion in X-axis direction

Make a unidirectional movement of 1 000 mm from an arbitrarily selected point in the X-axis direction by an NC command. Measure the length of the movement using a standard scale, and determine the difference in length between the programmed value and measured value.

5.2.3.7 Positioning accuracy of the motion in Y-axis direction

Make a unidirectional movement of 1 000 mm from an arbitrarily selected point in the Y-axis direction by an NC command. Measure the length of the movement using a standard scale, and determine the difference in length between the programmed value and measured value.

5.2.3.8 Machining speed accuracy

Measure the deviation between the programmed speed and the actual machining speed, in regard to 1/4, 1/2, and 1/1 of the maximum speed in the X-axis and Y-axis directions respectively. Measurement shall be made of the time when the head passes between the two target positions, when normal constant speed is attained. Otherwise, checking the speed by the self-diagnosis function of NC machine is permitted.

5.2.4 Acceptance criteria

The results of the tests carried out in accordance with 5.2 shall be within the acceptance limits given in Table 1.

Table 1 — Acceptance criteria

Letter (see 5.2.1)	Accuracy test variable	Judgement criteria/allowance value	
		Class A	Class B
a)	Trajectory accuracy Measured items: 1) deviation of intersection 2) meandering of trajectory 3) deviation of arc trajectory	 less than or equal to 0,5 mm less than or equal to 0,2 mm less than or equal to 0,5 mm	 less than or equal to 0,2 mm less than or equal to 0,1 mm less than or equal to 0,3 mm
b)	Straightness of the motion in X-axis direction	less than or equal to 0,4 mm	less than or equal to 0,1 mm
c)	Straightness of the motion in Y-axis direction	less than or equal to 0,4 mm	less than or equal to 0,1 mm
d)	Squareness between X-axis and Y-axis	difference in length between diagonals is less than or equal to 0,5 mm	difference in length between diagonals is less than or equal to 0,2 mm
e)	Positioning accuracy of the motion in X-axis direction	difference with programmed value is less than or equal to ± 0,2 mm	difference with programmed value is less than or equal to ± 0,1 mm
f)	Positioning accuracy of the motion in Y-axis direction	difference with programmed value is less than or equal to ± 0,2 mm	difference with programmed value is less than or equal to ± 0,1 mm
g)	Machining speed accuracy	error against programmed speed is less than or equal to ± 5 %	error against programmed speed is less than or equal to ± 2 %

6 Records of test results

The following items should be recorded according to the test results:

— model numbers of laser machines;

— manufacturing number of machine;

— date of test;

— place of test;

— names of the persons responsible for test;

— test items and measured values;

— description of the equipment used for testing and certification and/or calibration records for the measuring devices used to certify the performance of the equipment.

Annex A
(informative)

Class A test report on acceptance test of CO_2-laser beam machines

Customer (name, address): .....

Manufacturer (name, address): .....

Model numbers of laser machines: .....

Manufacturing number of machine: .....

Date of test: .....

Place of test: .....

Names of the persons responsible for test: .....

Letter (see 5.2.1)	Accuracy test variable	Measuring instruments		Judgement criteria/ allowance value	Measured value	Remarks
		Description of the instruments	Calibration records			
a)	Trajectory accuracy 1) deviation of intersection 2) meandering of trajectory 3) deviation of arc trajectory			 less than or equal to 0,5 mm less than or equal to 0,2 mm less than or equal to 0,5 mm		
b)	Straightness of the motion in X-axis direction			less than or equal to 0,4 mm		
c)	Straightness of the motion in Y-axis direction			less than or equal to 0,4 mm		
d)	Squareness between X-axis and Y-axis			difference is less than or equal to 0,5 mm		
e)	Positioning accuracy of the motion in X-axis direction			difference is less than or equal to ± 0,2 mm		
f)	Positioning accuracy of the motion in Y-axis direction			difference is less than or equal to ± 0,2 mm		
g)	Machining speed accuracy			error is less than or equal to ± 5 %		