EWF Guideline
EUROPEAN THERMAL SPRAYER

Minimum Requirements for the Education, Examination and Qualification

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MINIMUM REQUIREMENTS FOR THE EDUCATION, TRAINING, EXAMINATION AND QUALIFICATION

EWF Guideline
EUROPEAN THERMAL SPRAYING (ETS)

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Section I: Minimum Requirements for the Education and Training of the European Thermal Sprayers

The use of this guideline is restricted to organisations approved by the Authorised National Body (ANB). The section II of this guideline covers the examination, qualification (EWF), and certification (EN ISO 14918) of Thermal Sprayers. The section II of this guideline reviews the certification of sprayers on the basis of European standards.

1. Introduction

This guideline for the European education and training of Thermal Sprayers has been devised, evaluated and formulated by Members of the Subcommittee Thermal Spraying of the Committee for Education and Training of the EWF. It is designed to provide a harmonised scheme for a comprehensive education and training of Thermal Sprayers. The European Standard EN ISO 14918 provides a scheme of sprayer tests, to evaluate and re certify the capability of a thermal sprayer. It serves for quality assurance for a specific job, but does not provide an education program based on experience in which steps and sequence a high skill in thermal spraying can be acquired. At the same time, industry needs thermal sprayers with a more comprehensive capability for the sake of flexibility in production. For these reasons an EWF education scheme is set up described below in detail, in which of course the corresponding EN ISO 14918 qualifications are included. Thermal sprayers successfully completing this program have the possibility to achieve a wide range of EN ISO 14918 qualifications, if required. The training program consists of the modules A, A1-4, B, B1-4. The modular training system was chosen to take into account the individual practical experience of the participants. Therefore Modules B1-4 may be dropped, if the practical experience can be proved by the curriculum vitae of the candidate and a skill test spraying.

The guideline covers the minimum requirements for the education and training, agreed upon by all national welding societies within the EWF to which thermal spraying is related, in terms of training pieces, and theoretical lessons in terms of themes, keywords and times devoted to the theoretical education and basic practical training. The section II of this guideline covers the examination procedures. It is to be noted that EWF-diplomas of the European Thermal Sprayers - Flame, Arc, Plasma or HVOF are valid for the whole life, whereas EN ISO 14918 certificates have a restricted time of validity according to the EN-standards.

This guideline will be revised periodically by the Subcommittee Thermal Spraying to take into account any changes which may effect the "state of the art".

2. Access to Education

For entry to the module A normal physical and mental capability is assumed. Knowledge and basic skill in metalworking is required otherwise a basic training is recommended. Course attendees and teachers shall have good command of a common language in reading and writing, so that course attendees can successfully participate in instructions and take part in the theoretical tests.

3. Instruction Program

The full EWF course consists of modules A, A1-4, B, B1-4. The modules themselve break down into theoretical education (A, A 1-4) and practical training (B, B 1-4). The practical training - practice and production related thermal spraying - is based on the relevant instruction and exercise schedules (see B1-4). The type of base material will usually be unalloyed or low alloyed steel. In addition, other types of materials may be chosen.

The periods of time given in table 1 represent the average time required to attain the theoretical knowledge. The time for the specific practical part (B 1-4) needed is individual according to the capability and the skill of the student.

The theoretical instruction given to the trainees aims at a basic understanding of the process and the material including standards and safety regulations. The themes and keywords are given under the modules description A, A 1-4.

Reference to appropriate CEN standards, directives and regulations may be made throughout the course. A "teaching hour" will contain at least 50 minutes of direct teaching time.

4. Tests and Examinations

After modules A and B the participant has to pass an intermediate examination, see also fig. 1 and table 1. The general rules for examination are given in section II of this guideline.
Within a period of three years after this intermediate examination, the participant may attend all modules A1-4 and B1-4 to finish the education and training in the different thermal spray processes.

After the period of three years, it is at the discretion of the ANB to decide, whether the participant can continue with further education (A1/2/3/4//B1/2/3/3), because of his experience and practice, or if he has to pass a professional interview or an entrance test covering the contents of Module A and B.

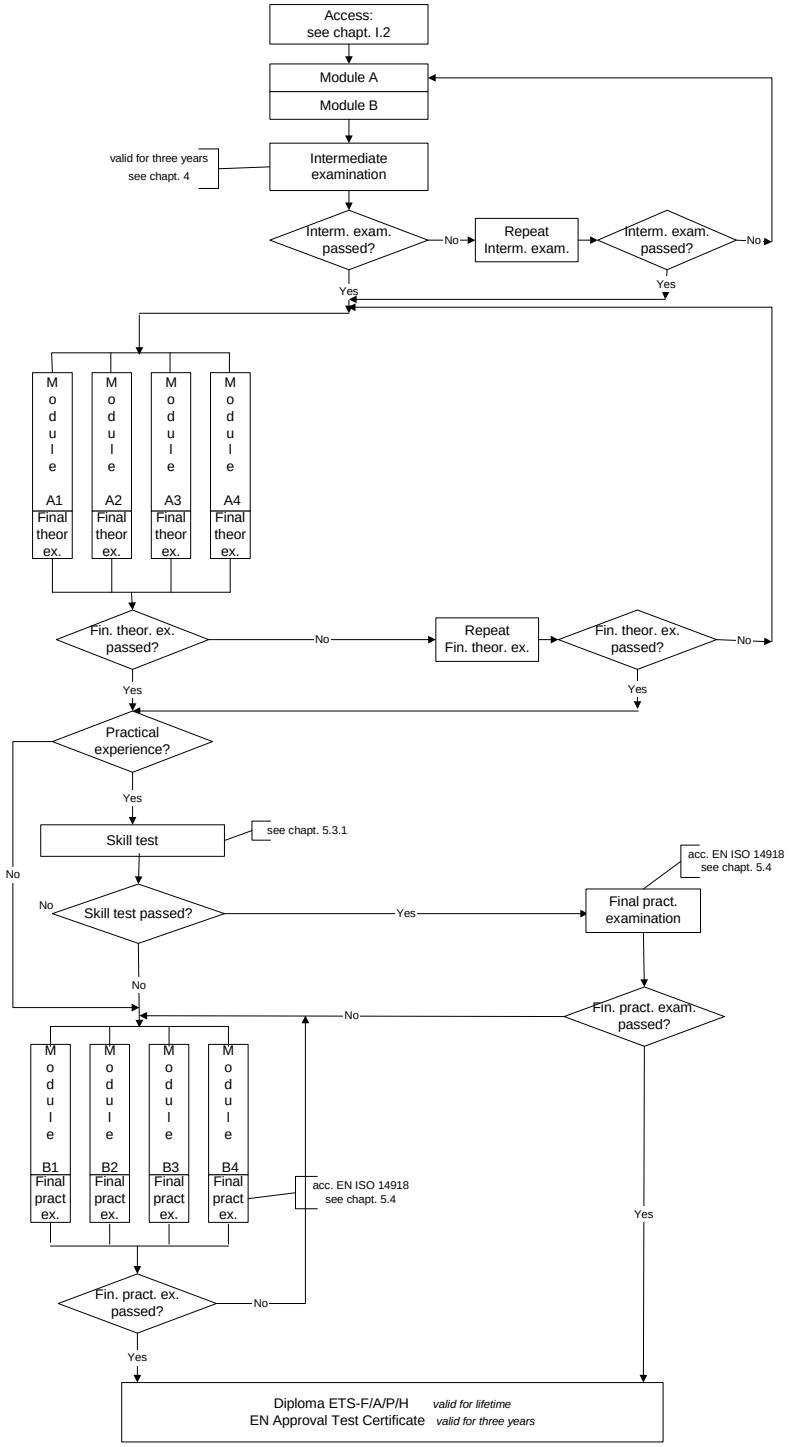


Fig. 1: Scheme of the education and training of the European Thermal Sprayer - ETS

Example for reading the scheme of the education and training of the European Thermal Sprayer - ETS (fig. 1):

If a candidate applies for the ETS qualification and wants to become an European Thermal Sprayer -Flamespraying, he has to show that he meets the access conditions (see chapt. 2).

Meeting the access conditions, he starts the ETS-education and training with Module A - Basic theoretical education in all processes - 13h.

Then follows Module B - Basic practical training in all processes - 14h

After Modules A and B, the candidate has to pass an intermediate examination of 1h. *This intermediate examination is valid for three years, in case the candidate intents to continue his education in further processes like Arc, Plasma or HVOF spraying. Then within these three years the candidate does not need to repeat the Modules A and B.*

Having passed the intermediate examination successfully the candidate goes on with Module A1 - Specific theoretical education for flame spraying - 7h. After this Module he has to pass a final theoretic examination.

If a candidate has no practical experience, the duration of the specific practical training (Module B1) is fixed with a minimum of three days and he has to go through this module.

Candidate having already practical experience can to do a skill test. If he has already practical experience and passes the skill test successfully, he may continue directly with the final practical examination according EN ISO 14918. If this candidate is fails the final practical examination, he has to do Module B1- specific practical training, for which the duration is fixed according his experience.

A candidate having successfully passed the skill test, but having no practical experience, may continue with the practical training - Module B1 for flame spraying, where as the duration of his specific practical training will be fixed according his practical experience.

After the specific practical training - Module B1 - the candidate has to do the final practical examination according EN ISO 14918.

At the end of the ETS-course the candidate is awarded the diploma of "ETS-F" - European Thermal Sprayer - Flamespraying, and he is holding the approval test according EN ISO 14918 as a "Thermal Sprayer - Flame spraying - manual or mechanised Spraying (with the information of the material applied: engineering application - stainless steel).

5. Training modules

The full EWF course for manual thermal spraying consists of the modules A, A1-4, B and B1-4:

ETS **Education and Training**

Module A	(common part) BASIC THEORETICAL EDUCATION	all spray processes	13 h
Module B	(common part) BASIC PRACTICAL TRAINING	all spray processes	14h
Module A+B	Intermediate examination	all spray processes	1h

Module A1	Specific theoretical education	Flame spraying	1h
Module A2	Specific theoretical education	Arc spraying	1h
Module A3	Specific theoretical education	Plasma spraying	2h
Module A4	Specific theoretical education	HVOF-spraying	2h
Mod. A1/2/3/4	Final theoretical examination		

Module B1	Skill test	Specific practical training	Flame spraying	*
Module B2	Skill test	Specific practical training	Arc spraying	*
Module B3	Skill test	Specific practical training	Plasma spraying	*
Module B4	Skill test	Specific practical training	HVOF-spraying	*
Mod. A1/2/3/4	Final practical examination		EN ISO14918	

* Duration of the specific practical training depends on the experience and result of the skill test of the thermal sprayer, and may be fixed individually in the responsibility of the training organisation and the thermal sprayer. Without practical experience, a minimum practical training of 3 days (24 h) is expected to be necessary for the specific practical training.

Table 1: ETS - Education and training

5.1 Module A: Basic theoretical education

The module provides basic education in thermal spraying, covering all processes. This first module gives information about all spray processes.

The themes and keywords to be dealt with and the minimum times devoted to them are listed below.

Module A:	**Basic theoretical training**	**hours**
1.	**General introduction** Wear problems Methods to protect surfaces (thermal spraying, painting, welding, and others) Thermal spraying - definition and general aspects Coating properties Application possibilities and limits - overview (no details)	**1**
2.	**Principles of thermal spraying and Overview of the different thermal spraying processes and health and safety** Including build up of coatings (in general) Heat, particle velocities, ... in principle Flame, Arc, Plasma, HVOF } equipment, peripheral equipment and other processes (e.g. D-gun)	**2**
3.	**Overview of properties of coatings and bonding mechanism** Porosity - types, orientation, alignment Structure Adhesion Oxide content - hardness Inclusions Imperfection and defects in general (cracks etc.) Intermediate layers/bond coatings Basic information about metallographical preparation and failures	**1**
4.	**Materials** Base materials Spray materials: powder, wire, rods etc Handling and storage	**1**
5.	**Pre-spray conditions and preparation** Degreasing Cleaning Activating - mechanical, chemical (detailed) Blasting Masking	**1**
6.	**Spraying** Cold/hot spraying, fusing Calculating passes Mounting test samples on/beside the part to be sprayed	**2**

	Geometrical effects (radius, corners, roundings, oversize/overmeasure spraying being machined) Cooling devices, ways of cooling surfaces, CO_2-cooling Temperatures of parts Influence of parameters in general Spraying on site Working according TSPS (thermal spraying procedure specification)	
7.	**Overview of maintenance and calibration and post-treatment** General information Machining (detailed) Sealing	**1**
8.	**Measuring and testing** Measuring before, during and after thermal spraying Testing: hardness, adhesion strength, ...	**1**
9.	**Workpiece handling, storage and transportation and mechanisation, automation** Before, meanwhile and after spraying	**1**
10.	**Health and safety, environmental aspects** Basics: including safe assembly, setting up and closing down procedures, personal protection Fire hazards, dust explosions, electrical hazard, flash backs Leak detection, radiation, noise - specific to the process to be qualified in Gases: physical properties, safety rules	**2**
		13 h

5.1.1 Module A1: Specific theoretical education

Module A1: Specific theoretical education - Flame spraying **hours**

1. Principles of process
Gases, compressed air
Flame temperatures, mixtures
Consumables

Sprayable materials
Identification (acc. EN-standard, company spec.)
Powder/wire delivery form, reels, drums
Self fluxing powders, metals and alloys, ceramics
Plastics

2. Equipment
Gun, control unit, powder/wire feeder, straighteners
Maintenance - spare parts exchange

3. Spraying
Setting up and closing down procedure
Specific spray parameters, controlling parameters
Relation between as-sprayed coating thickness and fused coating
up to 1,5 mm thickness, limits
Limits due to the base material
Dimensional changes, shrinkage
wet glance, temperature, colour
Fusing in detail: manual, oven, inductive, laser
heat input and control

Health, safety and personal protection
Noise, fumes, dust

4. Coating properties
Bond strength values, porosity, voids,
Permissible thickness, roughness

5. Areas of use
Engineering application
Electrical application
Chemical application (anticorrosion)
Thermal application
Typical consumables related to application

1 h

5.1.2 Module A2: Specific theoretical education

Module A2: Specific theoretical chapters - Arc spraying **hours**

1. Principles of process
Power: electricity, open arc and closed arc systems
Compressed air, secondary air
Gases

Sprayable materials
Identification (acc. EN-standard: En 1274 etc., company spec.)
Consumables - wires:
Delivery form (reels, drums), dimensions
Solid wires, cored wires, compositions

2. Equipment
Power source
Torch/gun
Feeding system
Cables, hoses

3. Spraying
Setting up and closing down procedure
Influence of spray parameters

Health, safety and personal protection

Environment:
- Noise
- Fumes and dust
- UV-radiation (arc)
- Electrical risks

4. Coating properties
Bond strength values, porosity, voids,
Thickness limitations, surface structure

5. Areas of use
Engineering application
Electrical application
Chemical application (anticorrosion)
Mouldmaking

1 h

5.1.3 Module A3: Specific theoretical education

Module A3: Specific theoretical chapters - Plasma spraying **hours**

1. Principles of process
Power: electricity
Gases - mixtures (explaining plasma)

Sprayable materials
Powder – identification (EN-standard: EN 1274, company spec.)
Ceramics, metals and alloys, cermets,
Carbides, carbon material compositions, plastics

2. Equipment
Power source
Torch/gun
Cooling, Nozzle lifetime
Feeding system
Cables, hoses
Equipment of LPPS - low pressure plasma spraying,
APS - atmospheric plasma spraying,
WPS - waterstabilized plasma spraying,
CAPS - controlled atmosphere plasma spraying

3. Spraying
Setting up and closing down procedure
Influence of spray parameters

Health, safety and personal protection
Environment:
Noise, fumes and dust, UV-radiation (arc)
Electrical hazards

4. Coating properties
Bondstrength values, porosity, voids,
Thickness limitations, surface structure
Graduated coatings

5. Areas of use
Engineering application
Electrical application
Thermal application
Biochemical application

2 h

5.1.4 Module A4: Specific theoretical education

Module A4: Specific theoretical chapters - HVOF-spraying **hours**

1. Principles of process
Explaining differences between flamespraying and HVOF-spraying (velocity of gases and particles)
Fuels: gases and liquid fuels
Oxygen

Sprayable materials
Powder identification (EN-standard: EN 1274, company spec.)
Metals and alloys, metal matrix carbides, (ceramics)

2. Equipment
Gun
Expansion nozzle, barrel (loading, built up problems)
Cooling system
Design: air cooled, water cooled, hybrid
Gas supply / fuel supply - heating
Tanks, bottles
Control unit
Powder feeder / powder injection
Maintenance - spare parts exchange

3. Spraying
Setting up and closing down procedure
Influence of spray parameters
Heat into part - cooling during spraying

Health, safety and personal protection
Noise, fumes, dust

4. Coating properties
Coating quality, permissible thickness
Porosity, voids, bondstrength values
Visual appearance, porosity values

5. Areas of use
Engineering application
Electrical application
Chemical application
Thermal application
Biomedical application

2 h

5.2 Module B: Basic practical training

The module provides demonstration and basic practical training in thermal spraying. This practical module is particularly recommended for trainees in metalworking industry or craft professions, who do not have much knowledge and experience in thermal spraying.
The themes and keywords to be dealt with in practice and the minimum times devoted to them are listed below.

Module B:	Basic practical training	hours
1.	**Surface preparation** Cleaning Degreasing Mechanical surface roughening Storage between roughening and spraying Dimensions, geometrical measurements Masking Material storage and handling	**3**

The training institute has to demonstrate using one of the four processes for the following topics

2.	**Spraying** Parameter setting Set up and closing down of the equipment Handling gases, pressure regulators, connecting hoses etc. Fixing the work piece Fixing the gun Starting up and closing down the spray gun Preheating Calculating traversing speed of the gun and number of passes Measurements during spraying Thickness test, temperature, cooling Oversize/overmeasure spraying (to be machined) Demonstration of fusing	**7**
3.	**Testing of the sprayed coating** Final thickness test Spray quality: visual inspection Machining test Tests to be done in workshops: bend test, ...	**1**
4.	**Post treatment** Sealing Cooling after spraying Taking off masking, machining, grinding Handling and storage of the part	**2**
5.	**Personal health and safety** Dust, noise, gases, electricity, Heat Environmental responsibility: waste, where to store etc.	**1**
		14 h

5.2.1 Module B1: specific practical training

The student has to go through the whole procedure from preparing to testing of a practical training piece, supported and controlled by the trainer.

The skill test pieces have to include flat, round and internal spraying, oversize/overmeasure spraying, see as an example (fig. 2a and b) the drawing, showing the level of difficulty to be mastered.

The practical training pieces and test pieces for final practical test are according EN ISO 14918.

Module B1: Specific practical training - Flame spraying

1. Surface preparation
Cleaning
Degreasing
Mechanical surface roughening
Geometrical measurements
Masking

2. Spraying
Spraying the learning piece according to instructions
Spraying with fusing according to instructions
Measuring and testing meanwhile spraying

3. Testing of the sprayed coating
Final thickness test
Spray quality: visual inspection
Choice of test methods related to the piece and spray material

4. Post treatment
Choice of test methods related to the piece and spray material

5. Personal health and safety

6. Maintenance of the equipment
Powder feeder, calibration

5.2.2 Module B2: Specific practical training

The student has to go through the whole procedure from preparing to testing of a practical training piece, supported and controlled by the trainer.

The skill test pieces have to include flat, round and internal spraying, oversize/overmeasure spraying, see as an example (fig. 2a and b) the drawing, showing the level of difficulty to be mastered.

The practical training pieces and test pieces for final practical test are according EN ISO 14918.

Module B2: Specific practical training - Arc spraying

1. Surface preparation
Cleaning
Degreasing
Mechanical surface roughening
Geometrical measurements
Masking

2. Spraying
Spraying the learning piece according to instructions
Preheating
Wire feeding - feed rates
Limitations to coating thickness
Measuring and testing meanwhile spraying

3. Testing of the sprayed coating
Final thickness test
Spray quality: visual inspection
Choice of test methods related to the piece and spray material

4. Post treatment
Choice of test methods related to the piece and spray material

5. Personal health and safety

6. Maintenance of the equipment
Calibration

5.2.3 Module B3: Specific practical training

The student has to go through the whole procedure from preparing to testing of a practical training piece, supported and controlled by the trainer.

The skill test pieces have to include flat, round and internal spraying, oversize/overmeasure spraying, see as an example (fig. 2a and b) the drawing, showing the level of difficulty to be mastered.

The practical training pieces and test pieces for final practical test are according EN ISO 14918.

Module B3: Specific practical training - Plasma spraying

1. Surface preparation
Cleaning
Degreasing
Mechanical surface roughening
Geometrical measurements
Masking

2. Spraying
Spraying the learning piece according to instructions
Preheating
Powder injection (inside, outside, angles)/ checking and control
Limitations to coating thickness
Changing nozzles and electrodes (nozzle lifetime)
Measuring and testing meanwhile spraying

3. Testing of the sprayed coating
Final thickness test
Spray quality: visual inspection
Choice of test methods related to the piece and spray material

4. Post treatment
Choice of test methods related to the piece and spray material

5. Personal health and safety

6. Maintenance of the equipment
Powder feeder, calibration
Calibration test
Leakage test of powder feeder
Wear control of nozzles and electrodes, nozzle lifetime
Adjusting distance between electrode and nozzle
Type of cooling water

5.2.4 Module B4: Specific practical training

The student has to go through the whole procedure from preparing to testing of a practical training piece, supported and controlled by the trainer.

The skill test pieces have to include flat, round and internal spraying, oversize/overmeasure spraying, see as an example (fig. 2a and b) the drawing, showing the level of difficulty to be mastered.

The practical training pieces and test pieces for final practical test are according EN ISO 14918.

Module B4: Specific practical training - HVOF-spraying

1. Surface preparation
Cleaning
Degreasing
Mechanical surface roughening
Geometrical measurements

2. Spraying
Preheating - in most cases no preheating
Stock material
Limitations to coating thickness
Changing nozzles (nozzle lifetime)
Spraying the learning piece according to instructions
Measuring and testing meanwhile spraying

3. Testing of the sprayed coating
Final thickness test
Spray quality: visual inspection
Choice of test methods related to the piece and spray material

4. Post treatment
Choice of test methods related to the piece and spray material

5. Personal health and safety

6. Maintenance of the equipment
Powder feeder, calibration
Powder injection, checking and control
Calibration test
Leakage test of powder feeder
Wear control of nozzles
Type of cooling water

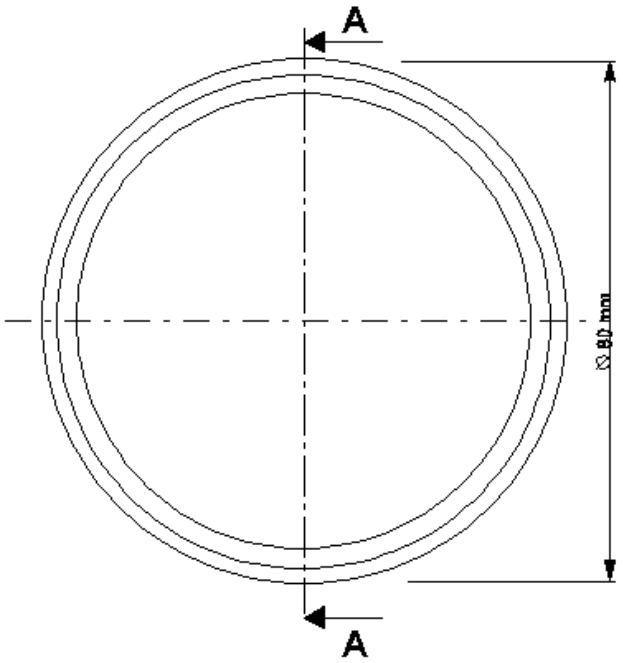
5.3 Skill test pieces and evaluation

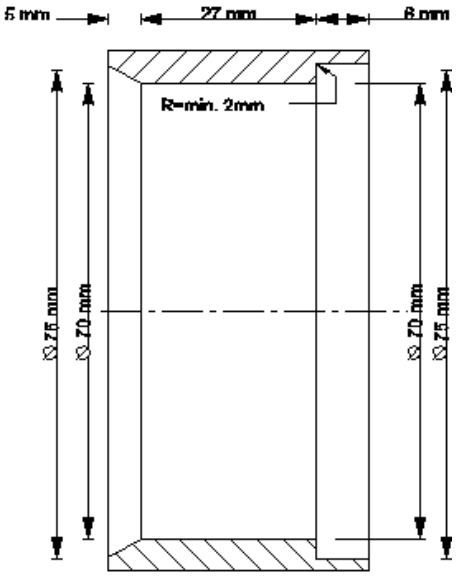
Fig. 2 a and b: Skill test

2a: Testpiece for inside diameter (I.D.) spraying

2b: Testpiece for outside diameter (O.D.) spraying

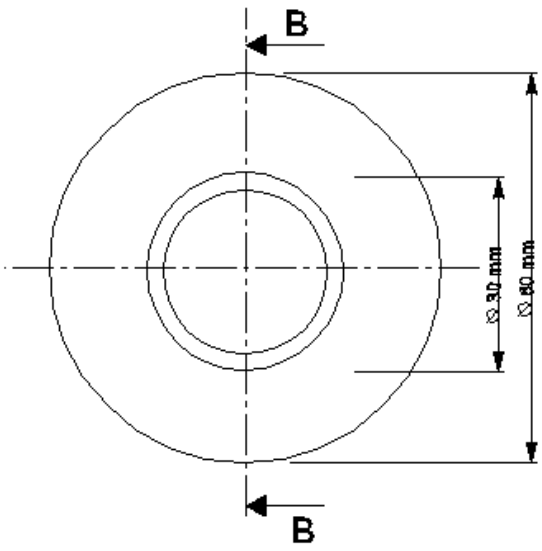
Testpiece A for I.D. spraying:

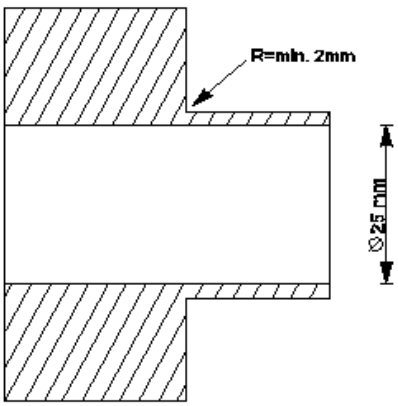




Cross-section A-A

Testpiece B for O.D. spraying:





Cross-section B-B

5.3.1 Skill test

The testpiece(s) must be treated and checked according to the TSPS (thermal spraying procedure specification).

The following treatments and checks must be done:

- Check for corrosion
- Degrease the testpiece(s) - Mask the testpiece according the TSPS - Check gritmaterial (size, contamination, etc.) - Gritblast the testpiece according the TSPS and check the result - Adjust and calibrate the equipment (e.g. leaktest, calibration of powder feeders)
- Check powder or wire
- Determine the coating thickness or final spray dimensions
- Preheat the part
- Spray the part
- Check the coating thickness and temperature - Perform all necessary tests (visual appearance, brush test, bend test - if necessary)

5.3.2 Evaluation of the skill test

The candidate will be evaluated on:

- workmanship of the process,
- handling of the equipment,
- theoretical knowledge,
- personal safety,
- general impression (process control).

Special attention will be addressed to:

- use of correct parameters,
- treatment of contaminated parts,
- thickness measurements Evaluation of the test samples after spraying:

- Dimensions:
  a. Uniformity (parallelity, perpendicularity)
  b. coating thickness

- Visual appearance
  The coating shall be checked for complete coverage, uniform structure, cracks, voids, spalling, chipping, flaking or other indications of poor adhesion

- Adherence
  a. The quality of adherence of the coating to the substrate shall be tested by the following methods:
  - wire brush test
  - bend test
  - machinability

5.3.3 Description of the skill test pieces

There are 2 different skill test pieces: A and B, A will be used for testing the skill of the candidate on inside diameter spraying, B for outside diameter spraying.
Each test piece can be treated in an other way, according to the TSPS made by the examiner.

The following items can be different for each individual examination:- the surface to be sprayed, - the coatings, - the spraying parameters.

Example of a TSPS:

- Gritblasting :
  - blasting pressure: 5 bar
  - blasting distance: 15 cm
  - blasting angle: 80°
- Spraymaterial: bondcoat: Ni/Al, topcoat: Al_2O_3
- Thickness topcoat: 0.3 mm
- preheat to: 60 °C
- surface to be sprayed: .....
  .....
- Overspray permitted on: .....
  .....
- Spray parameter: .....
  .....
  .....
  .....

5.4 Practical training pieces and final practical examination

Practical training pieces and test pieces for final practical examination are according EN ISO 14918 equivalent to the application technique (manual/mechanized spraying) and to the spray process, for which the candidate has chosen the training modules.

- Evaluation

Evaluation will be done adequately to EN ISO 14918 "Approval testing of thermal sprayers" taking also into account chapter 5.3.2 and 5.3.3.

Section II: Examination and Qualification

1. Introduction

The guideline seeks to achieve harmonisation and common rules in the examination and approval testing of thermal sprayers in Europe. It provides for the assessment of both theoretical knowledge and practical skills, the latter being linked to the requirements of EN ISO 14918 "Approval Testing of Thermal Sprayers".

The national welding organisations to which in most cases thermal spraying is allied within the EC/EFTA region, being members of the EWF, mutually acknowledge the Diploma of the European Thermal Sprayer awarded in any Member State following the education, examination and testing conducted in accordance with this guideline.

Education must have followed the instructional units specified in Section I of this Guideline, and have been given at a training establishment approved by the ANB.

For the practical tests, the test pieces, given in fig 2a and b, have to be sprayed by the candidate and assessed by the training organisation, supervised by the Authorised Examiner.

During the final practical test, the participant has to spray test pieces in accordance with EN 14918 to pass the approval test of thermal sprayers.

Qualification of the European Thermal Sprayer - Flame, Arc, Plasma or HVOF - involves full examination of the test pieces following EN ISO 14918 "Approval Testing of Thermal Sprayers".

The final theoretical examination and practical tests must be carried out at a training establishment approved by the ANB in accordance with the requirements of this guideline. An Authorised Examiner shall witness the examination and tests, and approve the test results.

2. Requirements for Training Centres

Requirements for thermal spraying teachers, training organisations and courses are documented in Doc. No. EOTC/AG-15/97/001/416.

3. Theoretical Examination

3.1 Intermediate Examination
Participants who have passed Module A "Basic theoretical training" and Module B "Basic practical training" have to pass an intermediate test based on these modules. Having passed this intermediate test successfully, a "Intermediate examination confirmation" is handled out to the participant. The "Intermediate examination confirmation" is valid for three years, in case a participant, who did not attend all modules of specific theoretical and practical training, want to continue his education and training of further spray processes (module) at later times (see also Section I.4).

3.2 Final Theoretical Examination
The final theoretical examination papers for Modules A 1-4 can be multi-choice and will be set under the authority of the Board of Examiners of the ANB, sealed, and opened in the presence of the candidates and the Authorised Examiner immediately before the examination begins. The Authorised Examiner must sign all completed papers to confirm that the examination has been conducted in a proper manner.

The theoretical examination pass mark is 60 %. Failure requires re-examination, see fig. 1 of this guideline.

4. Practical Tests

4.1 Skill test

Thermal sprayers having practical experience, who want to get the ETS-certificate without attending Modules B1/2/3/4 have to prove their practical skill by doing the skill test. The test pieces meet the requirements and level of the final practical training test pieces shown in fig. 2a and b.

If the candidate fail the skill test, he has to participate at Modules B1/2/3/4, see fig. 1 of this guideline.

4.2 Final Practical Test

Final practical training test pieces has to be performed according EN 14918. The sprayer has to spray manually and in a mechanised way.

Failure requires re-examination, see fig. 1 of this guideline.

5. Surveillance during test spraying (Final Practical Test)

Final practical test, on completion of Modules B1 - B4 shall be conducted following the requirements of EN ISO 14918 and shall be witnessed by an Authorised Examiner on behalf of the ANB. The candidate must be provided with clear unambiguous instructions and a Thermal Spraying Procedure Specification (TSPS). All test materials and consumables must be properly identified. Calibrated equipment shall be used according to industrial needs.

6. Destructive and non-destructive examination

Test pieces and specimen shall be clearly identified and the test specimen submitted for destructive and/or non-destructive examination to a laboratory approved under the national testing laboratory certification scheme.

7. Evaluation of results

The test results of the practical test shall be evaluated by a Authorised Examiner in accordance with the guideline and En ISO 14918. Test certificate shall be countersigned by the Authorised Examiner or third party.

8. Transition arrangements

Up to the end of 2001 the following transition arrangement will apply:

Practising thermal sprayers having followed a structured training programme* and having practised** in thermal spraying in one of the methods*** for at least 2 years, may be awarded the diploma of European Thermal Sprayer following assessment by the ANB, after having passed a practical test and a theoretical examination and if the following requirements are fulfilled:

* The training programme must have been according to national guidelines or supplier courses. The national ANB has to make sure about the contents and time duration and how many years backwards the contents of the course was constant

** An authentic curriculum vitae would be considered to fulfil the requirements for documented evidence.

*** One of the following methods:

1. Flame spraying - powder
   - wire
2. Arc spraying
3. Plasma spraying
4. HVOF-spraying

Two additional rules must be observed when applying the transition arrangements:

1. Only the country from which the applicant received his thermal spraying qualification or in which he currently is practising, can award the qualification certificate under the transition arrangement.

2. The thermal spraying qualification from countries not being the EWF-member cannot be used to justify the award of a qualification certificate under the transition arrangements.

For each country specific transition arrangements will be approved by the Committee for Education and Training, and may be obtained from the ANB.

9. Renewal of EN ISO 14918 approval tests

The EWF-Diploma is valid for lifetime.
Additional CEN-approval tests have to be renewed according to EN-standard.

10. Re-examination

Re-examination and appeals are covered by Doc. EWF-416.