

Augmented Reality Welding Simulator

Autism-Aware Vocational Education & Training

A structured, safe, and sensory-considerate pathway to welding skills

1. About This Training

This training programme uses augmented reality technology to teach welding in a calm, structured, and predictable environment. Learners use real welding equipment — torches, gloves, and physical coupons — while the welding arc, bead formation, sound, and parameter response are visualised through the AR system, calibrated from real laboratory conditions.

The approach is built around two core principles: learning through repetition without pressure and transitioning to real welding only when the learner is genuinely ready. This makes it well-suited for autistic learners and others who benefit from clear structure, reduced sensory load, and objective feedback.

AR Helmet Design	Real-World Awareness	Real-World Alignment
The welding helmet has an embedded screen that avoids sudden darkness and provides stable visual feedback throughout the session, reducing sensory stress and supporting sustained attention.	The AR system overlays the welding simulation onto the real physical environment. Learners can still see their hands, the workpiece, and the space around them throughout the session — supporting orientation, reducing anxiety, and making the transition to real welding feel like a natural continuation.	The simulation is calibrated from real industrial welding data, so learners develop accurate physical sensations and procedural understanding that transfer directly to the real workshop.

2. Training Guidelines

The programme follows the Augmented Training methodology, which moves learners gradually through three connected stages: structured theory, simulator practice, and real welding. Each stage is designed to reduce uncertainty and cognitive load while maintaining professional standards.

Core Principles

- Individual learning paths** — Each learner follows their own pace. Exercises and difficulty levels can be adapted individually, and learners may repeat any task as many times as they need, without comparison or time pressure.
- Simulator-first approach** — It is recommended that more than 40% of total training time takes place in the simulator. Practising without noise, heat, fumes, or arc flashes

allows learners to build motor skills and process understanding in a calm environment.

- **Readiness-based progression** — Moving to the real workshop happens when simulator results clearly show that the learner has the motor control, process understanding, and confidence needed. There is no fixed schedule.
- **Safety through awareness** — The AR helmet keeps learners aware of their surroundings during practice. The transition from simulator to real welding is gradual, reinforcing safe habits before exposure to higher-risk environments.
- **Instructor-supported learning** — Instructors use objective performance data — angles, speed, arc length, parameter settings — to provide structured feedback that is clear and free from subjective judgement.

3. Enhancements & Options

3.1 Advanced Welding Multijoints (AWM)

The system includes a structured catalogue of Advanced Welding Multijoints — physical and digital exercise coupons that extend beyond the standard curriculum. These are organised by material, thickness, position, and process, allowing instructors to select exercises that match each learner's technical and sensory readiness.

Available multijoints cover a wide range, from foundational motor exercises to sector-specific scenarios:

Code	Name	Focus / Application
AWM-001	Foundational Ambidex	Basic motor coordination
AWM-002	Foundational Complex Sequence	Step sequencing and consistency
AWM-003	Heavy Industry Specific Practices	Heavy industry welding training
AWM-004	Automotive Chassis Assembly	Automotive welding training
AWM-005	Automotive Thin Plates	Precision on thin materials
AWM-006	Shipbuilding Open Root	Shipbuilding welding training
AWM-007	Shipbuilding Backing Strip	Shipbuilding — backing technique
AWM-008	Pipeline 6" Schedule 80	Oil & gas pipeline
AWM-009	Robotic Foundational 'House'	Introduction to robotic paths
AWM-010	Robotic Foundational 'Face'	Introduction to robotic paths
AWM-011	Pipeline 6GR	Advanced pipeline
AWM-012	Pipeline Monster Coupon	Complex pipeline challenge
AWM-013	Open Root with V-Groove (Aluminium)	Aluminium open root
AWM-014	Foundational Multilap	Lap joint sequences
AWM-015–019	Robotic Foundational Series	Robotic assembly and certification prep
AWM-020	AWS Education Practice Coupons	AWS curriculum alignment
AWM-021	NIL Practical Evaluation Coupon	Netherlands Welding Institute prep
AWM-022	Corner Joint Coupon	Corner joint technique

AWM-023	Pressure Vessel	Complex industrial component
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3.2 Curriculum Frameworks

The training content is aligned with internationally recognised welding qualification frameworks. These provide clear learning objectives, predictable progression, and professional references that schools can use as the basis for their programmes.

Framework	Processes Covered	Languages
DVS Media	GMAW / SMAW / GTAW	AR, ZH, EN, FR, DE, PT, RO, RU, SR
AWS Fundamentals	Fundamentals of Welding (with practice coupons)	EN, ES
International Welder (EWF / IIW IAB 089r5-14)	GMAW, SMAW, GTAW + position qualifications	EN, ES
TWI Structural Module	MMA / MAG / MAG Flux Cored / TIG	EN
NIL (Netherlands Welding Institute)	GMAW — Level 1, with certification coupon	NL

Note: Curriculum frameworks define learning content and progression. Formal certification, where applicable, remains the responsibility of the relevant awarding body and assessment process.

4. Course Content — Augmented Training Welding Curricula

Duration	2 hours theoretical content + simulator and real welding practice (self-paced)
Languages	Czech, English, French, German, Italian, Polish, Spanish
Access	Available directly on the simulator unit and as downloadable e-learning in PDF format

This curriculum provides a complete foundation in welding theory and practice, covering the three most widely used welding processes. It is structured to support step-by-step skill development, with each unit built on the previous one and reinforced by simulator exercises before any real welding takes place.

Module 1 — Introduction to Welding

- General introduction and applications
- Self-assessment questionnaire

Module 2 — Manual Metal Arc Welding (SMAW)

Theory units:

- Principles of the procedure and equipment
- Operational technique
- Filler materials and safety

Simulator practice:

- Test plate initiations — Flat, Horizontal, Vertical positions
- Plate butt-joint V-Groove — 1G/PA, 2G/PC, 3G/PG
- Plate T-joint fillet — 1F/PA, 2F/PB, 3F/PF, 3F/PG, 4F/PD
- Plate lap joint fillet — 1F/PA, 2F/PB, 3F/PF, 3F/PG, 4F/PD
- Pipe T-joint fillet — 2F/PB, 4F/PD
- Pipe butt joint V-Groove — 2G/PC

Real welding practice (once readiness is confirmed):

- Same exercise set as simulator — identical structure for continuity and confidence

Module 3 — Semi-Automatic Welding (MIG/MAG / GMAW)

Theory units:

- Principles of the procedure and equipment
- Operational technique
- Filler materials and safety

Simulator and real welding practice:

- Same progressive exercise set as Module 2 — same positions, same joint types

Module 4 — TIG Welding (GTAW)

Theory units:

- Principles of the procedure and equipment
- Operational technique

Simulator and real welding practice:

- Same progressive exercise set as Modules 2 and 3

Institutions may customise this curriculum by selecting only the processes relevant to their programme, or by adjusting the level of precision to align with their learners' needs. The structure and sequencing remain consistent regardless of the selection made.

Educational Approach

- Consistent structure and sequencing — each session follows the same pattern, reducing learning uncertainty
- Unlimited simulator practice — learners build confidence through repetition without any cost or consequence for mistakes

- Objective performance feedback — measurable data replaces subjective judgement, reducing anxiety for both learners and instructors
- Gradual transition to real welding — learners move to the real workshop only when results clearly show they are ready

5. Product Configuration — Educational Welding Setup

The standard educational configuration provides everything needed to begin welding training. All core components are included as standard; additional items can be added to extend the system's capabilities over time.

Standard Educational Package (included as standard)

#	Component	Role in Training
1	Welding simulator (Soldamatic 6.0)	The main AR unit — reproduces arc behaviour, bead formation, sound, and parameter feedback calibrated from real welding data
2	Manual Training License	The basic training license includes all five training coupons, the three most commonly used materials, and covers four welding processes: GMAW, SMAW, FCAW (with and without gas), and GTAW.
3	WorkStand	Adjustable training workstand that holds the coupon at the correct angle and height for each exercise position
4	5 training coupons	Physical workpieces used with the AR system — T-joint, Lap joint, butt joint, pipe to plate, pipe to pipe
5	3 welding torches (GMAW, SMAW, GTAW)	Actual torches equipped with AR barcodes are utilised in the simulation, matching the weight and mechanism of real welding equipment to enhance muscle memory development.
6	Instructor & LMS software	Allows instructors to monitor learner progress, set individual parameters, review session data, and manage the learning pathway for each student



Optional Additions

The following items can be added to extend the system's capabilities as learners progress or as the programme expands:

- Advanced torches (GMAW, GTAW, SMAW rotatable) — required for complex joint multijoints and advanced training coupons
- Advanced Welding Multijoints (AWMs) — sector-specific exercise coupons covering automotive, shipbuilding, pipeline, and robotic welding
- Advanced License upgrade — unlocks cross-section analysis, mechanical resistance data, and AWM-compatible content
- Robotic Welding License — for robotic welding exercises and curriculum
- Robotics torch and disk — for introduction to robotic welding pathways
- Server – for multi-station classroom setup
- Flight case — for transport and storage of the simulator unit

Single-station setups are standard; multi-station classroom configurations are available for larger groups. All configurations share the same reduced sensory environment — no heat, no fumes, no arc flashes during simulator use.

6. Grading and Progress Assessment

The system includes an Analysis Module that provides transparent, data-based performance feedback after each session. All measurements are objective — based on sensor data from the simulator — rather than subjective instructor judgement.

What is assessed:

- Work angle and travel angle
- Travel speed and arc length
- Equipment parameter setting (voltage, wire feed, shielding gas where applicable)
- Welding defects detected (porosity, inclusions, spatter)



Three progression levels:

Beginner	Broad tolerance ranges, supportive feedback phrasing, and no time pressure. Learners build foundational technique with a focus on consistency rather than precision.
Intermediate	Tolerances tighten moderately. Feedback encourages refinement of technique and greater consistency across positions and passes.
Advanced	Professional-level tolerance standards. Feedback mirrors the criteria used in real welding qualification assessments.

Learners can review their own session data after each exercise. This transparency helps build self-awareness without relying on comparison with peers.

7. The Augmented Training Method

The training is built around three connected elements that work together throughout the programme. Learners are not required to move through them in a single linear sequence — they can return to theory or simulator practice at any point.



1. E-Learning

2. Simulator Practice

3. Real Welding

Structured, self-paced theoretical content. Instructors can tailor modules to individual skill levels, and progress is tracked automatically — giving both learner and instructor a clear, shared picture of development.

Repetitive, low-stress AR welding practice with immediate objective feedback. No consumables, no heat, no fumes. The learner can repeat any exercise without limit.

Practical application in the real workshop, introduced only when simulator data confirms the learner is ready. The structured approach continues — same exercises, same sequence.