TRANSPORTATION AND LOGISTICS

Autobody Repair

Technical Description

 TD13 v8.0 WSC2021

worldskills

WorldSkills International, by a resolution of the Competitions Committee and in accordance with the Constitution, the Standing Orders, and the Competition Rules, has adopted the following minimum requirements for this skill for the WorldSkills Competition.

The Technical Description consists of the following:

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1 Introduction

1.1 Name and description of the skill competition

1.1.1 The name of the skill competition is

Autobody Repair

1.1.2 Description of the associated work role(s) or occupation(s).

Autobody repairers realign both the structure and the panelling of both light and heavy-duty vehicles after they have been involved in collisions. This can often be a complex process as each collision will present different degrees and directions of damage. The repaired vehicle must conform to the stringent specifications established by the vehicle manufacturer and meet both their tolerances and their safety specifications. An autobody repairer needs to be familiar with MET (mechanical/electrical/trim) components and their function as well as the specific and often complex safety restraint systems (SRS) fitted to modern vehicles. The autobody repairer returns the vehicle to a condition where it is ready for refinishing.

An autobody repairer works in a facility dedicated to repair and is equipped with the machinery and equipment suitable to repair a wide variety of modern passenger cars. An autobody repairer's work is often divided between major and minor collision damage; however, skills in both areas may often be used on the same vehicle. In a major collision repair the autobody repairer will mount the vehicle onto a specialized body jig with which he or she can diagnose the direction and extent of the misalignment to the car body structure. He or she then attaches heavy hydraulic pulling equipment to the body and uses this pulling force to reverse the damaging force.

After the misalignment has been rectified to the structure the repairer will normally have to remove damaged structural and non-structural members which are replaced with new sections or part sections using various welding processes and/or riveting and bonding. For a minor collision an autobody repairer may replace or repair non-structural panels to a condition suitable for refinishing. Repairers must be able to use vehicle body alignment benches and associated measuring equipment (universal and fixed bracket) as a means of assessing the extent of damage and reinstating the structure to its original specifications. An autobody repairer must be a skilled welder who is capable of joining a variety of metals such as low carbon steel, high strength steels or aluminium alloys using metal active gas welding (MAG), and resistance/inverter spot welding.

He or she must be able to select the correct consumables for the metal being welded and adjust the machine to provide an efficient high quality weld. In some circumstances body panels may be replaced using bonding and riveting equipment. The repairer must be able to prepare, adjust and use this equipment effectively following manufacturers specifications to reinstate damage panels.

Autobody repairers must be able to remove damaged sections with minimum disruption to surrounding body work and re-attach/re-align the parts to reinstate the integrity of the body shell. These parts or panels may be welded, bolted or riveted.

For minor damage that does not require the replacement of a part or panel an autobody repairer will use a variety of repair tools to remove the damage and reinstate the panel's original contours. These may involve a range of shaped hammers and 'dollies', bumping files, body files, pry bars and oil stones.

1.1.3 Number of Competitors per team

Autobody Repair is a single Competitor skill competition.

1.1.4 Age limit of Competitors

The Competitors must not be older than 22 years in the year of the Competition.

1.2 The relevance and significance of this document

This document contains information about the standards required to compete in this skill competition, and the assessment principles, methods and procedures that govern the competition.

Every Expert and Competitor must know and understand this Technical Description.

In the event of any conflict within the different languages of the Technical Descriptions, the English version takes precedence.

1.3 Associated documents

Since this Technical Description contains only skill-specific information it must be used in association with the following:

- WSI – Code of Ethics and Conduct
- WSI – Competition Rules
- WSI – WorldSkills Occupational Standards framework
- WSI – WorldSkills Assessment Strategy
- WSI online resources as indicated in this document
- WorldSkills Health, Safety, and Environment Policy and Regulations.

2 The WorldSkills Occupational Standards (WSOS)

2.1 General notes on the WSOS

The WSOS specifies the knowledge, understanding, and specific skills that underpin international best practice in technical and vocational performance. It should reflect a shared global understanding of what the associated work role(s) or occupation(s) represent for industry and business (www.worldskills.org/WSOS).

The skill competition is intended to reflect international best practice as described by the WSOS, and to the extent that it is able to. The Standard is therefore a guide to the required training and preparation for the skill competition.

In the skill competition the assessment of knowledge and understanding will take place through the assessment of performance. There will only be separate tests of knowledge and understanding where there is an overwhelming reason for these.

The Standard is divided into distinct sections with headings and reference numbers added.

Each section is assigned a percentage of the total marks to indicate its relative importance within the Standards. This is often referred to as the "weighting". The sum of all the percentage marks is 100. The weightings determine the distribution of marks within the Marking Scheme.

Through the Test Project, the Marking Scheme will assess only those skills that are set out in the Standards Specification. They will reflect the Standards as comprehensively as possible within the constraints of the skill competition.

The Marking Scheme will follow the allocation of marks within the Standards to the extent practically possible. A variation of up to five percent is allowed, provided that this does not distort the weightings assigned by the Standards.

2.2 WorldSkills Occupational Standards

Section		Relative importance (%)
1	**Work organization and management and communication and interpersonal skills**	**10**

The individual needs to know and understand:

- Current occupational health and safety regulations relating to the autobody repair industry
- Correct use and maintenance of all personal protective equipment and clothing
- All recommendations and information published by the suppliers or manufacturers of products and equipment
- The process for maintaining and using specialized equipment
- Terminology that relates to body repair processes
- Terminology that relates to the car body structure and its construction
- The importance of the correct handling and disposal of environmentally harmful products
- The basis for communication and interpersonal skills
- The potential harmful impact that repair products and processes can have upon the environment
- The range and purposes of documentation, including written and technical drawings including schematic and wiring diagrams, in both paper based and electronic forms
- The technical language associated with the occupation
- The industry standards required for inspection and fault reporting in oral, written, and electronic formats
- The required standards for customer service and care.

The individual shall be able to:

- Apply occupational health and safety regulations and best practice to the autobody repair industry
- Use correctly and maintain personal protective clothing and equipment
- Set-up, use, adjust, and maintain all specialist repair equipment, promote health and safety practices in the workplace, apply all recommendations and guidance provided by suppliers and manufacturers of equipment or products
- Adhere to MSDS (manufacturers safety data sheets)
- Adopt correct procedures for handling and disposing of environmentally harmful products
- Select and use products that are environmentally acceptable
- Dispose of environmentally harmful products in a safe and responsible way

Section		Relative importance (%)
2	**Diagnosis and correction**	**20**

The individual needs to know and understand:

- The safety recommendations associated with mounting and pulling damaged vehicle bodies
- Manufacturers' data and how this is translated to the vehicle body
- The principles surrounding the construction of vehicle bodies, including light passenger, light commercial and commercial
- Characteristics of body construction relating to strength and collision protection
- Characteristics and purpose of structural and non-structural panels
- The importance of positional correctness to retain vehicle safety and performance
- The role played by direction and weight of damage force as well as the impact at the point of collision
- How position, shape and strength of individual body assemblies affect the paths taken by collision forces
- Methods of correcting forces including vectors of force Principles of body jig measuring systems including bracket and computerized measuring systems
- Principles of pulling systems including fixed post, swinging arm and vector systems

The individual shall be able to:

- Mount vehicles on anchoring equipment
- Interpret manufacturers' specifications relating to vehicles
- Diagnose the extent of vehicle damage and rectify the damage with reference to vehicle manufacturers' recommendations
- Determine the direction of damaging forces or impacts
- Determine the extent of damaging forces or impacts
- Determine structural damage using appropriate diagnostic equipment
- Identify the correct and appropriate methods for the correction of vehicle body damage
- Reinstate correct vehicle body alignment
- 'Rough out' damaged sections or panels prior to removal for replacement
- Straighten and align damaged structural components and reinstate their dimensional accuracy
- Diagnose frame damage using any of:
- Toe in gauge
- Self-alignment gauge
- Tram gauge
- Vehicle manuals etc.
- Repair and align full frame and suspension damage.

Section		Relative importance (%)
3	**Replace necessary welding on parts/panels**	34

The individual needs to know and understand:

- The importance of following manufacturers' recommended repair methods and warranty procedures
- Suitable methods of identifying fixing types weld positions and weld types
- Methods of safely and cleanly removing fastenings to free damaged panels for replacement
- Use, setting and maintenance of pneumatic tools used for panel removal and replacement
- Principles of operation and adjustment of welding systems used for panel replacement including MAGS, Resistance spot and MIG brazing
- Processes and procedures for preparing replacement panel work and panel fixing positions
- The importance of realigning structural parts and assemblies to reinstate vehicle integrity and driving characteristics
- Principles of reinstating suitable corrosion protection to replaced parts
- The importance of working within agreed time schedules.

The individual shall be able to:

- Repair or replace structural parts correctly including composites (GRP, carbon)
- Remove structural panels with minimal disturbance to surrounding panels and prepare surfaces appropriately to receive new parts
- Prepare replacement parts to ensure correct fit up and alignment
- Remove welded panels (rails, rear quarter panels, pillars, structural body panels etc.)
- Replace major welded panels or panel assemblies at manufacturers' seam positions
- Carry out structural part replacement using sectioning methods and procedures
- Use correct welding procedures when replacing structural parts, taking into consideration materials being joined, the identity of parts and unforeseen hazards such as brake, fuel and electrical lines
- Replace structural panels using any of the following jointing methods:
  - MIG welding
  - MIG brazing
  - Riveting and bonding
  - Carry out welding procedures necessary to complete the repair (MAGS)
  - Resistance spot welding
  - MIG Brazing
- Dress weld seams using sanding/grinding operations

Section		Relative importance (%)
4	**Remove, re-install or replace, and align exterior and/or interior parts and panels**	10

The individual needs to know and understand:

- The principles underpinning the use of any of the above fastening systems
- The types, availability and varieties of the above systems
- The range of tools used to carry out remove and replace operations and their safe/correct uses
- The range of methods for removing and replacing individual panels and parts methods used to align replaced parts and panels to reinstate manufacturers original settings

The individual shall be able to:

- Remove and re-install or attach parts and/or body panels (hoods, fenders, doors etc.) using any of the following methods:
  - Screwed
  - Riveted
  - Bolted
  - Clipped
  - Bonded
- Tag removed items for replacement and reassembly
- Re-align replaced parts to manufacturers' given tolerances where available for panel alignment and/or torque settings
- Remove, replace and adjust exterior/interior trims and/or other part necessary to complete repairs.

5	**Operate and/or manipulate any tools or equipment necessary to perform autobody repairs**	14

The individual needs to know and understand:

- The range, selection and assembly of hydraulic pull/push equipment
- The characteristics of common metals such as low carbon steel, high strength steels (HSS), ultra-high strength steels (UHSS)
- The direct effects of correct positioning, direction of push/pull etc.
- The principles behind the operation and maintenance of hydraulic push/pull equipment
- The range of set ups, ram ends and their purposes

Section		Relative importance (%)
	The individual shall be able to: • Select, assemble and correctly operate hydraulic push/pulling equipment such as bench mounted, rack or Porto-Power etc. • Manipulate body hammers, spoons, pick and pry bars, body files and any other tools used in the straightening process • Safely and efficiently operate the range of pneumatic tools used in the repair process (e.g. air hammer, disc grinder, file board, shears, adhesive/sealer and rivet guns to include self-piercing riveters etc.) • Safely and efficiently operate electric tools (e.g. welders, pulling tools, power tools) • Use a push set up to execute a pull direction • Prepare the push base to prevent induced damage • Operate a system tester – OBD diagnostic tool	
6	**Cosmetic repair of plastic non-structural components**	**12**
	The individual needs to know and understand: • The safety recommendations placed around correct repairs of non-structural cosmetic panels, e.g. bumpers, headlights, plastic outer trims • The operation of the range of plastic panels and bumpers which may include parking sensors and ADAS systems • Manufacturers' removal, replacement, repair, and testing procedures • Health and safety procedures around safe repairs directly from the OEM guidance	
	The individual shall be able to: • Remove, replace, repair .plastic non-structural components • Use OEM repair methods for both manufacturers and product suppliers • Perform repairs needed to complete safe repairs to components • Manually test sensors or systems to a "road safe" standard before handing vehicles back to customers.	
	Total	**100**

3 The Assessment Strategy and Specification

3.1 General guidance

Assessment is governed by the WorldSkills Assessment Strategy. The Strategy establishes the principles and techniques to which WorldSkills assessment and marking must conform.

Expert assessment practice lies at the heart of the WorldSkills Competition. For this reason, it is the subject of continuing professional development and scrutiny. The growth of expertise in assessment will inform the future use and direction of the main assessment instruments used by the WorldSkills Competition: the Marking Scheme, Test Project, and Competition Information System (CIS).

Assessment at the WorldSkills Competition falls into two broad types: measurement and judgement. For both types of assessment, the use of explicit benchmarks against which to assess each Aspect is essential to guarantee quality.

The Marking Scheme must follow the weightings within the Standards. The Test Project is the assessment vehicle for the skill competition, and therefore also follows the Standards. The CIS enables the timely and accurate recording of marks; its capacity for scrutiny, support, and feedback is continuously expanding.

The Marking Scheme, in outline, will lead the process of Test Project design. After this, the Marking Scheme and Test Project will be designed, developed, and verified through an iterative process, to ensure that both together optimize their relationship with the Standards and the Assessment Strategy. They will be agreed by the Experts and submitted to WSI for approval together, in order to demonstrate their quality and conformity with the Standards.

Prior to submission for approval to WSI, the Marking Scheme and Test Project will liaise with the WSI Skill Advisors for quality assurance and to benefit from the capabilities of the CIS.

4 The Marking Scheme

4.1 General guidance

This section describes the role and place of the Marking Scheme, how the Experts will assess Competitors' work as demonstrated through the Test Project, and the procedures and requirements for marking.

The Marking Scheme is the pivotal instrument of the WorldSkills Competition, in that it ties assessment to the standard that represents each skill competition, which itself represents a global occupation. It is designed to allocate marks for each assessed aspect of performance in accordance with the weightings in the Standards.

By reflecting the weightings in the Standards, the Marking Scheme establishes the parameters for the design of the Test Project. Depending on the nature of the skill competition and its assessment needs, it may initially be appropriate to develop the Marking Scheme in more detail as a guide for Test Project design. Alternatively, initial Test Project design can be based on the outline Marking Scheme. From this point onwards the Marking Scheme and Test Project should be developed together.

Section 2.1 above indicates the extent to which the Marking Scheme and Test Project may diverge from the weightings given in the Standards, if there is no practicable alternative.

For integrity and fairness, the Marking Scheme and Test Project are increasingly designed and developed by one or more independent people with relevant expertise. In these instances, the Marking Scheme and Test Project are unseen by Experts until immediately before the start of the skill competition, or competition module. Where the detailed and final Marking Scheme and Test Project are designed by Experts, they must be approved by the whole Expert group prior to submission for independent validation and quality assurance. Please see the Rules for further details.

Experts and Independent Assessors are required to submit their Marking Schemes and Test Projects for review, verification, and validation well in advance of completion. They are also expected to work with their Skill Advisor, reviewers, and verifiers, throughout the design and development process, for quality assurance and in order to take full advantage of the CIS's features.

In all cases a draft Marking Scheme must be entered into the CIS at least eight weeks prior to the Competition. Skill Advisors actively facilitate this process.

4.2 Assessment Criteria

The main headings of the Marking Scheme are the Assessment Criteria. These headings are derived before, or in conjunction with, the Test Project. In some skill competitions the Assessment Criteria may be similar to the section headings in the Standards; in others they may be different. There will normally be between five and nine Assessment Criteria. Whether or not the headings match, the Marking Scheme as a whole must reflect the weightings in the Standards.

Assessment Criteria are created by the person or people developing the Marking Scheme, who are free to define the Criteria that they consider most suited to the assessment and marking of the Test Project. Each Assessment Criterion is defined by a letter (A-I). *The Assessment Criteria, the allocation of marks, and the assessment methods, should not be set out within this Technical Description. This is because the Criteria, allocation of marks, and assessment methods all depend on the nature of the Marking Scheme and Test Project, which is decided after this Technical Description is published.*

The Mark Summary Form generated by the CIS will comprise a list of the Assessment Criteria and Sub Criteria.

The marks allocated to each Criterion will be calculated by the CIS. These will be the cumulative sum of marks given to each Aspect within that Assessment Criterion.

4.3 Sub Criteria

Each Assessment Criterion is divided into one or more Sub Criteria. Each Sub Criterion becomes the heading for a WorldSkills marking form. Each marking form (Sub Criterion) contains Aspects to be assessed and marked by measurement or judgement, or both measurement and judgement.

Each marking form (Sub Criterion) specifies both the day on which it will be marked, and the identity of the marking team.

4.4 Aspects

Each Aspect defines, in detail, a single item to be assessed and marked, together with the marks, and detailed descriptors or instructions as a guide to marking. Each Aspect is assessed either by measurement or by judgement.

The marking form lists, in detail, every Aspect to be marked together with the mark allocated to it. The sum of the marks allocated to each Aspect must fall within the range of marks specified for that section of the Standards. This will be displayed in the Mark Allocation Table of the CIS, in the following format, when the Marking Scheme is reviewed from C-8 weeks. (Section 4.1 refers.)

		CRITERIA								TOTAL MARKS PER SECTION	WSSS MARKS PER SECTION	VARIANCE
		A	B	C	D	E	F	G	H			
STANDARDS SPECIFICATION SECTION	1	5.00								5.00	5.00	0.00
	2		2.00					7.50		9.50	10.00	0.50
	3								11.00	11.00	10.00	1.00
	4			5.00						5.00	5.00	0.00
	5				10.00	10.00	10.00			30.00	30.00	0.00
	6		8.00	5.00				2.50	9.00	24.50	25.00	0.50
	7			10.00				5.00		15.00	15.00	0.00
TOTAL MARKS		5.00	10.00	20.00	10.00	10.00	10.00	15.00	20.00	100.00	100.00	2.00

4.5 Assessment and marking

There is to be one marking team for each Sub Criterion, whether it is assessed and marked by judgement, measurement, or both. The same marking team must assess and mark all Competitors. Where this is impracticable (for example where an action must be done by every Competitor simultaneously, and must be observed doing so), a second tier of assessment and marking will be put in place, with the approval of the Competitions Committee Management Team.. The marking teams must be organized to ensure that there is no compatriot marking in any circumstances. (Section 4.6 refers.)

4.6 Assessment and marking using judgement

Judgement uses a scale of 0-3. To apply the scale with rigour and consistency, judgement must be conducted using:

- benchmarks (criteria) for detailed guidance for each Aspect (in words, images, artefacts or separate guidance notes)
- the 0-3 scale to indicate:
  - 0: performance below industry standard
  - 1: performance meets industry standard
  - 2: performance meets and, in specific respects, exceeds industry standard
  - 3: performance wholly exceeds industry standard and is judged as excellent

Three Experts will judge each Aspect, normally simultaneously, and record their scores. A fourth Expert coordinates and supervises the scoring, and checks their validity. They also act as a judge when required to prevent compatriot marking.

4.7 Assessment and marking using measurement

Normally three Experts will be used to assess each aspect, with a fourth Expert supervising. In some circumstances the team may organize itself as two pairs, for dual marking. Unless otherwise stated, only the maximum mark or zero will be awarded. Where they are used, the benchmarks for awarding partial marks will be clearly defined within the Aspect. To avoid errors in calculation or transmission, the CIS provides a large number of automated calculation options, the use of which is mandated.

4.8 The use of measurement and judgement

Decisions regarding the choice of criteria and assessment methods will be made during the design of the competition through the Marking Scheme and Test Project.

4.9 Skill assessment strategy

WorldSkills is committed to continuous improvement. This particularly applies to assessment. The SMT is expected to learn from past and alternative practice and build on the validity and quality of assessment and marking.

Experts will prepare the aspects of criterion.

Test Project marking document

- The Test Project Marking Scheme (used by the Experts at the Competition) must include the assessment criteria and all explanations for mark deductions (penalties).

Diagnosis

- Set-up:
  - Deductions for each anchoring clamp not installed according to equipment maker's recommendations.
- Measuring system;
  - Deductions for the incorrect installation of the measuring bridge and locking braces;
  - Deductions for each measuring point not recorded or displayed;
  - Deductions for each jig (if used) with excessive tension on the pin or bolts.

Correction

- If measuring system is used each measuring point must not exceed manufacturer's tolerances; but only judged on measurement points previously out of alignment when first measured.
    - Deductions for each measuring point (length, width, height) exceeding manufacturer's tolerances, but only judged on measurement points previously out of alignment when first measured.
    - Deductions for each tear or deforming caused by incorrect pulling or incorrect clamping;
- Jig bolts and sill clamp nut torque must be checked using a torque wrench according to the equipment manufacturer's specifications;
    - Deductions for each bolt or nut without proper torque;
    - Deductions for each bolt missing.

Panel removal (structural and non-structural)

- Deductions for each hole left by drilling or grinding unless they are to be used for a MIG plug weld where required by the manufacturer and/or Competitor instructions;
  (Other drilling damage criteria must be clearly defined (i.e. drilling depth and scoring));
- Deductions for every tear in adjacent panels;
- Deductions for each 5 mm of reinforcement cut when cutting off panel;
- Deduction for each spot remnant not removed by grinding or panel finishing;
- Deduction for each 25 mm of flange not repaired/straightened.

Panel preparation (structural and non-structural)

- Paint/sealer removal in preparation for welding;
    - Resistance spot welding – all four flange surfaces;
    - Butt MIG weld joints – inside and outside of the joint;
    - Plug MIG weld joints – the first three surfaces (back side is not required);
    - Deductions for each 50 mm of flange or section not cleaned;
- Weld through primer must be applied to all joint matting surfaces in preparation for resistance spot and MIG plug welding;
    - Deductions for each 50 mm without weld-through primer applied in weld site;
    - Removal of weld through primer after inspection and during assembly is not permitted;
    - Deductions for each 50 mm of weld through primer removed.

Install replacement panel/part (fit-up)

- Butt joint gaps in preparation for welding as per manufacturer's specifications;
- If manufacturer's specifications are not available, the following should apply:
    - Metal up to 1 mm thickness – close butt to a maximum gap of 1 mm;
    - Metal exceeding 1 mm thickness – minimum gap should be one metal thickness and maximum, twice the metal thickness;
    - Deductions for each 5 mm of overlap or gap larger than specified gap;
    - Hole diameter for plug welding as per instructions, tolerance +/- 0.5 mm;
    - Deduction for each incorrect hole size;
    - Drilling depth for multi panel plug welds as per instructions;
    - Deduction for each hole drilled incorrect depth.

- Swage/fold lines:
  - Deductions for each swage/fold line not aligned correctly where welded. This is measured using a template that matches the swage/line contour. Tolerance + or –1 mm;
- Panel flanges:
  - Deductions for every area (at or between plug welds) where there is a gap greater than 0.5 mm between the two panels. On 1 mm low carbon steel only.

MIG tack welding for butt and lap joints

- Minimum tack weld spacing required, unless specified otherwise; (1 per 20 mm);
- Tack may be ground flush before applying final weld.

MIG continuous welds

- Butt and lap MIG welding runs (minimum length):
  - There is no minimum length required, unless specified otherwise;
- Weld quality;
  - Deductions for every 5 mm of weld having any of the following defects (holes, skips, voids, porosity, etc.);
  - Deductions for every 5 mm of weld exceeding 2 mm high;
  - Deductions for each 5 mm of no visible penetration

MIG plug welds

- Weld quality:
  - Deductions for each incorrect placement or number of plug welds;
  - Deductions for each plug weld where the hole hasn't been completely welded;
  - Deductions for each plug weld exceeding 2 mm high;
  - Deductions for plug welds that exceed 1.5 times the diameter (elongation) of the hole;
  - Deductions for each faulty weld, tested at random.

Resistance spot welds

- Weld quality:
  - Deductions for each incorrect placed or number of spot welds;
  - Deductions for each spot weld which has blown a hole;
  - Deductions for each spot weld where metal edge is missing due to "splashing or explosion";
  - Deductions for each faulty weld, tested at random.

Metal adhesive bonding technique

- Panel preparation, procedure and finishing as per manufacturer's instructions:
- Deductions for incorrect panel preparation, procedure or finishing;
- Incorrect formation of mechanical fastening rivets.

Dressing (Grinding/Sanding) of welds

- Completed welds must not be altered or reduced in size by grinding, chiselling or mechanical buffing, before marking takes place;
- Deductions for each plug weld and each 5 mm of continuous weld altered or reduced in size;
- Deductions for each 5 mm of continuous weld that has been ground too deep or not ground enough;
- Deductions for each MIG plug weld ground too deep or not enough.

Panel gaps and alignment

- All "bolt-on" panels/parts must be replaced as per manufacturer's specifications:
  - Deductions for each panel gap, swage/body line, inward and outward alignment in excess of tolerance;
- 0.5 mm tolerance is applied where manufacturer's tolerance is not specified.

Panel repairs (finishing)

- Judgement marking:
  - The repaired panel may be coated (with a solvent or similar) to produce a glossy surface and looked at in the light for imperfections (visual inspection);
  - The repaired area may be felt by hand;
- Templates:
  - The contour of a panel is checked by using a metal template. Expert's templates are constructed with the correct contour and shape;
  - Where the panel contour/shape is lower than the template the largest gap is measured;
  - Where the panel is too high/full, one end only the template is held against the panel and the size of the gap is measured at the other end;
  - Deductions for each 1 mm in excess of 1 mm tolerance;
- Cosmetic Repair of plastic non-structural components:
  - Cleaning and sending of repair area;
  - Bonding and after 24 hour break test;
- Deductions for each incorrect procedure.

4.10 Skill assessment procedures

Assessment and marking are an intense process that depends upon skilful leadership, management, and scrutiny.

The following is used as a guide for the Experts for marking the Test Project modules completed by the Competitors:

- The Experts are divided into marking groups (a minimum of three per group) with a designated leader;
- Once the provisional Marking Scheme has been prepared the marking team leader will present and summarize their section of the Competitor Instructions and the marking scale;
- All templates and other tools used for marking must be displayed and checked for accuracy;
- Every completed module is marked on the same day in which it was completed;
- To ensure transparency, each Competitor is provided with a copy of the same Mark Summary Form as used by the Experts;
- Where a clarification on marking criteria or process is required throughout the Competition the
- Chief Expert must ensure that all Experts are present and aware of any decision made and the result documented for future reference;
- Agree on a solution for disputes concerning marks awarded etc. by way of majority vote;
- Certain tasks need to be marked by Experts "while in progress" these are indicated in the Competitor's instructions where STOP is shown;
- A "request for judging chart" must be centrally located near the Experts' office;
    - This chart is numbered in the same manner as the Competitor instructions and the assessment document.
    - When the Competitor is ready to be marked on STOP A.0.1 (for example) they will write down the time in the appropriate STOP box on the chart. After the Experts have finished marking that component, the Competitor is verbally advised;
    - An individual "request for judging chart" is also installed in the Competitor's workstation, the Experts will record on that chart that the marking has been completed;
    - The Competitor can proceed with another task while the marking is taking place, providing there is no interference with the evaluation taking place where possible.

5 The Test Project

5.1 General notes

Sections 3 and 4 govern the development of the Test Project. These notes are supplementary.

Whether it is a single entity, or a series of stand-alone or connected modules, the Test Project will enable the assessment of the applied knowledge, skills, and behaviours set out in each section of the WSOS.

The purpose of the Test Project is to provide full, balanced, and authentic opportunities for assessment and marking across the Standards, in conjunction with the Marking Scheme. The relationship between the Test Project, Marking Scheme, and Standards will be a key indicator of quality, as will be its relationship with actual work performance.

The Test Project will not cover areas outside the Standards, or affect the balance of marks within the Standards other than in the circumstances indicated by Section 2. This Technical Description will note any issues that affect the Test Project's capacity to support the full range of assessment relative to the Standards. Section 2.1 refers.

The Test Project will enable knowledge and understanding to be assessed solely through their applications within practical work. The Test Project will not assess knowledge of WorldSkills rules and regulations.

Most Test Projects (and Marking Schemes) are now designed and developed independently of the Experts. They are designed and developed either by the Skill Competition Manager, or an Independent Test Project Developer, normally from C-12 months. They are subject to independent review, verification, and validation. (Section 4.1 refers.)

The information provided below will be subject to what is known at the time of completing this Technical Description, and the requirement for confidentiality.

Please refer to the current version of the Competition Rules for further details.

5.2 Format/structure of the Test Project

The Test Project is a series of five (5) standalone modules.

5.3 Test Project design requirements

In the Competitor's instructions, STOP must be written with a border at each evaluation point/section. The STOP must clearly define what is to be evaluated. All STOPs on the Competitor instructions must be numbered in this manner:

- A1
- A2
- B1
- B2
- C1
- C2
- D1
- D2
- E1
- E2 etc.

The evaluation criteria must also be numbered so that each STOP number matches the STOPs on the Competitor instructions. These STOP numbers must appear in the assessment criteria.

The Competitor must be tasked to demonstrate a range of skills in Autobody Repair. There should be at least five (5) different modules prepared.

- Module A - Diagnosis and Correction
- Module B - Structural Part Replacement
- Module C - Non-Structural Part Replacement
- Module D - Panel Repair
- Module E – MET (mechanical electrical and trim) and Safety Restraint System SRS.

Module A – Diagnosis and Correction

- Safe work practices must always be adhered to and apply to Host Country's regulations;
- Diagnose, repair and realign structural damage on a vehicle mounted on a realignment bench provided by the Competition Organizer;
- Remove bolt-on parts for access as necessary;
- Ensure that the sill clamps and/or centring jigs are in recommended position and secure (tightened);
- Vehicle must be measured by either a jig system or a universal mechanical measuring system;
- A misalignment report is compiled as required;
- Realign and repair components that are not being replaced;
- Repair all structural components to manufacturer's contours and shape that are not to be removed and replaced. The repair must be finished to a state that could be chemically treated and primed.
- The repair must not lose its strength due to over thinning of steel;
- There may be upper engine bay measuring points given to assist you to realign front engine bay to manufacture's measurements;
- All front-end bolt on panels supplied must be refitted to manufacturers' specifications;
- After the repairs are completed the engine bay must be realigned to the specification provide by the equipment manufacturer. A printout should be provided for verification if applicable;
- Manufacturer's specifications and tolerances should be respected. If none are available, and using a universal measuring system, + or – 3 mm is the tolerance used for each measuring point (dimension).

Module B – Structural Part(s) Replacement

- Safe work practices must always be adhered to and apply to Host Country's regulations;
- Remove bolt-on parts for access as necessary;
- Assessment is done as the module evolves as determined by the stop points in the Competitor instructions and at the end of the four days of the Competition.

Panel Removal

- Remove parts damaged beyond repair listed in the Competitor's instructions (full or partial) following the vehicle repair manual using manufacturers' specifications. If unavailable, the Experts will supply necessary procedural information;
- Remove corrosion protection and paint materials as necessary in areas where panels or panel flanges are heated by any welding method;
- Straighten (repair) all parts and components deformed during the repair process and dress/clear appropriately.

Panel Preparation

- Drill or punch holes for plug welds on flanges as necessary;
- Welding primer should be applied to all weld areas, according to the vehicle manufacturer's guidelines;
- Prepare reinforcements as required;
- Apply adhesive on correct areas should the part be bonded

Install replacement panel/parts (fit-up)

- Produce joint gaps to within manufacturer's tolerances;
- Ensure the correct alignment of swage/fold lines of the replacement parts to existing vehicle part locations;
- Produce flush mating flange fit-up.

Replace panel/part(s) by welding and/or metal adhesive bonding technique

- Replace parts listed in the Competitor's instructions (full or partial) following the vehicle repair manual using manufacturers' specifications. If unavailable, the Experts will supply necessary procedural information.
- All placement and type of welding is to be completed as specified by the vehicle manufacturer. If none are available, the Test Project sample (located at the Competition in a stall with Competitor and Expert access) is used.
- Welding procedures are performed as per manufacturers repair manual instructions unless otherwise specified because of lack of manufacturer repair information or the project design.
- All MIG plug and continuous welds must be marked before grinding takes place unless directed otherwise.
- Welds are tested for strength (random selection).
- Welded areas must be finished in a state that would enable the areas to be chemically treated and primed.
- Metal adhesive bonding as per manufacturer's instructions.

Dress/Grind/Sand Welds

- After MIG welding (plug or continuous welds) the welds must be ground (as determined by the Experts at the competition) flat and finished;
- Welded areas must be finished in a state that would enable the areas to be chemically treated and primed;
- When you finish grinding/sanding welds, they must be checked, Inspection and marking may be required before fitting bolt on parts;
- Metal finishing in the polyester filling location is not required;
- Metal finishing - sand to P80 g or finer;
- Paint edges feathered to P120 g or finer.
- Panel gaps
- Reinstall all "bolt-on" parts removed for repair operations using manufacturer's specifications and tolerances.

Module C – Non-Structural Part(s) Replacement

- Safe work practices must always be adhered to and apply to the Host Country's regulations;
- Remove bolt-on parts for access as necessary;
- Assessment is done as the module evolves as determined by the stop points in the Competitor
- Instructions and at the end of the four days of the Competition.

Panel Removal

- Remove a panel/part following sectioning guidelines in the Competitor's instructions;
- Remove corrosion protection and paint materials as necessary in areas where panels or panel flanges are heated by any welding method;
- Straighten (repair) all deformation and remove spot weld remnants

Panel Preparation

- Drill or punch holes for plug welds on flanges as necessary;
- Welding primer should be applied to all weld areas, according to the vehicle manufacturer's guidelines.

Install replacement panel/parts (fit-up)

- Produce joint gaps to within manufacturer's tolerances;
- Ensure the correct alignment of swage/fold lines at the replacement part to existing vehicle part locations;
- Produce flush mating flange fit-up;
- The panel must be fitted to suit manufacturer's measurements and gaps with adjacent panels.

Replace panel/part(s) by welding and/or metal adhesive bonding technique

- All welding is to be completed as specified by the vehicle manufacturer and/or Experts instructions.
- All welded butt joints that would normally require polyester filler are to be dressed ready for a thin application of filler however, filler will not be applied;
- All MIG continuous and plug welds must be marked before grinding takes place unless directed otherwise;
- Welds are tested for strength (random selection);
- Welded areas must be finished in a state that would enable the areas to be chemically treated and primed;
- Metal adhesive bonding as per manufacturer's instructions.

Dress/Grind/Sand Welds and bonded areas.

- After inspection the MIG plug or continuous welds must be ground flat and finished;
- Welded areas must be finished in a state that would enable the areas to be chemically treated and primed;
- Bonded areas need to be prepared for metal filler.

Module D – Panel Repair

- Safe work practices must always be adhered to and apply to the Host Country's regulations;
- Repaired area must have the original contour and shape on secured (welded) panels only
- Repaired area must be file finished, this should be completed if marks are to be awarded
- Panel shrinking must be done with electrical equipment or cold shrinking as needed, miracle/welded dent pull systems only to be used if agreed in the Test Project and specified on the IL and provided by the sponsors only.
- Repaired area is to be carried out without filler to a standard ready for chemical treatment and primer;
- Repaired areas must not have deep file marks;
- Metal finishing - sand to P80 g or finer;
- Paint edges feathered to P120 g or finer;
- The panel repair area must not be damaged by excessive filing or sanding (example, file or grind through body lines and folds).

Module E – Cosmetic repair on plastic and non-structural components

- Safe work practices must always be adhered to and apply to the WorldSkills Health, Safety, and Environment policy and guidelines;
- Thermal joining or cold adhesive repairs methods to be followed by either OEM or manufacturers methods or standards;
- Repairs finished to a standard ready for primer in the paint shop (P180 or higher);

5.4 Test Project development

The Test Project MUST be submitted using the templates provided by WorldSkills International (www.worldskills.org/expertcentre). Use the Word template for text documents and DWG template for drawings.

5.4.1 Who develops the Test Project or modules

The Test Project/modules are developed by an Independent Test Project Designer in collaboration with the Skill Competition Manager.

The Independent Test Project Designer may include technicians from the major sponsors and the Workshop Manager. They shall be known as the Test Project Design Team.

5.4.2 When is the Test Project developed

The Test Project/modules are developed according to the following timeline:

Time	Activity
As close to CPW as possible	As soon as possible the Competition Organizer advises the make and model of the car body shell for the Competition by listing it on the IL.
Four (4) months prior to the Competition (if the body shell has been identified and is available for development)	The Test Project/modules are Developed.
Three (3) months prior to the Competition	Pre-competition information is circulated on the WorldSkills website.
At the Competition on C-4	The Test Project/modules are presented to Experts.
At the Competition on C-2	The Test Project/modules are presented to Competitors.

5.5 Test Project initial review and verification

The purpose of a Test Project is to create a challenge for Competitors which authentically represents working life for an outstanding practitioner in an identified occupation. By doing this, the Test Project will apply the Marking Scheme and fully represent the WSOS. In this way it is unique in its context, purpose, activities, and expectations,

To support Test Project design and development, a rigorous quality assurance and design process is in place (Competition Rules sections 10.6-10.7 refer.) Once approved by WorldSkills, the Independent Test Project Designer is expected to identify one or more independent, expert, and trusted individuals initially to review the Designer's ideas and plans, and subsequently to verify the Test Project, prior to validation.

A Skill Advisor will ensure and coordinate this arrangement, to guarantee the timeliness and thoroughness of both initial review, and verification, based on the risk analysis that underpins Section 10.7 of the Competition Rules.

5.6 Test Project validation

The Skill Competition Manager coordinates the validation and will ensure that the Test Project/modules can be completed within the material, equipment, knowledge, and time constraints of Competitors.

5.7 Test Project selection

Upon development of the Test Project, the Marking Scheme is tested to confirm the validity of it and the modules according to the manufacturer's data on repair methods and in alignment with the WSOS (section 2).

5.8 Test Project circulation

If applicable, the Test Project is circulated via the website as follows:

The Test Project/modules are not circulated prior to the Competition. The Test Project is presented to Experts on C-4 and to Competitors on C-2.

Pre-competition information is circulated three (3) months prior to the Competition.

5.9 Test Project coordination (preparation for Competition)

Coordination of the Test Project/modules is undertaken by the Skill Competition Manager.

5.10 Test Project change

There is no 30% change required to be made to the Test Project/modules at the Competition. Exceptions are amendments to technical errors in the Test Project documents and to infrastructure limitations.

5.11 Material or manufacturer specifications

Specific material and/or manufacturer specifications required to allow the Competitor to complete the Test Project will be supplied by the Competition Organizer and are available from www.worldskills.org/infrastructure located in the Expert Centre. However, note that in some cases details of specific materials and/or manufacturer specifications may remain secret and will not be released prior to the Competition. These such items may include those for fault finding modules or modules not circulated.

The Competition Organizer shall advise all Experts via the Infrastructure List of the make and model of the body shell and the realignment and measuring system that is supplied for the Competition as soon as possible after the CPW in order that the design team can commence their project design. As far as possible the make and model of the body shell should be a globally available car.

The Workshop Manager will post the car manufacturer's repair manual and the measuring system datasheet in the Infrastructure List as soon as the make and model is confirmed.

6 Skill management and communication

6.1 Discussion Forum

Prior to the Competition, all discussion, communication, collaboration, and decision making regarding the skill competition must take place on the skill specific Discussion Forum (http://forums.worldskills.org). Skill related decisions and communication are only valid if they take place on the forum. The Chief Expert (or an Expert nominated by the Chief Expert) will be the moderator for this Forum. Refer to Competition Rules for the timeline of communication and competition development requirements.

6.2 Competitor information

All information for registered Competitors is available from the Competitor Centre (www.worldskills.org/competitorcentre).

This information includes:

- Competition Rules
- Technical Descriptions
- Mark Summary Form (where applicable)
- Test Projects (where applicable)
- Infrastructure List
- WorldSkills Health, Safety, and Environment Policy and Regulations
- Other Competition-related information

6.3 Test Projects [and Marking Schemes]

Circulated Test Projects will be available from www.worldskills.org/testprojects and the Competitor Centre (www.worldskills.org/competitorcentre).

6.4 Day-to-day management

The day-to-day management of the skill during the Competition is defined in the Skill Management Plan that is created by the Skill Management Team led by the Skill Competition Manager. The Skill Management Team comprises the Skill Competition Manager, Chief Expert, and Deputy Chief Expert. The Skill Management Plan is progressively developed in the six months prior to the Competition and finalized at the Competition by agreement of the Experts. The Skill Management Plan can be viewed in the Expert Centre (www.worldskills.org/expertcentre).

6.5 General best practice procedures

General best practice procedures clearly delineate the difference between what is a best practice procedure and skill-specific rules (section 9). General best practice procedures are those where Experts and Competitors CANNOT be held accountable as a breach to the Competition Rules or skill-specific rules which would have a penalty applied as part of the Issue and Dispute Resolution procedure including the Code of Ethics and Conduct Penalty System. In some cases, general best practice procedures for Competitors may be reflected in the Marking Scheme.

Topic/task	Best practice procedure
Tools/infrastructure	• Competitor's toolbox must be suitably sized to fit within the boundaries of the workstation without encroaching on walkways, neighbouring Competitor workstations or cause obstruction to the free and safe movement of the Competitor or Experts within the workshop.
Templates, aids	• Experts may decide to remove any items brought to the Competition by the Competitor, which are not considered normal autobody repair tools and would give any Competitor an unfair advantage. This applies specially to prefabricated, pre-formed, or pre-drawn templates or repair jigs of any kind.

7 Skill-specific safety requirements

Refer to WorldSkills Health, Safety, and Environment Policy and Regulations for Host country or region regulations.

Task	Safety glasses with side protection	Dust mask	Fume MASK/ Respirator	Welding helmet	Nitrile gloves	Welding gloves	Cut protection gloves	Safety shoes with protective cap	Sturdy shoes with closed toe and heel	Tight fitting work clothes (long trousers)	Fire resistant protective clothes	Hearing protection
General PPE for safe areas									√			√ Optional
Cutting	√	√					√	√		√		√
Drilling	√	√					√	√		√		√
MIG/MAG welding			√	√		√		√			√	√
Resistance welding	√		√*			√		√			√	√
Grinding	√	√					√	√		√		√
Straightening (hammer, pulling)	√							√		√		√
Bonding	√		√		√			√		√		

8 Materials and equipment

8.1 Infrastructure List

The Infrastructure List details all equipment, materials, and facilities provided by the Competition Organizer.

The Infrastructure List is available at www.worldskills.org/infrastructure.

The Infrastructure List specifies the items and quantities requested by the Skill Management Team for the next Competition. The Competition Organizer will progressively update the Infrastructure List specifying the actual quantity, type, brand, and model of the items. Note that in some cases details of specific materials and/or manufacturer specifications may remain secret and will not be released prior to the Competition. These such items may include those for fault finding modules or modules not circulated.

At each Competition, the Skill Management Team must review and update the Infrastructure List in preparation for the next Competition. The Skill Competition Manager must advise the Director of Skills Competitions of any increases in space and/or equipment.

At each Competition, the Technical Observer must audit the Infrastructure List that was used at that Competition.

The Infrastructure List does not include items that Competitors and/or Experts are required to bring and items that Competitors are not allowed to bring – they are specified below.

8.2 Competitors toolbox

The Competitor's toolbox must be suitably sized to fit within the boundaries of the workstation without encroaching on walkways, neighbouring Competitor workstations or cause obstruction to the free and safe movement of the Competitor or Experts within the work area.

8.3 Materials, equipment, and tools supplied by Competitors

The Competitor must supply any tools, special equipment, and individually desired materials not covered in the Infrastructure List. These must be presented to the Experts for inspection prior to the start of the Competition.

All Competitors must use the Metal Inert Gas MIG and Resistance Spot Welders supplied by the Competition Organizer.

Competitors are required to supply their own Personal Protective Equipment as specified in section 7 skill-specific safety requirements.

8.4 Materials, equipment, and tools supplied by Experts

Experts are required to supply their own Personal Protective Equipment as specified in section 7 skill-specific safety requirements.

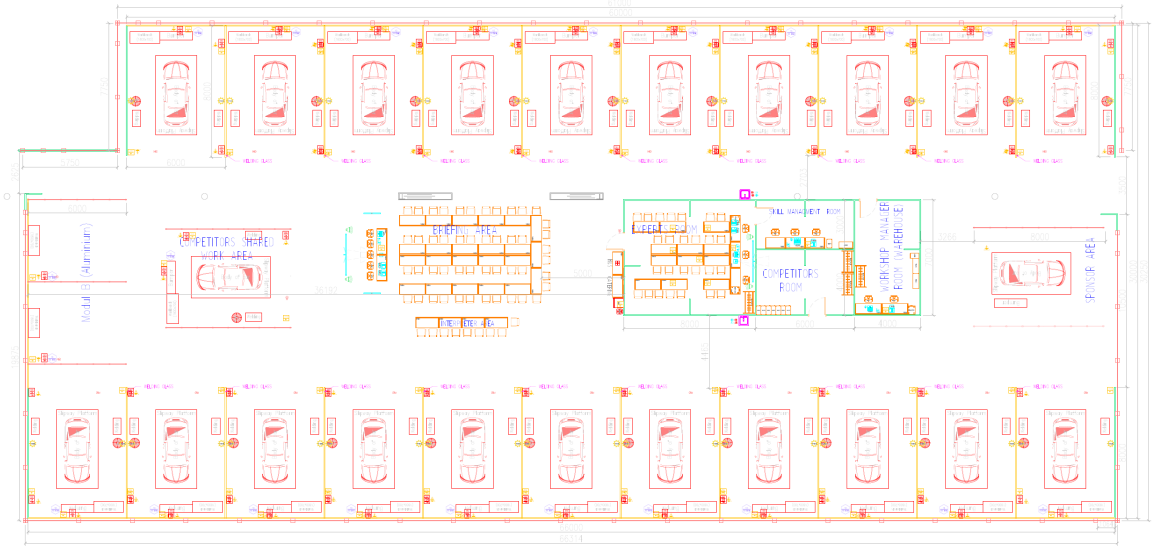
8.5 Materials and equipment prohibited in the skill area

The Experts may rule out any items brought to the Competition, which are not considered normal autobody tools and would give any Competitor an unfair advantage. This applies specially to refabricated, pre-formed or pre-drawn templates or repair jigs of any kind. These are not allowed to be brought to the Competition. Everything of this nature must be made or fabricated on site if so desired. Profile gauges must not be pre-adjusted prior to the start of the Competition.

8.6 Proposed workshop and workstation layouts

Workshop layouts from previous competitions are available at www.worldskills.org/sitelayout.

Example workshop layout



9 Skill-specific rules

Skill-specific rules cannot contradict or take priority over the Competition Rules. They do provide specific details and clarity in areas that may vary from skill competition to skill competition. This includes but is not limited to personal IT equipment, data storage devices, Internet access, procedures and workflow, and documentation management and distribution. Breaches of these rules will be solved according to the Issue and Dispute Resolution procedure including the Code of Ethics and Conduct Penalty System.

Topic/task	skill-specific rule
Use of technology – USB, memory sticks	• Skill Competition Manager, Chief Expert, Deputy Chief Expert, Experts, Competitors, and Interpreters are not allowed to bring memory sticks into the workshop from C-4 until C+1.
Use of technology – personal laptops, tablets and mobile phones	• Skill Competition Manager, Chief Expert, Deputy Chief Expert, Experts, Competitors, and Interpreters are allowed to bring personal laptops, tablets, and mobile phones into the Expert room only. These can be removed from the workshop at lunchtime and at the end of each day.
Use of technology – personal photo and video taking devices	• Competitors, Experts, and Interpreters are only allowed to use personal photo and video taking devices in the workshop at the conclusion of the competition on C4. • Skill Competition Manager, Chief Expert, and Deputy Chief Expert are exempt from this rule.
Templates, aids, etc.	• Competitors and Experts are not allowed to bring prefabricated, pre-formed, or pre-drawn templates into the workshop. Competitors are allowed to fabricate templates in the workshop on C1 to C4 if so desired. • Profile gauges must not be pre-adjusted before the start of the Competition.
Drawings, recording information	• Competitors may only record information and make notes on the Test Project documentation.

10 Visitor and media engagement

Following is a list of possible ways to maximize visitor and media engagement:

- Try-a-Skill;
- Display screens;
- Test Project descriptions;
- Enhanced understanding of Competitor activity;
- Competitor profiles;
- Career opportunities;
- Daily reporting of competition status.

11 Sustainability

This skill competition will focus on the sustainable practices below:

- Recycling;
- Use of "green" materials;
- Use of completed Test Projects after Competition;
- Reducing the duplication of equipment.

12 References for industry consultation

WorldSkills is committed to ensuring that the WorldSkills Occupational Standards fully reflect the dynamism of internationally recognized best practice in industry and business. To do this WorldSkills approaches a number of organizations across the world that can offer feedback on the draft Description of the Associated Role and WorldSkills Occupational Standards on a two-yearly cycle.

In parallel to this, WSI consults three international occupational classifications and databases:

- ISCO-08: (http://www.ilo.org/public/english/bureau/stat/isco/isco08/) ILO 7232
- ESCO: (https://ec.europa.eu/esco/portal/home)
- O*NET OnLine (www.onetonline.org/)

This WSOS (Section 2) appears to relate closely to *Automotive Body and Related Repairers:* https://www.onetonline.org/link/summary/49-3021.00.

These links can also be used to explore adjacent occupations.

The following table indicates which organizations were approached and provided valuable feedback for the Description of the Associated Role and WorldSkills Occupational Standards in place for WorldSkills Shanghai 2021.

Organization	Contact name
MIT Automobile Service Company Limited. China (China)	Yuan Shilong, Departmental Director
The National Institute for Automotive Service Excellence (United States of America)	Teresa Bolton, Director, Collision Repair Test Development