

**INTEGRAL COACH FACTORY, CHENNAI- 600 038**

**SCHEDULE OF REQUIREMENTS FOR MANUFACTURE  
AND SUPPLY OF STAINLESS STEEL SIDEWALL &  
ROOF ASSEMBLIES**

ICF/MD/SPEC-200  
Issue Status : 01  
Revision : 04  
Date : 28.09.2017

**IDENTIFICATION SHEET**

No of Pages 19 +1

Amendment Nos.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Date Of Issue	05/05/2018				

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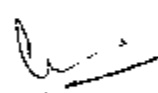
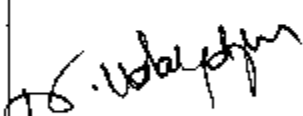

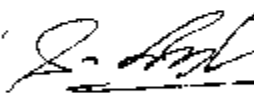
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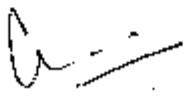
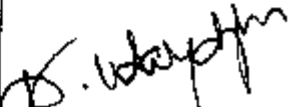
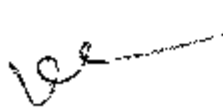
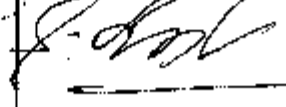
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Page No	Clause No.	EXISTING DESCRIPTION	REVISED DESCRIPTION
11	12.4	The Quality Assurance Plan (QAP) to be submitted to ICF initially for approval.	<b>The Quality Assurance Plan (QAP) Shall be made as per ICF/QAP/LHB-10,ISSUE STATUS-01,REV-00 and shown to the Inspection Authority.</b>

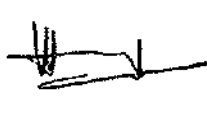
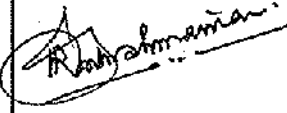


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Changes Data on Rev.03


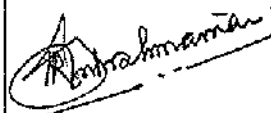
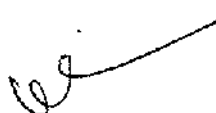

Sl. No	Month / Year of issue	Revision / Amendment	Clause No.	Reason for Revision / Amendment
1	AUGUST-2017	Rev.04	<u>Changes</u>	The following changes are made by including the requirements as per ISO 3834, EN 15085, Laser welding and spot weld quality requirement including argon gas purging to avoid discoloration.
			4.1.A.(iv)	"Automatic/CNC/robotic spot welding" machine added.
			4.1.A.(vii)	Modified as " Laser cutting machine of effective bed size (min. 1.5M width x 3M length)and Laser welding machine of effective bed size (min 2.5M width x 3M length ) or Laser cutting cum welding machine of effective bed size (Min 2.5m width x 3m length)" to suit the cutting and welding requirements of sidewall sheet joints
			6.0	Tension of 8 tonnes modified to 12 tonnes to suit 3 mm thick sheet.
			7.1	Clause modified by including Welders qualification as per ISO 9606-1,Laser weld and Spot welding operator qualification as per ISO 14732.

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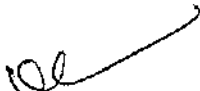
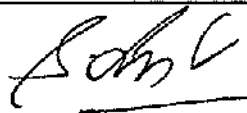
			7.2	Clause modified by including Supervisors additional qualification with IWE/IWT/IWS given by IIW or WRI/Trichy or AWTI/ICF
			7.3	Existing clause deleted. New clause for Inspection and testing personnel qualification as per ISO 9712 level-2 or SNT-TC-1A level 2 added. Renumbered as 7.7
			7.4	New clause for Welding plant calibration as per ISO 17662/ BS EN 50504 added.
			7.5	New clause on WPS for critical joints added. Welding Procedure Specification (WPS) shall be as per ISO 15609, 15613 and 15614.
			7.6	New clause on "Pickling/Passivation after welding" added.
			8.1	Clause modified by including measurement for spot welding indentation.
			8.2	Permission for Testing at NABL Lab for 8.2(i) deleted.
			8.2(iv)	DIN 8.1M: 2007 deleted.

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			9.1.(viii)	DIN 8.1M:2007 changed as "drawing" and spot size details deleted.
			10.1	Prototype sample drawing modified as "Lavatory sidewall of a LHB build".
			10.3	New clause on "Quality of Spot Weld" added. (Ref: Principal/AWTI letter no. AWTI/210 dated 09-01-2017.)
			12.1	Clause modified to include ISO 3834 and to follow EN 15085-CL1 standard requirements.
			12.3	Welding activities as per ISO 3834 & EN 15085 requirements added. Documentation for Spot weld data added.
			12.6	New clause for Quality requirement for spot welds as per CP C2 of ISO 15085-Part-3 added.
			Annexure-A	Replaced with Tables for tests to be conducted on test specimens and actual jobs.
			Annexure-B	Tables for quality requirements of spot welding added.

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**1.0 SCOPE**

- 1.1 This schedule covers requirements for manufacture and supply of sidewall & roof assemblies for LHB type coaches.

**2.0 REQUIREMENTS**


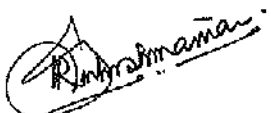


- 2.1 All vendors seeking registration with ICF must fulfill the requirements of this schedule.
- 2.2 They should have demonstrated their competence for manufacture of large size stainless steel fabrications.

**3.0 COVERED AREA**

- 3.1 The firm shall have adequate covered area for storage of raw material, finished products and work in progress. There should be a separate area earmarked for Stainless steel, to avoid mix up with mild steel fabrication.

**4.0 MACHINERIES AND INFRASTRUCTURE REQUIRED**

- 4.1 The firm shall have the following machinery and infrastructure with them as a minimum requirement for manufacture of heavy fabricated items.
- A. (i) MIG welding facility.  
(ii) TIG welding facility.  
(iii) Stainless steel fabrication handling facilities e.g. Crane, Nylon slings  
(iv) Automatic /CNC/ robotic spot welding machine of suitable capacity to weld at a stretch with adequate clear space to handle long subassemblies with handling equipment.

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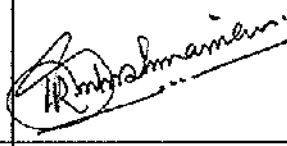
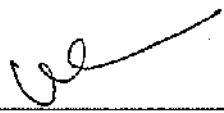
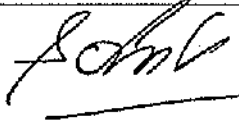
- (v) Hydraulic press with sufficient capacity for window forming for Non-AC coaches (or a proper MOU /back to back agreement with OEM's shall be submitted along with the tender).
- (vi) Sheet straightening machine for straightening of sheets before laser cutting.
- (vii) Laser cutting machine of effective bed size (min. 1.5M width x 3M length) and Laser welding machine of effective bed size (min 2.5M width x 3M length ) or Laser cutting cum welding machine of effective bed size (Min 2.5m width x 3m length) to suit the cutting and welding requirements of sidewall sheet joints.

B. Separate stainless steel fabrication bay to be earmarked with minimum covered shed of 2000 sq. metres area having crane facility of at least 5 tonnes. Evidence for the above (Clause 4.1) shall be submitted along with the tender documents.

- 4.2 For manufacture of roof assemblies, the firm shall have Cold Forming facility within the premises or a proper Memorandum of Understanding/Back to back agreement with OEMs manufacturing heavy duty CRF sections of thickness exceeding 2mm.

**5.0 GENERAL PRACTICE TO BE FOLLOWED DURING MANUFACTURE**

- 5.1 The stainless steel for manufacture of sidewall & Roof shall be procured only from the reputed stainless steel producers in the country, such as 1. M/s. SAIL and 2. M/s. JINDAL. For any other source, approval from ICF shall be taken.
- 5.2 The Sub-assemblies shall be manufactured as per the relevant drawing issued by ICF using fixtures. For the first time supplier the prototype shall be approved by ICF design office before series production.

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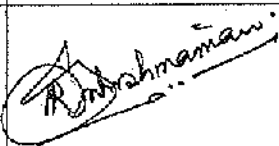
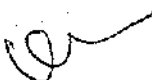
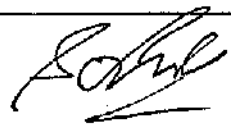
- 5.3 Sheets and plates shall be carefully straightened and flattened in straightening machine before laser cutting. Welded components or members shall be correctly matched and accurate levels and clearances shall be ensured to result in perfect welds.
- 5.4 Certain minor modifications in the assembly if required have to be done as advised by ICF.
- 5.5 The firm shall have necessary jigs and fixtures to ensure verticality and dimension as specified in the drawing.

**6.0 SKIN STRETCHING**

- (a) To ensure flatness of sidewall surface and to avoid undulations, the sheets shall be stretched before further welding of stiffeners in the fixture by applying a tension of 12 tonnes approx. on both sides (longitudinal side) by suitable stretching system (screw / hydraulic).
- (b) Stretching shall be released only after completion of welding of all stiffeners allowing sufficient cooling time.

**7.0 REQUIREMENT OF WELDING ACTIVITIES**

- 7.1 Welders qualified with ITI or equivalent qualification and qualified as per ISO 9606-1 for all critical joints, positions shall be only employed. Laser weld and Spot welding operator shall be qualified as per ISO 14732.
- 7.2 Supervisors shall have sufficient welding knowledge having minimum qualification of diploma in mechanical engineering. Firms shall identify and nominate a welding coordinator responsible for all welding operations. The welding coordinator should preferably have qualified as per ISO 14731 of IWE/IWT/IWS, diplomas awarded by Indian Institute of Welding or certificate from WRI/ Trichy or AWTI/ICF.

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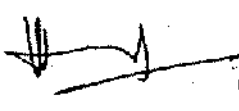
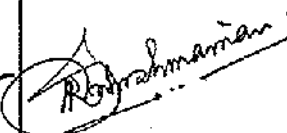


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- 7.3 Inspection and testing personnel shall have qualification as per ISO 9712 level-2 or SNT-TC-1A level 2.
- 7.4 All welding plants should be calibrated as per ISO 17662/ BS EN 50504.
- 7.5 WPS (Welding procedure specification) shall be prepared for all critical joints & qualified as per ISO 15609, 15613 and 15614 for applicable parts.
- 7.6 Pickling/Passivation shall be done after completion of all welding. Firm shall indicate in their QAP about this process and shall conduct trials in test plates before applying in the sidewall and roof.
- 7.7 Record of above details shall be maintained for verification.

**8.0 INSPECTION & TESTING FACILITIES**

- 8.1 The firm shall have calibrated measuring gauge, Vernier calliper, throat gauge, straight edge, level bed, etc. Spot welding indentation should be measured using digital depth gauge. The readings to be recorded in the inspection check list.
- 8.2 The firm shall have in house testing facilities for the following.
- (i) Chemical and Mechanical properties of raw material.
  - (ii) Macro etch test for fusion of fillet weld
  - (iii) Dye penetration test
  - (iv) Peel test & Chisel test of spot welds.
  - (v) Root bend, Face bend tests for butt welds.
- 8.3 Each completed assembly of the Roof shall be tested for water leakage at the works of the manufacturer. Appropriate test scheme & rig may be devised for the same to the satisfaction of ICF Engineers.

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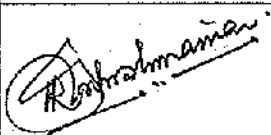
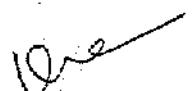
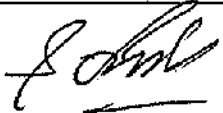
**9.0 PRECAUTIONS**

9.1 The firm shall take following precautions during manufacture/supply of stainless steel assemblies.

- (i) The outer surface should have no visible welding marks. No surface preparation will be done at ICF. Therefore, supplier shall prepare surface on which PU painting as per requirement of ICF can be directly done.
- (ii) Joint area to be welded must be clean. Use only stainless steel wire brush.
- (iii) Joint area must be free of grease, oil, water, dirt, finger marks.
- (iv) Use good commercial solvent cleaner to clean the weld area before welding.
- (v) Arc strikes adjacent to the weld must be avoided.
- (vi) Avoid excessive heat input.
- (vii) Grind the weld flush.
- (viii) Size of spot weld shall be chosen as per drawing.

**10.0 FINISH**

10.1 Exterior of roof and sidewall panels shall be without bulges or depressions that could be visible after painting. Concavity or convexity shall be less than 1.5 mm in a length of 2.5 metres and in this proportion for shorter length. The indices of concavity or convexity should be taken as guidance for manufacturing (refer clause 6.0). A prototype sample (2Nos.) of lavatory sidewall of a LHB build should be submitted to ICF by any new vendor seeking approval for supply of these sub assemblies for demonstrating the surface finish achieved by the firm and for prior approval before bulk manufacturing of sub-assemblies.

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10.2 Post welding stainless steel wire brush cleaning using mechanized wire brush should be done for side wall and roof sub-assembly. Roof / Side wall (on either side of each) would require to be provided with suitable primer as approved by ICF engineers, on both sides, leaving 50 mm strip along the edges that are required to be further integrated with other sub-assemblies by welding. Side wall of the LHB coaches which require skin tensioning shall be painted by ICF after skin tensioning process.

**10.3 QUALITY OF SPOT WELD (Argon Gas Purging)**

Spot welding shall be carried out in inert gas atmosphere to avoid any discoloration. Suitable arrangement shall be made in the machine to admit inert gas (Argon gas to purity 99.995% minimum). There shall not be any heat tint/ colour in the resultant spots.


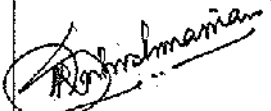


**11.0 DRAWINGS**

This specification shall be read along with the respective drawings for roof, sidewall and endwall issued by Railway engineers/ Purchaser.

**12.0 QUALITY CONTROL REQUIREMENTS**

12.1 The manufacturer shall have ISO: 9000 series and ISO 3834-CL2 certification. Firm shall follow EN 15085 – CL1 standard requirements and shall take steps to get certification for EN 15085 – CL1 standard.

12.2 There shall be a system to ensure traceability of the product from raw material stage to finished product stage.

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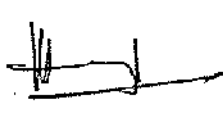
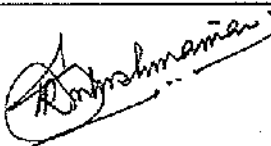
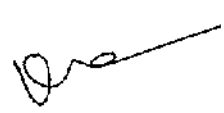

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12.3 Quality Assurance Plan (QAP) for the following aspects shall be ensured.

- Process flow chart
- Stage inspection details from raw materials stage to finished product stage.
- Various parameters to be checked and level of acceptance of such parameters indicated and method to ensure and control over them.
- Disposal system of rejected raw material and components.
- Check list for critical monitoring of above stages.
- Welding activities as per ISO 3834 & EN 15085 requirements.

**DOCUMENTATION**

- Incoming raw material register.
- Stage inspection results including finished products results as approved by QAP.
- Records of internal rejection and its analysis vis –a- vis action plan.
- Records of final products inspection by external agencies.
- Records of maintenance schedule of machinery and Plant
- Records of training imparted in Production, quality assurance, safety parameters and maintenance of machinery, periodical evaluation of welders etc.

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- Spot weld for daily production test, indentation measurement, spot welding tool dressing data.


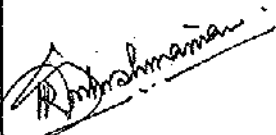

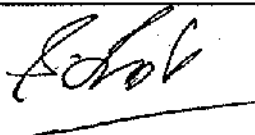
12.4 The Quality Assurance Plan (QAP) to be submitted to ICF initially for approval.

**12.5 ROUTINE INSPECTION**

Routine inspection of each finished item shall be carried out as follows for spot welds.

- a) Paper test- a stiff white paper shall be passed at random locations (at least two locations in each window bay) between spot welded members to ensure that the welding took place and there is no gap. If paper passes freely, then the item stands rejected.
- b) Chisel test – a chisel should be driven between two spot welds until one or both welds break. The fractured nugget should form cup and cone shaped fracture and size of nugget should be approximately to the size of spot weld. This test is to be done at two random locations to ensure fusion of spot weld. If the result is not satisfactory, the item stands rejected. If the result is satisfactory, the tested area should be levelled by tinkering and TIG welded.

12.6 Quality requirement of all the spot welds shall be evaluated to weld performance class CP C2 of ISO 15085- Part-3. (for reference annexure -A shall be followed.)

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**13.0 MARKING**

Manufacturers name or initial with month and year of manufacture shall be available in the finished products at two locations at the ends.


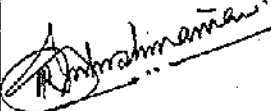


**14.0 PACKING**

The surface shall be properly protected against rubbing / impact / scratches during transportation via wagon/truck/trailers by wooden blocks / rubber pads at suitable locations in the transportation fixture.

Due care shall be taken to avoid mechanical damage during loading/transit /unloading. The packing should be such that while unpacking the consignment at ICF there should be no damage/dent mark to the finished product. As far as possible recyclable material to be used in packing of sub-assemblies.

Transit insurance shall be in the scope of supplier.

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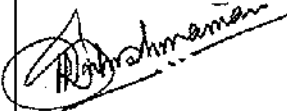


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**Annexure-A**

**Table 1**

(Tests to be conducted on test specimens for preparation of WPS or for proving  
quality at an interval of one year)

S.No.	Tests	No. of samples	Requirement As per EN 15085 -3 placed as Annexure-B.
1	Visual inspection (as per cl.7.3 of ISO:15614-12)	All specimens	Table F.2 (external)
2	Indentation	All specimens	Table F.3
3	Shear pull test (as per ISO:14273)	11 specimens	Table F.4
4	Macro examination (as per ISO:17639)	2 specimens	Table F.2 (inner findings , internal)
5	Peel test / Torsion test - nugget diameter (as per ISO:14270/ISO:17653)	11 specimens	Nugget dia shall be as per table F.4.
6	Hardness (as per ISO:14271)	2 specimens (Macro examination samples shall be used)	Table F.2 (General)

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**Table 2**


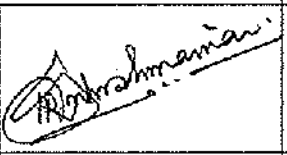
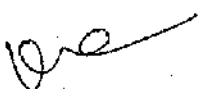

(Tests to be conducted on test specimens **daily** before start of work or at change of WPS or during tool change/tool dressing/after power cut)

S.No.	Tests	No. of samples	Requirement As per EN 15085 -3
1.	Visual inspection (external)	3 specimens	Table F.2
2.	Indentation		Table F.3
3.	Shear pull test as per ISO:14273		Table F.4

**Table 3**

(Tests to be conducted on actual jobs)

S.No.	Tests	No. of samples	Requirement As per EN 15085 -3
1.	Visual Inspection of production joints / fabricated components	100% on all spots	Table F.2 (external)

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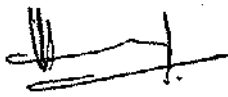
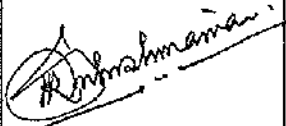
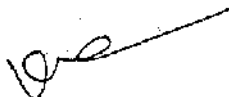

## **Annexure-B**

**EN 15085-3:2007 (E)**

Table F.2 defines the quality requirements for resistance spot welded joints, projection welded joints and resistance seam welded joints for production welds.

**Table F.2 — Quality requirements**

Serial No.	Ref. No. to EN ISO 6520-2	Requirements	Weld performance class CP C1 and CP C2	Weld performance class CP C3	Weld performance class CP D
<b>Quality requirements, general</b>					
1		Classification of welding processes according to EN ISO 4063	21, 22	21, 22, 23	
2		Type of machine	Welding machines with programme cycle control and process inspection	Welding machine with programme cycle	The requirements CP C1, CP C2 and CP C3 are valid. For 21 the use of manual, foot table machines is permissible.
3		Field of application	Supporting part of rail vehicles (side walls, front walls, floors and outside parts as instrument cases, flaps, aprons, doors)		Subordinate parts (panels, cable ducts, ventilation grids)
4		Permissible sheet metal thickness ratio	$t_2 : t_1 \leq 3 : 1$  Other sheet metal ratios and welding of more than two sheets shall be agreed with the customer.		No requirements
5		Minimum shear pulling force	For 21 Table F.4 and Table F.5  For 22 and 23 these tables are valid in the sense corresponding to the connecting sector.		75 % of CP C1, CP C2 and CP C3

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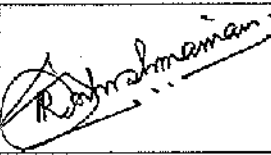
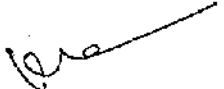

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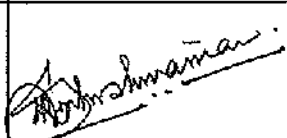
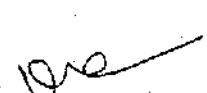
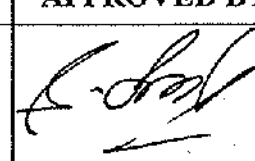
6		Surface appearance of the various parts	The surface of the joined parts shall be free of scale, rust, paint, dust, grease or other soiling at the place of the weld.  Additionally surface coatings, lamination, corrosion protective, sealing, pastes and glue can be used if their welding suitability has been proved.	
7		Maximum hardness values for steel	The general requirements of EN ISO 15614-12 shall be applied. For the hardness values, EN ISO 15614-1 shall apply.	No requirements
<b>Quality requirements, outor findings, external</b>				
9	P 100	Crack	Not permissible	
10	P 2011 P 2012 P 2013	Gas pore Uniformly distributed porosity Localized porosity	Not permissible	Permissible if agreed between the contracting parties
11	P 602 P 612	Spatter Material extrusion	Permissible if agreed between the contracting parties	Permissible if agreed between the contracting parties
12	P 526	Surface imperfection	Surface quality 2 and 3 to table F.3 permissible	Surface quality 2, 3 and 4 according to Table F.3 permissible
13	P 522	Burn through from one side	Not permissible	Permissible
14	P 5263	Adhering electrode material	Not permissible	Permissible if agreed between the contracting parties
<b>Quality requirements, inner findings, internal</b>				
15	P 5216	Insufficient depth of penetration of nugget	Minimum 30 % max. 90 % of the particular sheet metal thickness	No requirements
16	P 100	Crack	Permissible for 21 and 22 in the centre area of the welding lens (maximum half diameter)  Not permissible for 22	
17	P 2011 P 300	Gas pore Solid material inclusion	Permissible for 21 and 23 in the middle half of the welding lens diameter	

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18	P 2012 P 2013	Uniformly distributed porosity Localized porosity	For 22: $A \leq 2\%$ $d \leq 0.4t_1$ <sup>a</sup>	For 22: $A \leq 4\%$ $d \leq 0.5t_1$
19	P 400 P 401	Lack of fusion No weld	Not permissible	
20	P 525	Excessive sheet separation	Immediate next to the welding point: $h \leq 0.1(t_1 + t_2)$	Permissible
<b>Testing and documentation</b>				
21		Visual test <sup>b</sup>	100 %	
22		Simplified weld production test (SWPT) <sup>c</sup>	daily before start of work at change of the WPS at tool modification	
23		Normal weld production test (NWPT) <sup>d</sup>	for the prove of the WPS to prove the quality in the production at regular intervals, depending on weld volume, weld equipment and welding performance class	Not required
24		Documentation	NWPT 100 % Process inspection 100 %	NWPT necessary Not required
<p><sup>a</sup> A = area of imperfection, d = size of single imperfection (for instance length, width, diameter).</p> <p><sup>b</sup> Testing the completeness of welding and external assessment without use of optical instruments.</p> <p><sup>c</sup> SWPT: Rolling test, chipping test according to ISO 10447 or simplified torsion test (weld production test) according to EN ISO 17653.</p> <p><sup>d</sup> NWPT: for 21 and 23: button test according to EN ISO 15614-12 with a macrograph and for 22: NDT, button test according to EN ISO 15614-12 with a macrograph.</p>				

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Table F.3 defines the surface quality for resistance spot welded joints

**Table F.3 — Surface quality**

Surface quality	Requirements	Application
2	Surfaces where welding marks (electrode impressions, ring shaped reinforcement-formation, imperfections, through heat distortion etc.) do not amount to more than 10 % of the particular single sheet metal thickness.  Note: If required the indentation can be filled in.	For surfaces with aesthetic requirements (for instance side walls, front walls and roofs of passenger trains).
3	Surfaces where welding marks do not amount to more than 25% of the particular metal thickness.	Surfaces for non-aesthetic requirement (for instance freight wagons, transport containers, sheeting of floors).


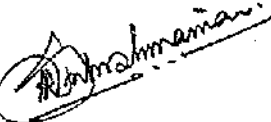
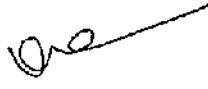

## **F.2 Minimum shear pull forces**

Table F.4 and Table F.5 contain the minimum shear pull forces for resistance spot welding joints dependent on metal thickness for weld performance classes CP C1, CP C2 and CP C3. These shall be proven by in the tensile shear test.

----- steel: Table F.4;

The given values are the minimum average values for one set of five individual spot welds.

Higher shear pull forces may be agreed between the contracting parties and shall be approved by production weld tests.

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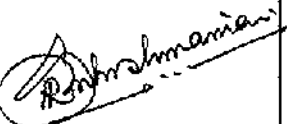
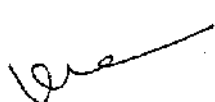
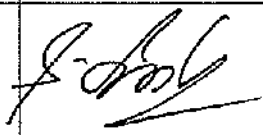
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**Table F.4 — Minimum shear pull forces for resistance spot welding joints of steel for weld performance classes CP C1, CP C2 and CP C3**

$t_1$ (mm)	$d_L$ (m)	Tensile strength $R_m$ of the parent metal [MPa]		
		$\leq 360$	$> 360$ to $< 510$	$510$ to $< 620$
		Minimum shear pull force per spot (KN)		
0.8	4.5	3.5	4.5	6.0
1.0	5.0	4.7	6.0	8.0
1.25	5.5	5.9	7.5	10.0
1.5	6.0	7.1	9.0	12.0
1.75	6.5	8.5	10.9	14.5
2.0	7.0	10.0	12.8	17.0
2.5	8.0	12.9	16.5	22.0
3.0	8.5	16.5	21.0	28.0

These values are valid for unalloyed and alloyed steel, also for the combination of them. For the combination of parent metals with different tensile strength, the material with the lower value shall be chosen. Supplier may refer EN15085-3 for more information if required.

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