

Welding Procedure Specification (WPS)

Welding Procedure No: CH92-01

| Consumables | | Base Material | |
|--|-------------------|--|-------------------|
| Welding process (root): | TIG (GTAW) | Parent Material: | A335 P92 |
| - Consumable: | 9CrWV | | |
| - Specification: | - | | |
| Welding process (fill): | MMA (SMAW) | Thickness: | 15-60mm |
| - Consumable: | Chromet 92 | Outside Diameter: | 16" NB (406mm OD) |
| - Specification: | - | | |
| Joint Details | | Joint Position | |
| Joint Type: | Butt single sided | Welding Position: | ASME: 5G |
| Manual/Mechanised: | Manual | | BS EN: PF |
| Joint Sketch | | | |
| <p>Joint for thickness < 20mm</p> <p>$f = 1-3\text{mm}; g = 2-4\text{mm}; \alpha = 70^\circ$</p> | | <p>Joint for thickness > 20mm</p> <p>$f = 1-3\text{mm}; g = 2-4\text{mm}; \alpha = 70^\circ; \beta = 20^\circ$</p> | |

Welding Details

| Run | Process | Consumable | Diameter mm | Current A | Voltage V | Type of current / Polarity | Wire Feed Speed m/min | Heat Input kJ/mm |
|-----|---------|-------------------|-------------|-----------|-----------|----------------------------|-----------------------|------------------|
| 1 | TIG | 9CrWV | 2.4 | 70-110 | ~12 | DC- | NA | ~1.2 |
| 2-3 | TIG | 9CrWV | 2.4 | 80-140 | ~12 | DC- | NA | ~ 1.2 |
| 4-7 | MMA | Chromet 92 | 3.2 | 90-130 | ~24 | DC+ | NA | ~ 1.0 |
| Rem | MMA | Chromet 92 | 4.0 | 120-170 | ~25 | DC+ | NA | ~ 1.2 |

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|----------------------------------|------------------|
| Electrode Baking or Drying: | 300-350°C/1-2h |
| Gas – root (TIG) shielding: | Pure Ar |
| purge: | Pure Ar (note 1) |
| Gas Flow Rate (TIG) – Shielding: | 8-15 l/min |
| Purge: | 4-10 l/min |
| Tungsten Electrode Type/Size: | 2% Th/2.4mm |
| Details of Back Gouging/Backing: | NA |

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|------------------------|--------------------|
| Preheat Temperature: | 200°C min (note 2) |
| Interpass Temperature: | 300°C max |

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|---------------------------|-----------------------|
| Post-Weld Heat Treatment: | Note 3. |
| Temperature: | 760°C ± 10°C |
| Time: | 1h/25mm (2 hours min) |
| | Note 4. |

Notes:

1. Maintain purge for runs 1-3.
2. Preheat 150°C min for TIG.
3. Cool to ~100°C before PWHT.
4. Heating & cooling rate <100°C/h (above 300°C).
5. Stringer beads, maximum weave 3 x ϕ .

Welding Procedure Specification (WPS)

Welding Procedure No: SCF92-01

| Consumables | | Base Material | |
|---|-------------------------------|--------------------------|-----------------------|
| Welding process (root): | TIG (GTAW) | Parent Material: | A335 P92 |
| - Consumable: | 9CrWV | Thickness: | 15-60mm |
| - Specification: | - | Joint Details | |
| Welding process (fill): | MMA (SMAW) | Joint Type: | Single side butt weld |
| - Consumable: | Chromet 92 | Manual/Mechanised: | Manual |
| - Specification: | - | Joint Position | |
| Welding process (fill): | FCAW | Welding Position: | ASME: 6G |
| - Consumable: | Supercore F92 (Note 1) | | BS EN: HL045 |
| - Specification: | - | Welding Sequences | |
| Joint Sketch | | | |
| <p style="text-align: center;">f = 1-2mm; g = 3-4mm; $\alpha = 75^\circ$; $\beta = 10-20^\circ$</p> | | | |

Welding Details

| Run | Process | Consumable | Diameter mm | Current A | Voltage V | Type of current / Polarity | Wire Feed Speed m/min | Heat Input kJ/mm |
|------|---------|----------------------|-------------|-----------|-----------|----------------------------|-----------------------|------------------|
| 1 | TIG | 9CrWV | 2.4 | 80-120 | ~12 | DC- | NA | ~1.4 |
| 2-6 | MMA | Chromet 92 | 3.2 | 90-110 | ~22 | DC+ | NA | ~1.0 |
| Fill | FCW | Supercore F92 | 1.2 | 160-190 | 25-27 | DC+ (Note 2) | ~6-8 | ~1.2 |

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|----------------------------------|----------------|
| Electrode Baking or Drying: | 300-350°C/1-2h |
| Gas – root (TIG) shielding: | Argon |
| Gas Flow Rate (TIG) – Shielding: | Argon (Note 3) |
| Purge: | 8-12 l/min |
| Purge: | 4-10 l/min |
| Tungsten Electrode Type/Size: | 2% Th / 2.4mm |
| Details of Back Gouging/Backing: | NA |

| | |
|------------------------|--------------------|
| Preheat Temperature: | 200°C min (note 4) |
| Interpass Temperature: | 300°C |

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|---------------------------|------------------------|
| Post-Weld Heat Treatment: | Note 5. |
| Temperature: | 760°C ± 10°C |
| Time: | 1 h/25mm (4 hours min) |
| | Note 6. |

Notes:

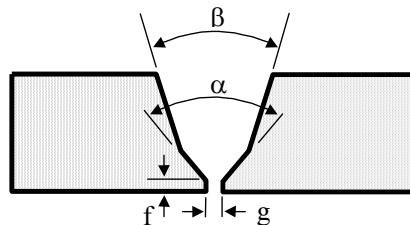
1. Shielding gas Ar-20%CO₂ at 15-25 l/min.
2. Electrode stickout 15-25mm.
3. Maintain purge for at least first two runs.
4. Preheat 150°C min for TIG.
5. Cool to ~100°C before PWHT.
6. Heating & cooling rate <100°C/h (above 300°C).

Welding Procedure Specification (WPS)

Welding Procedure No: SAW-P92-01

| Consumables | | Base Material | |
|-----------------------------|-----------------------------|-----------------------|-------------------------|
| Welding process (root): | TIG (GTAW) | Parent Material: | A335 P92 |
| - Consumable: | 9CrWV | Thickness: | 25-75mm |
| - Specification: | - | Outside diameter: | |
| Welding process (hot pass): | MMA (SMAW) | Joint Details | |
| - Consumable: | Chromet 92 | Joint Type: | Butt single sided |
| - Specification: | - | Manual/Mechanised: | Manual & mechanised |
| Welding process (fill): | SAW | Joint Position | |
| - Consumable: | 9CrWV + LA491 (flux) | Welding Position: | ASME, 1G (1GR; note 6). |
| - Specification: | - | | BS EN, PA (note 6). |

Joint Sketch



$f = 1-3\text{mm}$; $g = 2-4\text{mm}$; $\alpha = 70^\circ$; $\beta = 20^\circ$

Welding Details

| Run | Process | Consumable | Diameter mm | Current A | Voltage V | Type of current / Polarity | Travel Speed mm/min | Heat Input kJ/mm |
|-----|--------------|-------------------|-------------|-----------|-----------|----------------------------|---------------------|------------------|
| 1 | TIG | 9CrWV | 2.4 | 70-110 | ~12 | DC- | NA | ~ 1.0 |
| 2-3 | TIG | 9CrWV | 2.4 | 80-140 | ~12 | DC- | NA | ~ 1.2 |
| 4-7 | MMA | Chromet 92 | 3.2 | 90-130 | ~24 | DC+ | NA | ~ 1.2 |
| Rem | SAW (note 1) | 9CrWV | 2.4 | 350-450 | ~30 | DC+ | 400-500 | ~ 2.0 |

| | |
|----------------------------------|------------------|
| Electrode & Flux Drying: | 300-350°C/1-2h |
| Gas – root (TIG) shielding: | Pure Ar |
| purge: | Pure Ar (note 2) |
| Gas Flow Rate (TIG) – Shielding: | 8-15 l/min |
| Purge: | 4-10 l/min |
| Tungsten Electrode Type/Size: | 2% Th/2.4mm |
| Details of Back Gouging/Backing: | NA |

| | |
|------------------------|--------------------|
| Preheat Temperature: | 200°C min (note 3) |
| Interpass Temperature: | 300°C max |

| | |
|---------------------------|-----------------------|
| Post-Weld Heat Treatment: | Note 4. |
| Temperature: | 760°C ± 10°C |
| Time: | 1h/25mm (4 hours min) |
| | Note 5. |

Notes:

- SAW flux LA491.
~20mm wire extension, ~30mm flux depth.
- Maintain purge for runs 1-3.
- Preheat 150°C min for TIG.
- Cool to <100°C before PWHT.
- Heating & cooling rate <100°C/h (above 300°C).
- For rotated pipe, head to be 10° before TDC perpendicular to pipe.