Dulux PROTECTIVE COATINGS

Weldable ("Weld-Through") Shop Primers

Expanded Guidance for Fabricators, Specifiers, Inspectors and Asset Owners

Executive Summary

Weld-through primers are thin shop primers intended to provide temporary corrosion protection to blast-cleaned steel while still allowing subsequent welding. Testing under ISO 17652-2 assesses the influence of shop primers on weldability, particularly in relation to weld porosity and overall weld quality. Supporting hygiene monitoring recorded welding fumes and monitored aromatic solvent levels below the cited exposure limits under the tested conditions.

Independent test data reviewed for Metalshield Etch Primer indicates acceptable weldability performance at the tested film build and welding conditions, with 10/10 fillet weld lap-joint specimens assessed as satisfactory and porosity results of 0% on nine specimens and 1% on one specimen against a stated acceptance benchmark of maximum 16% pore area per specimen. From a practical perspective, this is a strong result. The observed porosity levels were substantially lower than the stated acceptance limit and indicate robust burn-off behavior and acceptable interaction with the tested welding procedure at the assessed film build.

Beyond the ISO assessment, airborne exposure should also be assessed via industrial hygiene monitoring to evaluate airborne exposure during welding of coated carbon steel. The assessments should be focused on aromatic hydrocarbons (toluene and xylene for example), using OSHA ID-125G (Metal and Metalloid Particulates by ICP) for welding fumes and NIOSH Method 1501 (Aromatic Hydrocarbons) for solvent analysis.

During testing assessments of Dulux Metalshield Etch Primer, the welding fume concentrations were measured by a 3rd party source to be at 0.46 mg/m³ compared to a permissible exposure limit (PEL) of 5 mg/m³, indicating exposures well within acceptable limits. Toluene and xylene were not detected above analytical limits, confirming negligible solvent exposure under the monitored conditions.

All results fell within the <10% of PEL category, representing a low exposure profile. Overall, the findings indicate that no immediate occupational health risks were identified, and the welding activities assessed are compliant with recognized hygiene and safety standards. Continued adherence to current controls, combined with periodic verification monitoring, is expected to maintain exposures at acceptably low levels.

This technical bulletin expands the practical guidance by explaining the interaction between coating chemistry and weld pool behavior, the significance of conservative ISO test conditions, process sensitivity, typical failure modes when misapplied, and stronger customer-facing positioning for reps and specifiers.

1. Purpose and Scope

This technical bulletin provides expanded guidance on the performance, application considerations and limitations of weldable ("weld-through") shop primers. The document is intended as a practical and educational reference for Dulux Representatives, fabricators, inspectors, specifiers and asset owners where steel is primed prior to welding operations.

The bulletin summarizes the standards framework commonly referenced when assessing shop-primer weldability and integrates product-specific supporting data reviewed for Metalshield Etch Primer.

2. What Is a Weld-Through Primer?

A weld-through primer is a thin prefabrication coating applied after surface preparation to provide temporary corrosion protection while still allowing subsequent welding without unacceptable loss of weld quality.

Unlike a conventional primer, a weld-through primer is expected to interact with heat from the welding arc in a controlled way. The coating is not expected to be "invisible" to the welding process; rather, it is expected to produce an acceptable outcome when the coating thickness, welding process and fabrication controls are appropriate.

3. Mechanism of Weld Interaction

3.1 Thermal decomposition of the coating

During welding, the shop primer is exposed to intense localized temperatures. Resin, pigments and any remaining volatile fractions undergo rapid thermal decomposition and volatilization. This can generate gases and vapours immediately adjacent to the weld pool.

3.2 Gas entrapment and porosity formation

Porosity forms when gas evolution from coating decomposition exceeds the ability of the molten weld pool to release gas before solidification. The result is discrete pores or pore fields trapped within the weld metal or fracture surface.

This is why ISO 17652-2 focuses on the number of pores, total pore area and average pore size: these are practical indicators of how strongly the coating influences gas formation during welding.

3.3 Influence of coating thickness

Film thickness is one of the most critical variables. Higher dry film thickness means more organic and pigment volume available for decomposition in the weld zone, which can increase fume generation, gas release and the risk of porosity.

For this reason, weld-through claims are meaningful only when tied to the qualified or recommended shop-primer film build.

3.4 Wetting and weld pool behaviour

The coating can also influence wetting, fusion, and arc stability. Poor burn-off or persistent coating residues at the joint interface can reduce wetting or promote lack of fusion. A well-designed weld-through primer allows the weld to establish and flow without unacceptable interference.

4. Standards and Test Framework

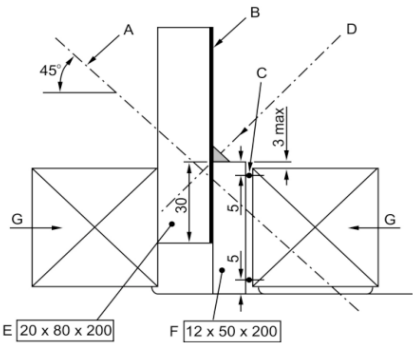
ISO 17652-2 describes tests for assessing the influence of shop primers on weldability. It includes a rating test and a weldability test. The standard notes that the rating test is a screening and comparison tool intended to differentiate the relative weldability of shop primers of specified thickness by examining the severity of porosity produced in a standard weld.

The standard also notes that the test conditions are intentionally severe and reproducible, and that porosity levels encountered in practical applications are expected to be lower than those measured in testing. This is a critical interpretation point when discussing results with customers or inspectors.

DNV acceptance criteria are commonly referenced in heavy fabrication, marine and offshore sectors as a practical benchmark for shop-primer weldability. In the reviewed test report, the acceptance benchmark applied was a maximum of 16% pore area per specimen.

Table 1 - Rating test welding parameters

Parameter	Value
Welding process	135, see EN ISO 4063
Current	(250 ± 5 %) A
Voltage	(30 ± 5 %) V
Welding speed	(300 ± 5 %) mm/min
Shielding gas	C1: 100% CO_2, see EN 439
Gas flow rate	15 l/min to 20 l/min
Gas cup diameter	16 mm to 19 mm
Stick out	18 mm to 20 mm
Consumable, type	G3 Si 1, see EN 440
Consumable, diameter	1,2 mm
Polarity	+ on electrode



Key

A Horizontal axis during welding
B Primed surface
C Soft-annealed copper wires — 2 mm
D Weld seam breakage angle
E Bright drawn steel plate (20 × 80 × 200)
F Bright drawn steel plate (12 × 50 × 200)
G Hydraulic clamps, 10 kN

5. ISO Testing Versus Real-World Fabrication

A frequent misunderstanding is to treat ISO rating test results as if they are direct predictions of every production weld. In practice, ISO 17652-2 is intentionally configured to provide a conservative and reproducible comparison under tightly controlled conditions.

Real fabrication often includes slight fit-up variation, different heat inputs, different welding procedures and multi-pass conditions. These factors may increase or decrease porosity depending on the process, but practical production welds frequently perform better than the deliberately severe rating test arrangement.

For customer communication, the correct interpretation is that good performance under ISO 17652-2 provides confidence that the coating is robust under controlled stress conditions, while final quality still depends on actual fabrication practice and qualified procedures.

6. Product Information – Metalshield Etch Primer

Metalshield Etch Primer is positioned as a single-pack etch primer suitable for properly prepared ferrous and non-ferrous substrates, including use as a shop primer where short-term or intermediate corrosion protection is required prior to full coating application.

The reviewed product data indicates a typical dry film thickness range of 10 µm to 15 µm for shop-primer use. This thin film build is important because weld-through performance is closely linked to film thickness control.

7. Weldability Test Results Summary

Independent physical weld testing reviewed for 462-LINE Metalshield Etch Primer reported testing to BS EN ISO 17652-2:2003 (Guideline) and DNVGL-CP-0109 (Acceptance Criteria) on carbon steel prepared to SA 2.5, using MAG (135) welding in PA (1F) position.

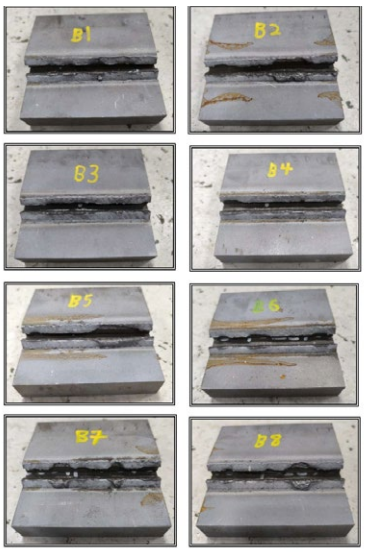
The report recorded 10 fillet weld lap-joint specimens. Nine specimens showed 0% porosity and one specimen showed 1% porosity. All ten specimens were recorded as satisfactory, with a stated acceptance benchmark of maximum 16% area pores per specimen.

From a practical perspective, this is a strong result. The observed porosity levels are substantially lower than the stated acceptance limit and indicate robust burn-off behavior and acceptable interaction with the tested welding procedure at the assessed film build.

Table: Fracture Test & Pore Evaluation

Sample Reference	Fillet Weld Lap Joint Welder Name : Silon WP No. 0 6262372 Weld Position : PA (1F) Welding Process : MAG (135)		
	Percentage of Porosity (%)	Fractured Test Result	DNVGL-CP-0109 Edition Apr 2016 Requirements
1	1	Satisfactory	Max 16% area pores per specimen
2	0	Satisfactory	
3	0	Satisfactory	
4	0	Satisfactory	
5	0	Satisfactory	
6	0	Satisfactory	
7	0	Satisfactory	
8	0	Satisfactory	
9	0	Satisfactory	
10	0	Satisfactory	

Appendix : Photographs of tested samples



8. Comparative Performance Interpretation

The reviewed data does not simply indicate "pass" or "fail"; it indicates a significant margin to the stated acceptance threshold. Where the benchmark is 16% pore area per specimen and the observed results are 0% for nine samples and 1% for one sample, the coating can reasonably be described as performing well within the accepted criterion under the tested conditions.

This distinction is important for technical sales and specification discussions. A large compliance margin strengthens confidence in process robustness and reduces the likelihood that outcomes are marginal or highly sensitive under similar controlled conditions.

9. Welding Process Sensitivity

Not all welding processes interact with shop primers in the same way. Arc energy, deposition rate, shielding environment, slag behavior and travel speed all influence how coating decomposition products escape from the weld zone.

The reviewed ISO rating test uses MAG (Process 135), which provides a consistent comparison basis. However, outcomes may vary under FCAW, SMAW or SAW because process characteristics differ. Accordingly, qualification in one process should not automatically be generalized to all others without technical review or validation.

10. Hygiene Monitoring and Fume Considerations

Supporting hygiene monitoring during welding over Metalshield Etch Primer recorded welding fumes at 0.46 mg/m³ against a cited permissible exposure level of 5 mg/m³, while toluene and xylene were reported as not detected at the monitored locations.

From a technical perspective, this data suggests that under the tested conditions, the coating did not generate elevated monitored aromatic solvent exposure and that welding fume levels were well below the cited benchmark. This supports the product's position as a practical weld-through shop primer at the tested application thickness.

These results do not remove the need for ventilation, fume extraction and compliance with workplace health and safety requirements. They should be viewed as supportive data from controlled testing, not as a substitute for normal welding hygiene controls.

Test Results :

Test Location / Personnel Monitored	Test Parameters	Test Results (mg/m^3)^	MOM Long Term PEL (mg/m^3)*	MOM Short Term PEL (mg/m^3)*
Welding of carbon steels coated with Metalshield Etch Primer	Welding Fumes	0.46	5	-
	Toluene	ND (< 3.70)	188	-
	Xylene	ND (< 7.30)	434	651

Notes :

1) "*" denotes the Long Term and Short Term Permissible Exposure Levels (PEL) stated in the "Workplace Safety and Health (General Provisions) Regulations", The First Schedule (Appendix 7A) "Permissible Exposure Limits of Toxic Substances" published by the Ministry of Manpower (MOM), Singapore.

2) "ND" denotes that the result is below the analytical detection limit (Actual detection limit is listed in the parenthesis).

11. Typical Failure Modes When Misapplied

Weld-through primers can still contribute to defects if they are over-applied, insufficiently dried or used outside suitable process conditions.

- Excessive porosity – often associated with over-thickness, excessive gas generation or unsuitable heat input.
- Lack of fusion or restricted wetting – possible where residual coating remains in the joint interface and is not sufficiently burned away.
- Weld contamination – possible where substrates are contaminated or coatings are not properly conditioned before welding.
- Elevated fume exposure – possible where film thickness is excessive or welding is undertaken in poorly ventilated or confined conditions.

12. Practical Guidance for Reps and Customers

1. Use the primer only at the recommended shop-primer film build and over the correct level of substrate preparation.
2. Confirm that adequate drying has occurred before welding and avoid assumptions where unusually fast throughput or adverse storage conditions apply.
3. Link weld-through performance claims to the actual tested or intended welding process, consumables and procedure where possible.
4. Avoid describing the coating as "no impact on welding". Instead, describe it as "demonstrating acceptable weldability under the qualified conditions".
5. Maintain standard welding safety controls, including ventilation and fume extraction, regardless of positive exposure monitoring data.

13. Specifier Positioning and Suggested Wording

A stronger specification position is to require evidence of acceptable weldability at the nominated shop-primer thickness rather than simply requesting a generic "weld-through primer".

Suggested specification wording:

Shop primer shall demonstrate acceptable weldability performance when assessed in accordance with ISO 17652-2 and meet the agreed acceptance criteria for the intended application and welding process.

Suggested customer-facing positioning statement:

Metalshield Etch Primer has demonstrated weld-through performance substantially better than the stated industry acceptance threshold used in the reviewed independent testing, with observed porosity results of 0–1% against a stated acceptance benchmark of 16% area pores per specimen, when applied and welded in accordance with the tested conditions.

14. Key Messages

- Weld-through primers are engineered thin-film shop primers, not general-purpose build coats.
- Film thickness control is the single most critical application parameter for reliable weld-through performance.
- Standardised testing under ISO 17652-2 enables meaningful comparison of how shop primers influence weldability.
- Observed low porosity relative to the stated acceptance threshold indicates strong weld-through performance under the tested conditions.
- Coatings support good fabrication practice; they do not replace the need for qualified welding procedures and normal safety controls.

15. Limitations and Disclaimer

This bulletin is intended as technical guidance only. It should not be interpreted as a substitute for project-specific welding procedure qualification, fabricator responsibility or statutory workplace health and safety obligations.

The separately supplied DNV acceptance document was scanned and not directly machine-readable in the source set used to prepare this bulletin. DNV-related wording in this document is therefore based on the acceptance benchmark and conformance statement recorded in the reviewed independent test report.

ISO 17652-2:2003 – Welding — Test for shop primers in relation to welding and allied processes — Part 2: Welding properties of shop primers.
SETSCO – Mechanical Test on Fillet Welded Lap Joint Steel Plates submitted by Duluxgroup (Australia) Pty Ltd, product tested: 462-LINE Metalshield Etch Primer.
SETSCO – Hygiene Toxic Substances Monitoring Report for welding of carbon steel coated with Metalshield Etch Primer.
Metalshield Etch Primer product data sheet.

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