TECHNICAL SPECIFICATION

OXIDATION OF STAINLESS STEEL WELDMENTS

DEP 30.10.60.31-Gen.

December 1998

DESIGN AND ENGINEERING PRACTICE

PREFACE

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Shell International Oil Products B.V. (SIOP)
and
Shell International Exploration and Production B.V. (SIEP)
and
Shell International Chemicals B.V. (SIC)

The Hague, The Netherlands,

and other Service Companies.

They are based on the experience acquired during their involvement with the design, construction, operation and maintenance of processing units and facilities, and they are supplemented with the experience of Group Operating companies. Where appropriate they are based on, or reference is made to, national and international standards and codes of practice.

The objective is to set the recommended standard for good design and engineering practice applied by Group companies operating an oil refinery, gas handling installation, chemical plant, oil and gas production facility, or any other such facility, and thereby to achieve maximum technical and economic benefit from standardization.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where DEPs may not cover every requirement or diversity of condition at each locality. The system of DEPs is expected to be sufficiently flexible to allow individual operating companies to adapt the information set forth in DEPs to their own environment and requirements.

When Contractors or Manufacturers/Suppliers use DEPs they shall be solely responsible for the quality of work and the attainment of the required design and engineering standards. In particular, for those requirements not specifically covered, the Principal will expect them to follow those design and engineering practices which will achieve the same level of integrity as reflected in the DEPs. If in doubt, the Contractor or Manufacturer/Supplier shall, without detracting from his own responsibility, consult the Principal or its technical advisor.

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Subject to any particular terms and conditions as may be set forth in specific agreements with users, SIOP, SIEP and SIC disclaim any liability of whatsoever nature for any damage (including injury or death) suffered by any company or person whomsoever as a result of or in connection with the use, application or implementation of any DEP, combination of DEPs or any part thereof. The benefit of this disclaimer shall inure in all respects to SIOP, SIEP, SIC and/or any company affiliated to these companies that may issue DEPs or require the use of DEPs.

Without prejudice to any specific terms in respect of confidentiality under relevant contractual arrangements, DEPs shall not, without the prior written consent of SIOP and SIEP, be disclosed by users to any company or person whomsoever and the DEPs shall be used exclusively for the purpose for which they have been provided to the user. They shall be returned after use, including any copies which shall only be made by users with the express prior written consent of SIOP and SIEP. The copyright of DEPs vests in SIOP and SIEP. Users shall arrange for DEPs to be held in safe custody and SIOP or SIEP may at any time require information satisfactory to them in order to ascertain how users implement this requirement.

All administrative queries should be directed to the DEP Administrator in SIOP.

NOTE: In addition to DEP publications there are Standard Specifications and Draft DEPs for Development (DDDs). DDDs generally introduce new procedures or techniques that will probably need updating as further experience develops during their use. The above requirements for distribution and use of DEPs are also applicable to Standard Specifications and DDDs. Standard Specifications and DDDs will gradually be replaced by DEPs.

TABLE OF CONTENTS

1. **INTRODUCTION** 4
1.1 SCOPE 4
1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS 4
1.3 DEFINITIONS 4
1.4 CROSS-REFERENCES 5

2. **PREVENTION OF OXIDATION** 6

3. **REMOVAL OF OXIDATION** 7
3.1 MECHANICAL CLEANING 7
3.2 PICKLING AND PASSIVATION USING LIQUIDS 7
3.3 PICKLING AND PASSIVATION USING PASTES 7

4. **OXIDATION ACCEPTANCE CRITERIA** 8

5. **REFERENCES** 9

APPENDICES

APPENDIX 1 ACCEPTANCE CRITERIA FOR OXIDATION OF STAINLESS STEEL WELDMENTS 10

1. INTRODUCTION

1.1 SCOPE

This new DEP specifies requirements and gives recommendations for the prevention and removal of oxidation that may develop at weldments in stainless steels whether applied as solid material or as cladding. The acceptance criteria for oxidation are also included.

These stainless steels include, but are not limited to:

- austenitic stainless steels AISI 316L and the high alloy type UNS S31254;
- austenitic/ferritic (duplex) stainless steels such as UNS S31803;
- high nickel austenitic alloys such as Incoloy 825 and Inconel 625.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by SIOP and SIEP, the distribution of this DEP is confined to companies forming part of the Royal Dutch/Shell Group or managed by a Group company, and to Contractors and Manufacturers/Suppliers nominated by them (i.e. the distribution DEP is “F”, as described in DEP 00.00.05.05-Gen.).

This DEP is intended for use in oil refineries, gas plants, chemical plants, oil and gas production facilities, and supply/marketing installations.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are more stringent and which combination of requirements will be acceptable as regards safety, environmental, economic, and legal aspects. In all cases, the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project, or operation or maintenance of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

GTAW	Gas Tungsten Arc Welding
SMAW	Shielded Metal Arc Welding
TIG	Tungsten Inert Gas (welding)

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section

number is shown in brackets. Other documents referenced by this DEP are listed in (5).

2. PREVENTION OF OXIDATION

The methods for prevention of oxidation of weldments shall be in accordance with DEP 61.40.20.30-Gen., DEP 30.10.60.30-Gen. and DEP 31.40.20.32-Gen.

Inert gas protection (purging before and during welding) shall be provided.

There shall be no hydrogen in the shielding or backing gas.

3. REMOVAL OF OXIDATION

3.1 MECHANICAL CLEANING

Oxidation may be removed by mechanical means. The surface shall be polished with a grinder and a smooth transition to the unpolished base material surface shall be made.

The final surface roughness, Ra, shall be less than 12.5 micrometres.

3.2 PICKLING AND PASSIVATION USING LIQUIDS

Pickling and passivation shall be carried out in acid solutions which should be based upon a mixture of HF/HNO_3. The acid concentrations shall be controlled by means of analysis. Details on minimum and maximum concentrations (including contaminating elements such as. Fe_2+, Fe_3+ and other metal ions), exposure time and temperature shall be included in the pickling procedure. For final rinsing, only fresh water with a chloride ion concentration of less than 200 mg/kg, shall be used.

After rinsing, the item shall be dried using blowers.

3.3 PICKLING AND PASSIVATION USING PASTES

Pickling and passivation using pastes shall only be carried out on the outside of equipment, pipelines, pipes etc. Pastes shall be specifically produced for the purpose of oxidation removal and shall contain no halogens. Any residuals of such pastes shall be removed after cleaning by washing with copious quantities of fresh water.

4. OXIDATION ACCEPTANCE CRITERIA

The seven colour plates included in Appendix 1 show examples of oxidation ranging from hardly any oxidation to very heavy oxidation. The acceptance of the grades of colouration is indicated on each plate.

5. REFERENCES

In this DEP, reference is made to the following publications:

NOTE: Unless specifically designated by date, the latest edition of each publication shall be used, together with any amendments/supplements/revisions thereto.

SHELL STANDARDS

Index to DEP publications and Standard Specifications	DEP 00.00.05.05-Gen.
Welding of pipelines and related facilities (amendments/supplements to ANSI/API Std 1104)	DEP 61.40.20.30-Gen.
Welding on pressurised piping	DEP 30.10.60.30-Gen.
CRA clad or lined steel pipe (amendments/supplements to API 5LD)	DEP 31.40.20.32-Gen.

APPENDIX 1 ACCEPTANCE CRITERIA FOR OXIDATION OF STAINLESS STEEL WELDMENTS

PLATE 1: ACCEPTABLE; VERY GOOD RESULT; NO DISCOLOURATION

PLATE 2: ACCEPTABLE; WELD FREE OF SIGNIFICANT OXIDATION

PLATE 3: ACCEPTABLE; SLIGHT DISCOLOURATION; WELD SHINY, NO SCALE PRESENT

PLATE 4: ACCEPTABLE; SLIGHT DISCOLOURATION; WELD SHINY, NO SCALE PRESENT

PLATE 5: UNACCEPTABLE; OXIDE LAYER PRESENT (GREY COLOUR) ON AND NEAR WELD; LACK OF PROPER BACK-PURGING

PLATE 6: UNACCEPTABLE; OXIDE LAYER PRESENT (GREY COLOUR), WELD BURNED; LACK OF PROPER BACK-PURGING

PLATE 7: UNACCEPTABLE; EXTREMELY BAD RESULT; VERY HEAVY OXIDE LAYER PRESENT - THIS MAY DEVELOP WHEN WELDING WITH COATED ELECTRODES (SMAW) OR WITH TIG WELDING (GTAW) WITH SEVERE LACK OF BACK-PURGING

PLATE 1: ACCEPTABLE; VERY GOOD RESULT; NO DISCOLOURATION

PLATE 2: ACCEPTABLE; WELD FREE OF SIGNIFICANT OXIDATION

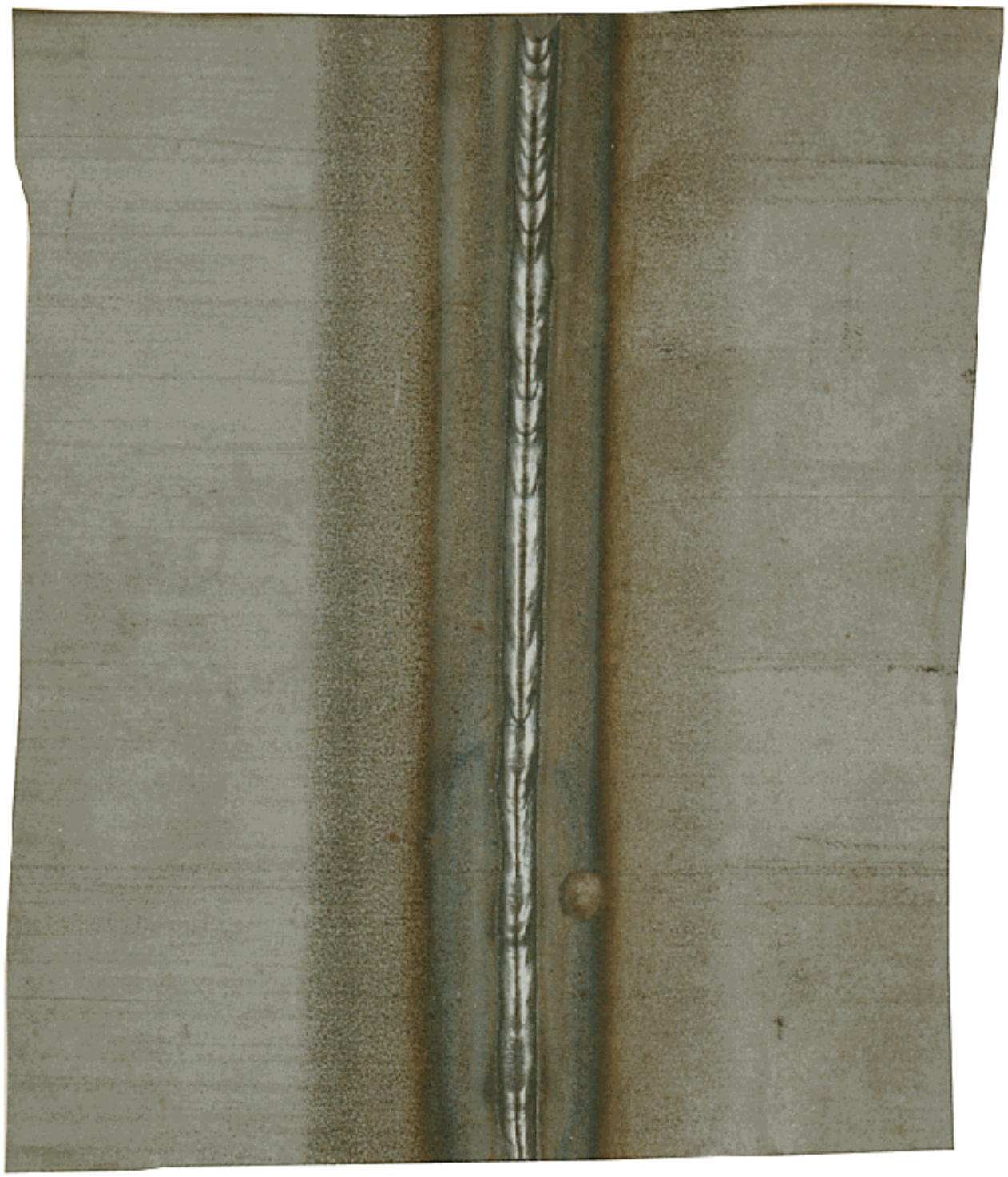

PLATE 3: ACCEPTABLE; SLIGHT DISCOLOURATION; WELD SHINY, NO SCALE PRESENT

PLATE 4: ACCEPTABLE; SLIGHT DISCOLOURATION; WELD SHINY, NO SCALE PRESENT

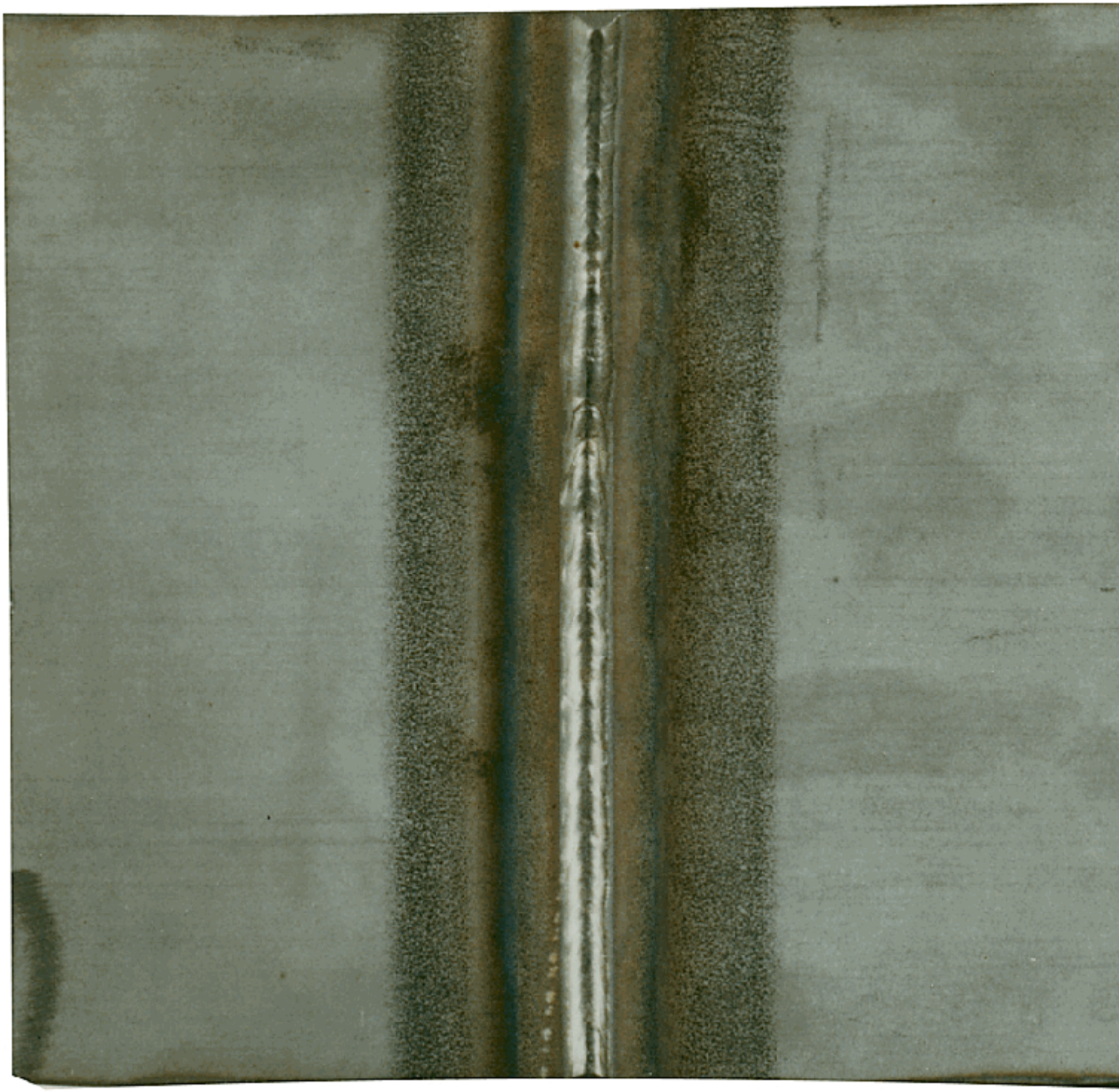

PLATE 5: UNACCEPTABLE; OXIDE LAYER PRESENT (GREY COLOUR) ON AND NEAR WELD; LACK OF PROPER BACK-PURGING

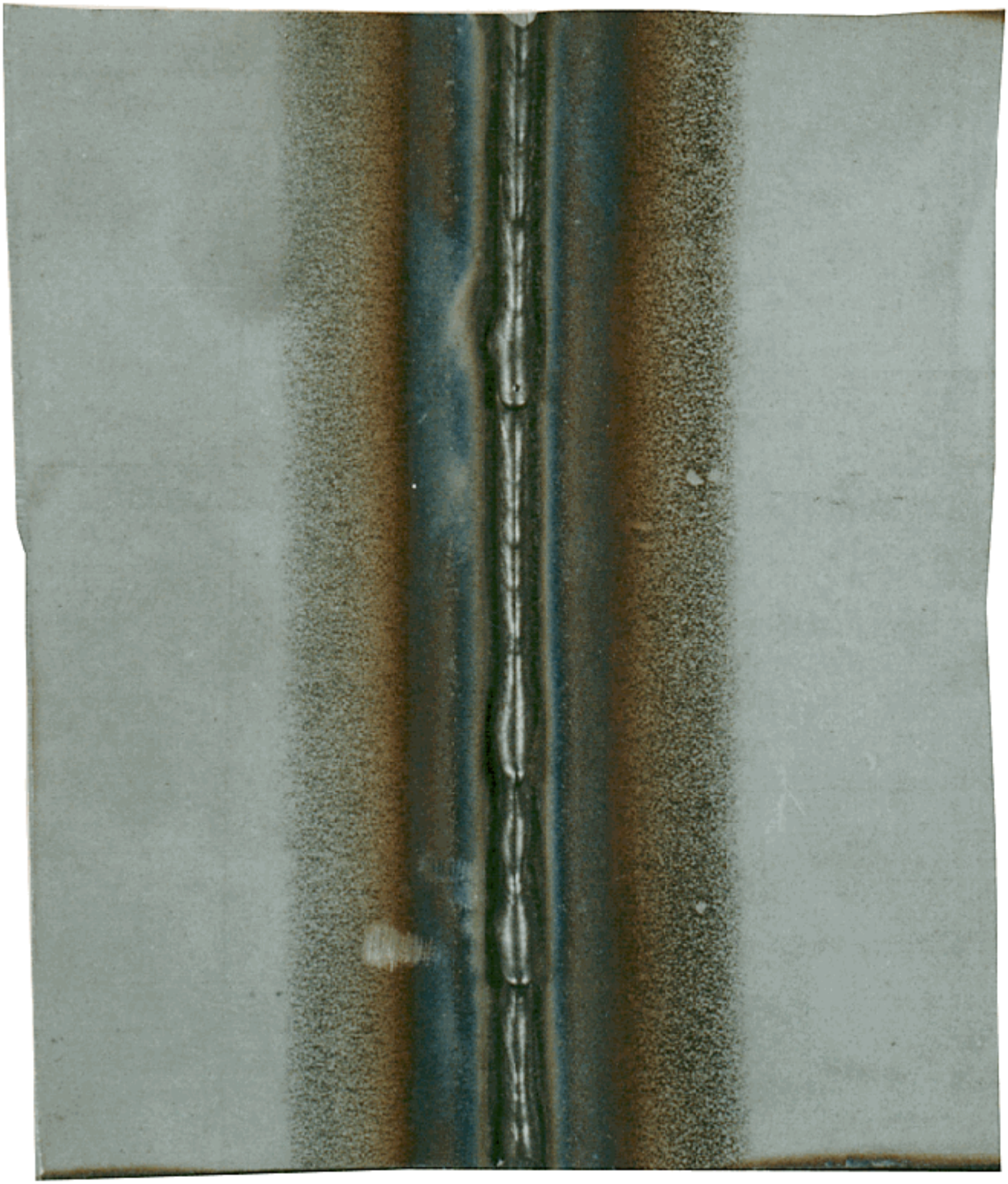

PLATE 6: UNACCEPTABLE; OXIDE LAYER PRESENT (GREY COLOUR), WELD BURNED; LACK OF PROPER BACK-PURGING

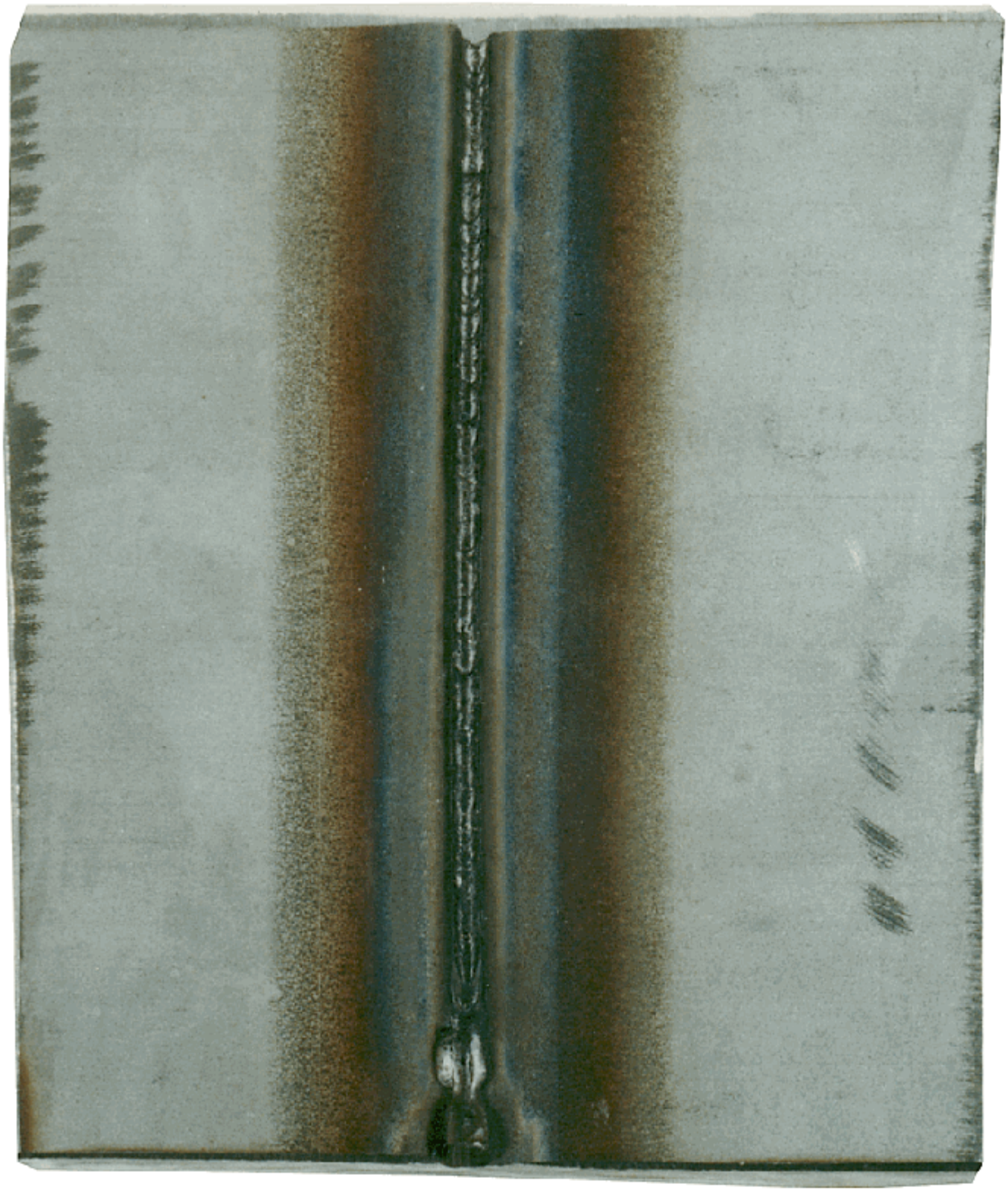

PLATE 7: UNACCEPTABLE; EXTREMELY BAD RESULT; VERY HEAVY OXIDE LAYER PRESENT - THIS MAY DEVELOP WHEN WELDING WITH COATED ELECTRODES (SMAW) OR WITH TIG WELDING (GTAW) WITH SEVERE LACK OF BACK-PURGING