


**AWS G1.10M:2001**  
**An American National Standard**



# **Guide for the Evaluation of Hot Gas, Hot Gas Extrusion, and Heated Tool Butt Thermoplastic Welds**



**American Welding Society**



**Key Words**—Hot gas welding, thermoplastics,  
heated tool butt welding, joints,  
evaluation, testing, hot gas extrusion

**AWS G1.10M:2001**  
**An American National Standard**

**Approved by**  
**American National Standards Institute**  
**February 21, 2001**

# **Guide for the Evaluation of Hot Gas, Hot Gas Extrusion, and Heated Tool Butt Thermoplastic Welds**

Prepared by  
AWS G1 Committee on Joining Plastics and Composites

Under the Direction of  
AWS Technical Activities Committee

Approved by  
AWS Board of Directors

## **Abstract**

This standard lists and describes defects in hot gas, hot gas extrusion, and heated tool butt welded joints in thermoplastics. Its intent is to make possible a generally valid evaluation giving consideration to graded quality requirements. This standard encompasses the classification, requirements, testing, evaluation, and acceptance of the welds. Details in recording engineering data are described. Tables illustrating cracks, voids, solid inclusions, lack of fusion, defects of shape, and other defects in thermoplastic welds are included. Defect features with descriptions and illustrations are compiled into tables to aid in the evaluation of welds.



**American Welding Society**

550 N.W. LeJeune Road, Miami, Florida 33126

# Table of Contents

	<b>Page No.</b>
<i>Personnel</i> .....	iii
<i>Foreword</i> .....	v
1. Scope, Purpose, and Range of Application .....	1
2. Referenced Documents .....	1
3. Definitions .....	2
4. Evaluation Groups .....	2
4.1 Classification .....	2
4.2 Criteria for Establishment .....	2
5. Requirements for Welded Joints .....	2
5.1 Quality Features for Classification of the Weld (Annexes VII through IX) .....	2
6. Details In Engineering Data.....	2
7. Testing and Evaluation.....	3
7.1 Evaluation.....	3
7.2 Reworking Defective Welded Joints .....	3
7.3 Overlapping Defects.....	3
8. Acceptance.....	3
 <i>Annexes—Mandatory Information</i>	
<i>Annex I—Cracks</i> .....	5
<i>Annex II—Voids</i> .....	7
<i>Annex III—Solid Inclusions</i> .....	9
<i>Annex IV—Lack of Fusion</i> .....	11
<i>Annex V—Defects of Shape</i> .....	13
<i>Annex VI—Other Defects</i> .....	15
<i>Annex VII—Description of Evaluation Groups for Hot Gas Fan and Speed Welds</i> .....	17
<i>Annex VIII—Description of Evaluation Groups for Hot Gas Extrusion Welds</i> .....	21
<i>Annex IX—Description of Evaluation Groups for Heated Tool Butt Welds</i> .....	25
 <i>Annexes—Nonmandatory Information</i>	
<i>Annex A—Other Documents</i> .....	29
<i>Annex B—Document Sources</i> .....	31
<i>Annex C—Guidelines for Preparation of Technical Inquiries for AWS Technical Committees</i> .....	33
<i>AWS List of Documents on Plastics Welding</i> .....	35

# Guide for the Evaluation of Hot Gas, Hot Gas Extrusion, and Heated Tool Butt Thermoplastic Welds

## 1. Scope, Purpose, and Range of Application

**1.1** These guidelines list and describe defects in welded joints in thermoplastic materials. The objective is to make possible a generally valid evaluation giving consideration to graded quality requirements.

**1.2** By classification into one of the evaluation groups in 4.1, specific defects can be excluded or kept within limits when welded joints are produced.

**1.3** The application of these guidelines and the measures through which they can be met may be included in contractual specification or form part of the generally recognized specifications.

**1.4 Welding Processes.** Defects produced by the following welding processes are addressed. This guide applies to the following processes:

	<u>Abbreviation</u>	<u>Annex</u>
Hot gas fan (rod) welding	WF	VII
Hot gas speed welding	WZ	VII
Hot gas extrusion welding	WE	VIII
Heated tool butt welding	HS	IX

**1.5 Materials.** These guidelines apply to welded joints on components and systems made from the engineering thermoplastics listed below:

<u>Abbreviation</u>	<u>Material Description</u>
ECTFE	Ethylene chlorotrifluoroethylene
ETFE	Ethylene tetrafluoroethylene
FEP	Fluorinated ethylene-propylene
MFA	Perfluoromethylvinylether
M PTFE	PFA modified PTFE
PE-HD	High density polyethylene (rigid PE)
PFA	Perfluoroalkoxy
PP-B	Polypropylene block copolymer
PP-H	Polypropylene homopolymer
PP-R	Polypropylene random copolymer
PTFE	Polytetrafluoroethylene
PVC-C	Chlorinated polyvinyl chloride

### Abbreviation Material Description

PVC-HI	High-impact polyvinyl chloride
PVC-U	Unplasticized polyvinyl chloride (rigid PVC)
PVDF	Polyvinylidene fluoride
PVDF/HFP	Polyvinylidene fluoride/hexafluoropropylene

**1.6** The use of these guidelines for welding other thermoplastic materials must be agreed upon between the customer and the fabricator.

**1.7** This standard makes use of the International System of Units (SI).

**1.8 Safety.** The activities described in this document may bring the user of this standard in contact with processes and materials that may be hazardous to the user's health. Safety precautions mandated by OSHA and recommendations for material handling in MSDS sheets should be observed. The fabricator's operating manual and safety instructions should always be carefully studied and complied with when operating equipment.

*Note: This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user to establish appropriate safety and health practices. The user should determine the applicability of any regulatory limitations prior to use.*

## 2. Referenced Documents

Reference should be made to the latest edition of the following documents:

ASTM C 904 Standard Terminology Relating to Chemical-Resistant Nonmetallic Materials<sup>1</sup>

1. ASTM documents are available from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.