HISTORIA

- SVETSFAKTORER
- SVETSTEORI

KUL MED STANDARDER

DVS 2025 - NYHETER

SMÅTT OCH GOTT

GPA
OPTIMIZING
YOUR
FLOW

Långtidshållfasthet av en svets är beroende av svetsteknik
- Reducerings faktorer vid beräkning av konstruktioner

February 2013

DVS – DEUTSCHER VERBAND FÜR SCHWEISSEN UND VERWANDTE VERFAHREN E.V.	Calculation of tanks and apparatus made of thermoplastics – Welding factors	DVS Technical Code DVS 2205-1 Supplement 6

Replaces DVS 2205-1 Supplement 17 (February 2006)

Short-time (f_Z) and long-time (f_S) welding factors

Processes / Materials	Welding factors, short-time / long-time	PE 1)	PP 2)	PVC-U	PVC-C	PVDF
Heated tool butt welding HS	f_Z	0.9	0.9	0.9	0.8	0.9
	f_S	0.8	0.8	0.6	0.6	0.6
Hot gas extrusion welding, discontinuous WE	f_Z	0.8	0.8	–	–	–
	f_S	0.4	0.4	–	–	–
Hot gas extrusion welding, continuous WE	f_Z	0.8	0.8	–	–	–
	f_S	0.6	0.6	–	–	–
Hot gas welding WZ/WF	f_Z	0.8	0.8	0.8	0.7	0.8
	f_S	0.4	0.4	0.4	0.4	0.4
IR welding for pipes, pressure-controlled	f_Z	–	0.9	–	–	0.9
	f_S	–	0.8	–	–	0.8
IR welding for pipes, displacement-controlled	f_Z	0.9	0.9	–	–	0.9
	f_S	0.7	0.8	–	–	0.8

1) Applies to PE 63, PE 80 and PE 100
2) Applies to PP-H, PP-B and PP-R

The prerequisites for the specified values are the command of the corresponding welding processes and the execution by qualified and certified personnel.

The short-time factors apply to loading times up to one hour. In the case of other materials and/or joining processes, the values must be proven individually.

The prerequisite for computation with higher welding factors than stipulated in the above table is proof which is provided on the material combination to be welded and must not be more than two years' old.

Annex F
(informative)

Design and installation

F.1 Design of a thermoplastics piping system for industrial applications

For the design of an assembled piping system (e.g. determination of the maximum allowable pressure, p_S), the following parameters should be taken into account:

- temperature, T, usually constant, if changing, then ISO 13760 Miner's Rule should be used;
- pressure, p, usually constant, if changing, then ISO 13760 Miner's Rule should be used;
- lifetime, t, usually 25 years;
- stress, σ, calculated with the formulae given in Annex A to Annex E, as applicable;
- resistance to rapid crack propagation for pipe for transport of air or a compressible gas;
- chemical resistance of the material against the fluid;
- required design coefficient, C (minimum values of C are given in ISO 12162);
- influence of wear and abrasion by solid matters in fluids;
- influence of changing of length (caused by temperature, swelling, internal pressure);
- kind of installation (fixed, floating, etc.);
- supporting distances in the installed piping system.

With these parameters, together with the minimum required hydrostatic strength curves, the design of a piping system can be carried out taking into account the national and/or local requirements, where appropriate, complemented by experimental design methods.

NOTE Due to the fact that there are several calculation methods available for the design of thermoplastics piping systems for industrial applications, only some general parameters can be given. Guidance can be found in national codes of practice for industrial systems.

Creep rupture strength and long term weld strength factors for welded high density polyethylene and polypropylene pipes and sheets*

by Ing. G. Diedrich and Dr.-Ing. E. Gaube,

Farbwerke Hoechst AG, vormals Meister Lucius & Brüning, Frankfurt/Main - Hoechst.

In an earlier publication [1, 2] the methods normally employed in welding high density polyethylene (hot gas welding with filler rod, heated wedge welding, extrusion welding and heated tool butt welding) were described (see fig. 1). In order to determine the weld strength factors attainable by these methods, sample lengths of pipe and of sheet up to 30 mm in thickness were welded, and from these test welds tensile test pieces were prepared for creep strength determination. In order to shorten the period of test, the creep strength determinations were carried out in water at 80° C, as is customary in the testing of high density polyethylene pipes. The long term weld strength factor was then calculated as the quotient of the two stress values at which equal service life for the welded joint and the parent material was obtained. Conclusions leading to improvement in welding conditions were drawn from the characteristic types of rupture in the creep test on joints made by the different welding methods.

The present publication includes further results on polyethylene samples, and describes analogous investigations on welded sheets and pipes made form polypropylene.

* Condensed version of a paper to be published in Kunststoffe, 63 (1973), September number

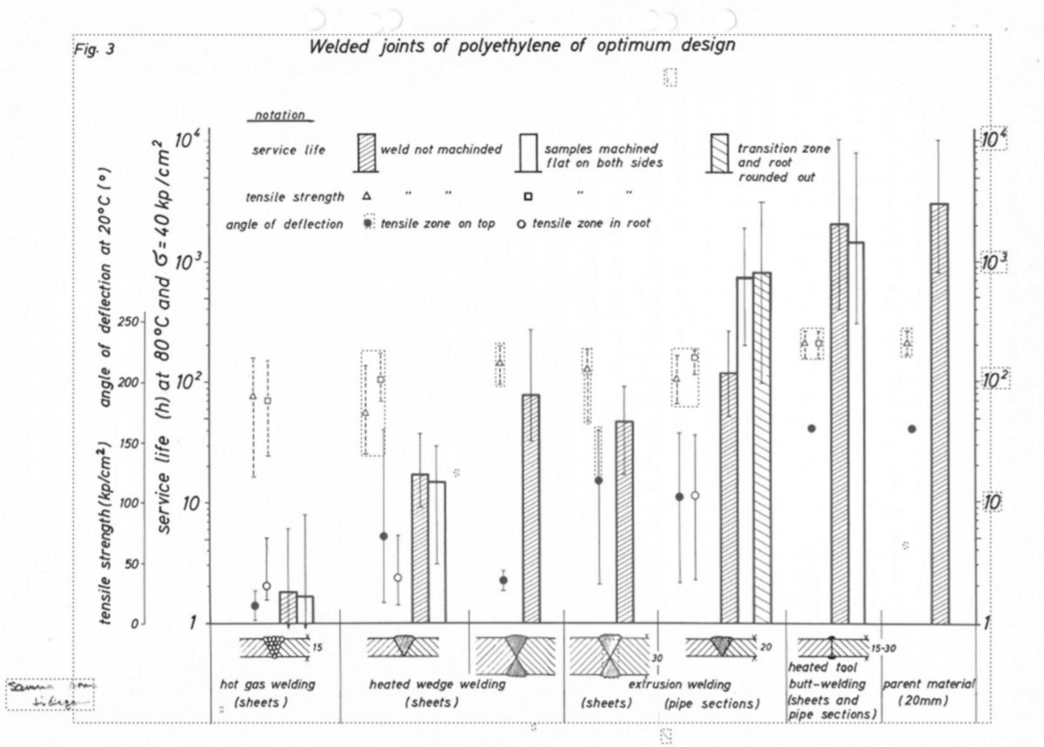
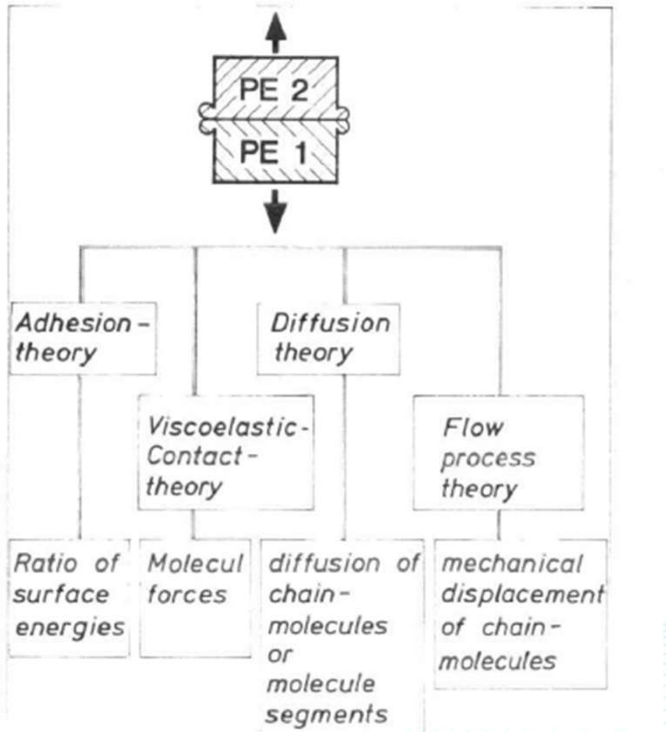


Fig. 3 Welded joints of polyethylene of optimum design

De olika teorierna bakom plastsvetsning



PLASTICS PIPES V

A THEORETICAL APPROACH TO THE PRACTICAL PROBLEMS INVOLVED IN JOINTING DIFFERENT PE GRADES

F. BRINKEN*

De olika teorierna bakom plastsvetsning

2.1 Adhesion theory /4, 5, 6, 7/

Energy is required to isothermically increase the surface of a weld. The energy required for isothermal formation of 1 cm^2 of surface corresponds to the specific free surface energy, also termed surface tension. This surface energy can be subdivided into a disperse and a polar portion.

$$\sigma = \sigma^p + \sigma^d$$

The polar portion comprises all dipolar, induction, and hydrogen bridge bonds. The component σ^d comprises the nondirectional dispersion forces.

When two substances make contact, a contact surface energy is built up at the contact surface: $\sigma_{1,2}$
(Fig.4).

Maximum adhesion is obtained when the specific contact surface energy is zero, i.e. the materials are identical. The Owens-Wendt equation shown in Fig.4 shows that this is the case when the quotients

$$\frac{\sigma_1{}^p}{\sigma_2{}^p} \quad \text{and} \quad \frac{\sigma_1{}^d}{\sigma_2{}^d} \quad \text{are equal.}$$

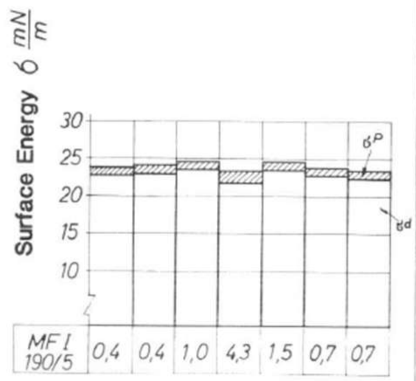
Fig.5 shows a graphic representation of this relationship.

/4/ Potente, H. — Textbook for Lecture Jointing and Thermoforming of Plastics
University of Aachen
1978 / 79

/5/ Kaelble, K. — Physical Chemistry of Adhesion
J. Wiley + Sons (1971)

/6/ Dyckerhoff, G.A.
Sell, P.J. — Ueber den Einfluss der Grenzflächenspannung auf die Haftfestigkeit.
Angewandte Makromolekulare Chemie 21
(1972) 312 s. 169 - 185

/7/ Potente, H.
Krüger, R. — Bedeutung polarer und disperser Oberflächenspannungsteile von Plastomeren für die Haftfestigkeit von Verbundsystemen.
Farbe und Lack 84 (1978) 2, p. 72 - 75



Surface Energy of Different PE Grades

Fig. 7

2.2 Viscoelastic contact theory /8, 9, 10/

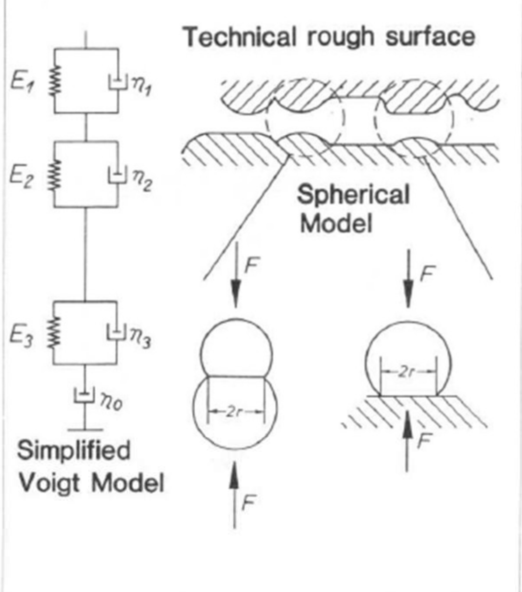
The viscoelastic contact theory is based on the fact that the surfaces of the jointed parts are brought so close to each other that van der Waals forces, i.e. dipolar, induction, dispersion, or hydrogen bridge bondes, come into effect. According to the theory, this is due to the fact that the surfaces of the jointed parts, e.g. pipe and socket fusion fitting, are deformed by the welding pressure, and the boundary surface is formed as a function of time. This is illustrated by the model shown in Fig. 8.

As shown by GABLER /8/, this requires thermal induction periods of 10 minutes and more, which contradicts practical experience with the three mentioned welding techniques.

/8/ Gabler, K. — Butt fusion of dissimilar Thermoplastics
Ph D Lecture
Plastics Processing Institute
University of Aachen, 1980

/9/ Anand, J.N.
Karam, H.J. — Interfacial Contact and Bonding in Autoadhesion
I. Contact Theory
J. Adhesion 1 (1969) 1 s. 16 - 23

/10/ Anand, J.L.
Dipzinsky, L. — Interfacial Contact and Bonding in Autoadhesion
IV. Experimental Verification of Theory
J. Adhesion 2 (1970) 2 p. 16 - 22



Description of Viscoelastic Contact–Theory

Fig.8

De olika teorierna bakom plastsvetsning

2.3 Diffusion theory /11, 12, 13/

The Diffusion theory was developed by VOYUTSKI and VASENIN and assumes that the molecules or chain segments diffuse into each other (Fig. 9). The diffusion theory is applicable if the following conditions are fulfilled:

a) the polymers must be mutually soluble,
b) the macromolecules must have sufficient mobility.

The description of solubility (also thermed in the physical chemistry literature compatibility) is very complex and demanding (13). From a thermodynamic point of view, free enthalpy determines whether mixing or separation takes place. For spontaneous processes, this is characterised by the condition $\Delta G \leq 0$. The influence of the mixing enthalphy ΔG is described by the interaction parameter which is basically determined by the physical structure. This structure being identical for all polyethylenes (additives in ppm magnitudes can be neglected), identical solubility parameters can be assumed, i.e. compatibility is assured.

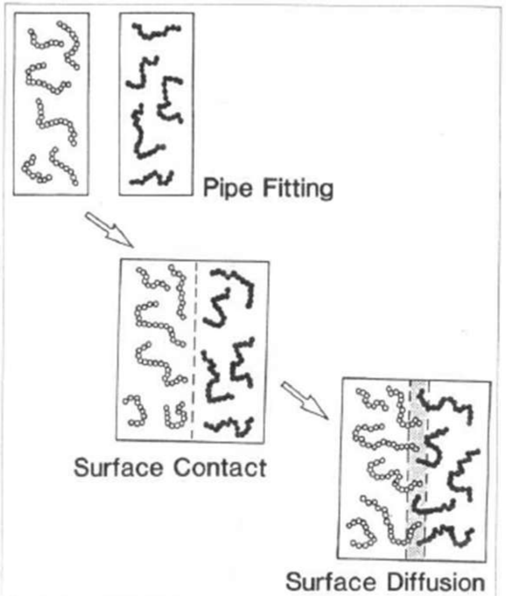
The requirement of high mobility of the macromolecules makes it necessary to exceed a certain minimum temperature with all welding techniques since the diffusion range at room temperature would only be a few Angstroms. The measured boundary layer thicknesses are much greater because they are formed at higher temperatures.

Application of the calculation methods shows that the required own diffusion times are longer than the welding times used in practice.

/11/ Voyutskii, S.S. — Some Comments on series of papers "Interfacial Contact and Bonding in Autoadhesion" J. Adhesion 3 (1971) p. 69 - 75

/12/ Kryszewski, M. — Ueber die Diffusion von Komponenten in den Grenzflächen von Polymermischungen Plaste und Kautschuk 20 (1973) 10 p. 743 - 747

/13/ van Krevelen, D.W. Hoftyzer, P.J. — Properties of Polymers, Elsevier Publishing Company, Amsterdam-Oxford-New York 1975



Model Description of Diffusion Theory
Source: (8)
Fig.9

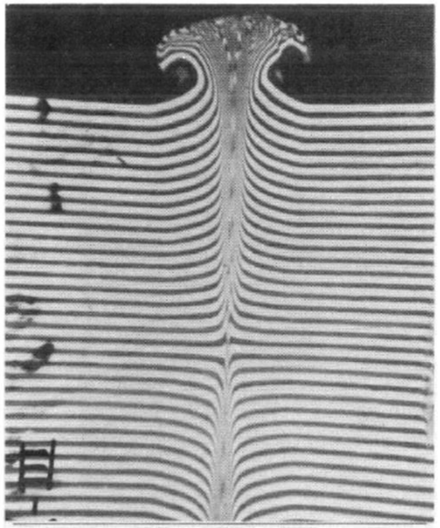
De olika teorierna bakom plastsvetsning

/14/ Potente H. Zur Theorie des Heizelementstumpfschweissens
Kunststoff 67 (1977) 2, s. 98 - 102

/15/ de Zeeuw, K. Untersuchungen zum Heizelementstumpfschweissen
Ph D Thesis
University of Aachen, 1978

2.4 Flow process theory

This theory was developed for the field of plastic pipes by POTENTE and DE ZEEUW /14, 15/. It assumes that during the jointing process, the welding pressure and the welding temperature create flow fields, i.e. flow movements. This is illustrated by the heating element butt fusion shown in Fig. 10
As a result, the thermal displacement processes are superposed by mechanical displacements which can become so intensive that mixing occurs in the jointing zone. Such processes are faster than diffusing or viscolelastic contact processes and, in the case of heating element butt fusion, have a serious impact on subsequent strength. For heating element butt fusion, a mathematical model was established to combine the process and material parameters with the obtainable joint quality.



Butt fusion Sample
Source: Bielomatic

Fig.10

KUL MED STANDARDER

EN 12814, *Testing of welded joints of thermoplastics semi-finished products*, is composed with the following parts:

— *Part 1: Bend test;*
— *Part 2: Tensile test;*
— *Part 3: Tensile creep test;*
— *Part 4: Peel test;*
— *Part 5: Macroscopic examination;*
— *Part 6: Low temperature tensile test;*
— *Part 7: Tensile test with waisted test specimens;*
— *Part 8: Requirements.*


SVENSK STANDARD
SS-EN 12814-4:2018

Fastställd/Approved: 2018-04-09
Publicerad/Published: 2018-04-10
Utgåva/Edition: 2
Språk/Language: engelska/English
ICS: 25.160.40

SWEDISH STANDARDS INSTITUTE

Provning av svetsförband i konstruktioner utförda av formvaror av termoplast –
Del 4: Urrivningsprovning

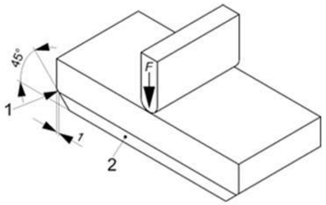
Testing of welded joints of thermoplastics semi-finished products –
Part 4: Peel test

KOMMANDE FÖRÄNDRINGAR I EN 12814-1

8 Cutting of test specimens

8.1 General requirement

A maximum of 1 mm of the longitudinal edges of the test specimen to be subjected to extension shall be removed at an angle of approximately 45°. These chamfers shall be continuous through the bead according to Figure 7.



Key

1 chamfer

2 bead

Figure 7 — Longitudinal chamfer of test specimens

Cutting of the test specimens shall not produce notches.

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 12814-1

November 1999

ICS 25.160.40

English version

Testing of welded joints of thermoplastics semi-finished products - Part 1: Bend test

Essai des assemblages soudés sur produits semi-finis thermoplastiques - Partie 1: Essais de pliage

Prüfen von Schweißverbindungen aus thermoplastischen Kunststoffen - Teil 1: Biegeversuch

This European Standard was approved by CEN on 30 September 1999.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 12814-1:1999 E

EN 12814-2

Annex C
(normative)

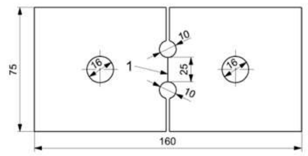
Notched tensile test specimen

A notched tensile test forces failure to occur in the weld and can be used in order to optimize welding parameters or to qualify welding personnel (e.g. EN 13067 [1]).

The values of f_s determined using the notched tensile test do not correlated with the values of f_s determined using type 1 or type 2 test specimens.

The test specimen used for the notched tensile test shall be as described in Figure C.1.

Dimension in millimetres



Key

1 weld line

Figure C.1 — Notched tensile test specimen

Annex B
(informative)

Recommended test speeds for some thermoplastics materials

The recommended test speeds used for some thermoplastics materials are given in Table B.1.

Table B.1 — Recommended test speeds for some thermoplastics materials

Material	**Speed** mm/min
PVC	10
PVDF, PP-H, PP-B	20
PE, PP-R	50

SVENSK STANDARD
SS-EN 12814-2:2021

Provning av svetsförband i konstruktioner utförda av formvaror av termoplast – Del 2: Dragprovning

Testing of welded joints of thermoplastics semi-finished products – Part 2: Tensile test

SIS Svenska Institutet för Standarder

Språk: engelska/English
Utgåva: 2

KOMMANDE FÖRÄNDRINGAR I EN 12814-2

European foreword

This document (PWI EN 12814-2 Rev:2025) has been prepared by Technical Committee CEN/TC 249 "Plastics", the secretariat of which is held by SIS.

This document is currently submitted to the NWIP.

This document supersedes EN 12814-2:2021.

In comparison with the previous edition, the following technical modifications have been made:

— the minimum test specimen lengths have been revised;

— Annex C (notched tensile test specimen) has been deleted.

A list of all parts in a series can be found on the CEN website: www.cencenelec.eu.

8 Mechanical testing

Test specimen shall be conditioned to a temperature of (23 ± 2) °C for a time according to EN ISO 291 and, unless otherwise specified, the test shall be carried out at a room temperature of (23^{+2}_{-5}) °C.

The test speeds and tolerances shall be in accordance with EN ISO 527-1.

For all materials the test speed shall be chosen to ensure that the test is terminated in about one minute. Examples of test speeds for some relevant thermoplastics materials are listed in Annex B.

At least five test specimens shall be tested for each welded and unwelded test piece.

Welded and unwelded test specimens shall be of the same geometry and shall be tested at the same speed with the same distance between the clamps.

If all welded test specimens fracture or yield within the calibrated length, but outside of the weld (L_w), the unwelded test specimen do not need to be tested, and the short-term tensile welding factor shall be taken as 1.

NOTE For certain materials, such as PE, when optimizing welding parameters or qualifying welding personnel (e.g. EN 13067 [1]), it is useful to be able to consistently achieve failure in the weld. This is achieved using a waisted test specimen geometry, as described in EN 12814-7 [2] or ISO 13953 (Type A) [3].

Table 3 — Dimension of type 2 test specimens

Dimensions in millimetres

D_n or a_n	b	min. b_1	L_0	L	r
$20 \le D_n < 50$	$a_n + \frac{D_n}{10}$	$b + 10$	80	≥ 170	60
$50 \le D_n < 100$	$a_n + \frac{D_n}{10}$	$b + 10$	120	≥ 220	60
$D_n \ge 100$ or flat assemblies:					
$a_n \le 10$	15	20	120	≥ 200	60
$10 < a_n \le 20$	30	40	120	≥ 300	60
$a_n > 20$	1,5 a_n	80	200	≥ 400	60

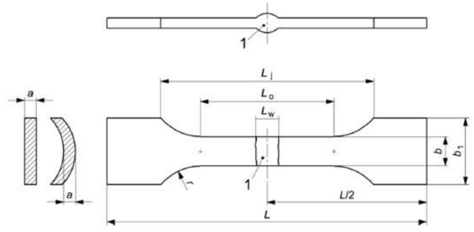


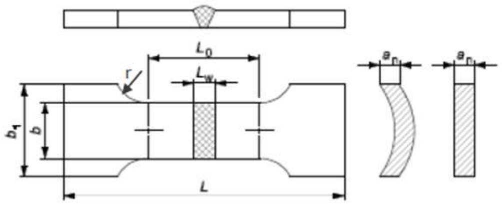
Table B.1 — Recommended test speeds for some thermoplastics materials

Material	Speed mm/min
PVC	10
PVDF, PP-H, PP-B, PA-U	20
PE, PP-R	50

FÖRSLAG PÅ FÖRÄNDRINGAR I EN 12814-3

EN 12814-3 (Tensile Creep Test)

- Type 2 specimen geometry



D_n = nominal OD of pipe
r = 60
All dimensions in mm

D_n or a_n	b	b_1 (min.)	L_0	L (min.)
$a_n \leq 10$	10	20	115	170
$10 < a_n \leq 20$	30	40	115	170
$a_n > 20$	1,5 a_n	2,5 a_n	3 a_n + L_w (min. 120)	L_0 + 80
$20 \leq D_n < 50$	$a_n + D_n/10$	b + 10	L_w + 60	120
$50 \leq D_n < 100$	$a_n + D_n/10$	b + 10	L_w + 60	170

TWI

SVENSK STANDARD
SS-EN 12814-3:2014

SWEDISH STANDARDS INSTITUTE

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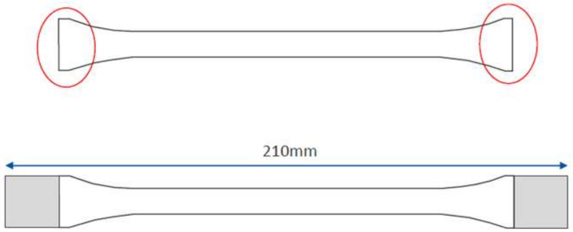
ICS: 25.160.40

Provning av svetsförband i konstruktioner utförda av formvaror av termoplast –
Del 3: Krypdragprovning

Testing of welded joints in thermoplastics semi-finished products –
Part 3: Tensile creep test

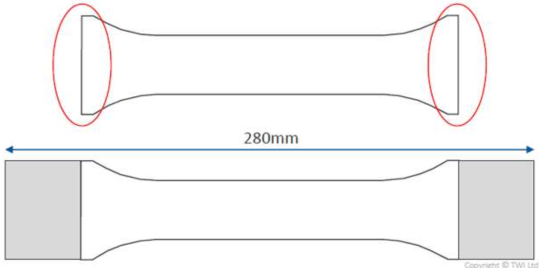
EN 12814-3 (Tensile Creep Test)

- $a_n \leq 10$
  - $b_1 = 20$
  - $L = 170$



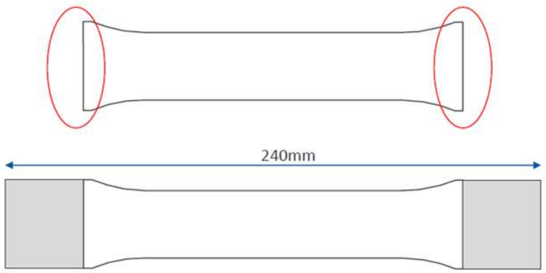
EN 12814-3 (Tensile Creep Test)

- $a_n > 20$
  - $a_n = 21$
  - $b = 1{,}5 \times a_n = 31{,}5$
  - $b_1 = 2{,}5 \times a_n = 52{,}5$
  - $L_0 = 120$
  - $L = L_0 + 80 = 200$



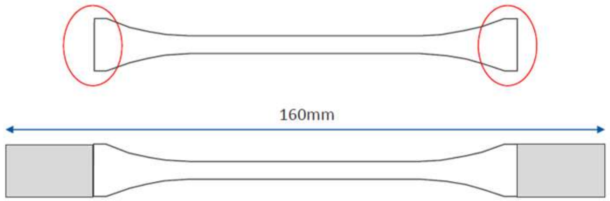
EN 12814-3 (Tensile Creep Test)

- $10 < a_n \leq 20$
  - $b_1 = 40$
  - $L = 170$



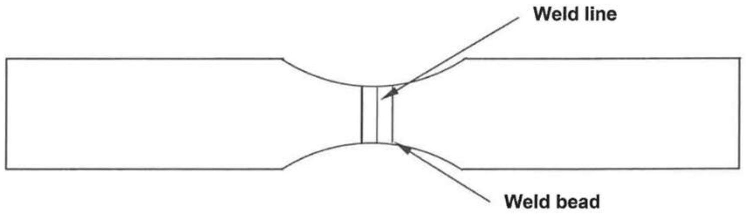
EN 12814-3 (Tensile Creep Test)

- $20 \leq D_n < 50$
  - $D_n = 20$
  - $a_n = 3$
  - $b = a_n + D_n/10 = 5$
  - $b_1 = b + 10 = 15$
  - $L_w = 5$
  - $L_0 = L_w + 60 = 65$
  - $L = 120$



KOMMANDE FÖRÄNDRINGAR I EN 12814-6

Another tensile test which induces fracture at the weld is the low temperature tensile test, as described by BS EN 12814-6:2000. This test again uses a wasted specimen geometry as shown in Figure 8.12. The test is mainly used for assessing welds in PP and PVDF pipe and is conducted at a nominal temperature of -40°C, in order to induce brittle fracture at the weld. Since, in the long term, welds often fail by brittle fracture it is proposed that a welding factor determined via this test should give a better indication of the long-term performance of the weld than tests performed at ambient temperature. The appearance of the fracture surface should be assessed to ensure that brittle failure has occurred. If any ductility is present, the test should be repeated at a lower temperature.



Test speeds and maximum test temperatures

Test speeds and test temperatures for some thermoplastics materials are given in table A.1.

Table A.1 — Test speeds and test temperatures for some thermoplastics materials

Material	Test speed	Maximum test temperature
PVDF	50 mm/min	- 40 °C
PP-H, PA-U	50 mm/min	- 40 °C
PP-R	100 mm/min	- 40 °C

13100-3 Oförstörande provning av svetsförband, formvaror av termoplast - Del 3: Ultraljudprovning

European foreword

This document (prEN 13100-3:2025) has been prepared by Technical Committee CEN/TC 249 "Plastics", the secretariat of which is held by SIS.

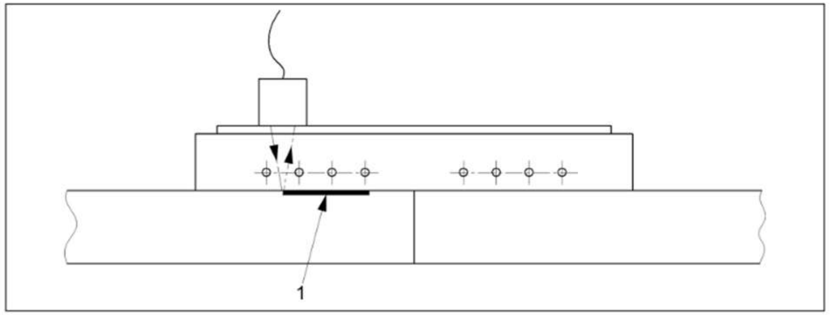
This document is currently submitted to the CEN Enquiry.

This document will supersede EN 13100-3:2004.

prEN 13100-3:2025 includes the following significant technical changes with respect to EN 13100-3:2004:

– the referenced standards have been updated, the figure showing the examination volume for electrofusion joints has been revised and it has been specified that the setting of range and sensitivity shall be carried out if the temperature of the joints being examined changes by more than 10°C.

A list of all parts in a series can be found on the CEN website: www.cencenelec.eu.



Key

Uppdatering av tekniska specifikationer för ultraljud 2024

TECHNICAL SPECIFICATION

ISO/TS 16943

Second edition
2023-11

Thermoplastic pipes for the conveyance of fluids — Inspection of polyethylene electrofusion socket joints using phased array ultrasonic testing

Tubes en matières thermoplastiques pour le transport des fluides — Contrôle des assemblages par emboîtures électrosoudables en polyéthylène au moyen de la technique par ultrasons multi-éléments

Reference number
ISO/TS 16943:2023(E)

Technical Specification

ISO/TS 22499

Second edition
2024-02

Thermoplastic pipes for the conveyance of fluids — Inspection of polyethylene butt fusion joints using phased array ultrasonic testing

Tubes en matières thermoplastiques pour le transport des fluides — Contrôle des assemblages par soudage bout à bout en polyéthylène au moyen de la technique par ultrasons multi-éléments

Reference number
ISO/TS 22499:2024(en)

7.3 Ultrasonic probes

Only longitudinal waves are feasible for polyethylene.

Any type of phased array probe can be used if it satisfies the requirements of Clause 8 with the phased array instrument.

The most suitable ultrasonic probe frequency shall be selected in accordance with the thickness of the electrofusion socket fitting. Table 1 shows recommended frequencies for each thickness range of the electrofusion socket fitting.

The optimal frequency can be shifted up or down depending on the attenuation and thickness of the EF socket fitting tested.

Table 1 — Selection of probe frequency

Recommended frequency MHz	Fitting wall thickness, t mm
3,5	$30 \le t \le 50$
5,0	$10 \le t \le 50$
7,5	$10 \le t \le 30$

NOTE In general, higher frequencies provide better resolution and lower frequencies provide better penetration.

Figure A.5 shows a phased array image from soil embedment at the fusion interface.

a) Pipes with soil contamination b) Cross-section of electrofusion socket joint c) related PAUT image

Figure A.5 — Soil in an electrofusion socket joint

Annex B
(informative)

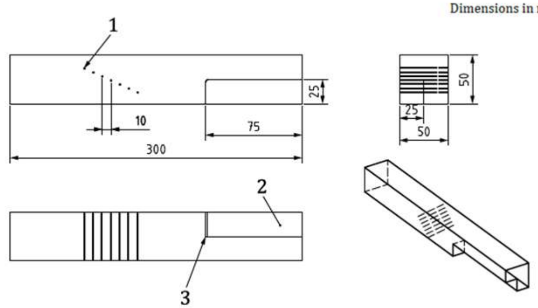
Example of a reference block

To set up the test sensitivity, a reference block can be used.

The reference block should be made of the same, or acoustically equivalent, material of the electrofusion socket fitting(s) tested.

Shape and dimensions of a possible reference block are illustrated in Figure B.1.

Dimensions in millimetres



Key

1 7 × Ø 3,0 mm SDHs at depths between 10 mm and 40 mm in 5 mm steps
2 velocity calibration step
3 radius ≤ 3 mm

Figure B.1 — Example of a reference block

Holes should be drilled and reamed, and they should be essentially parallel to the test surface.

The diameter of the holes should be similar to the diameter of the heating wire in the electrofusion socket to be tested.

Choose the SDH whose depth position (hole to surface) is closest to the thickness of the electrofusion socket fitting to be tested. Maximize the signal from the SDH and adjust the gain to give 80 % of full screen height.

Where there is a difference in sound attenuation between the reference block and the fusion joint(s) tested, a transfer correction is required to compensate for the difference. The correction is accomplished by noting the difference between signals received from the back surfaces of the reference block and the test object having equal thickness and correcting for this difference.

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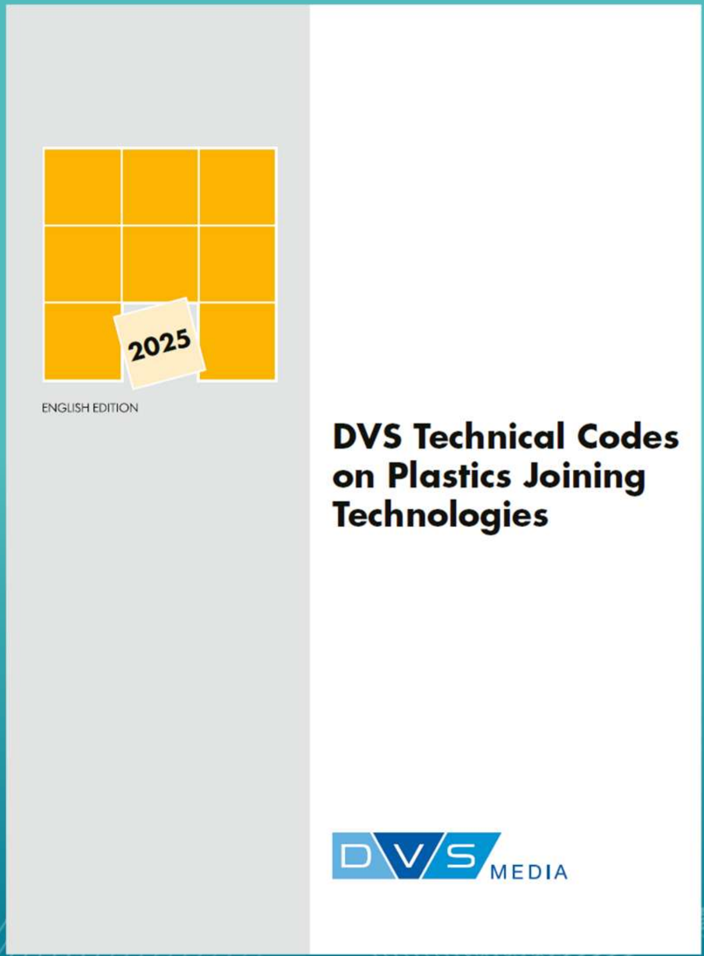
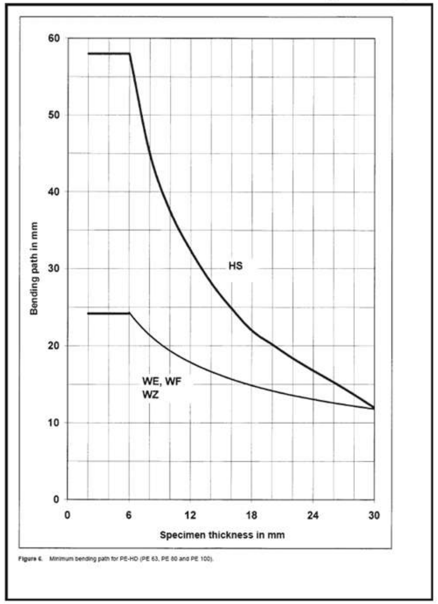


DVS 2203-1 Requirments in the technological bending test



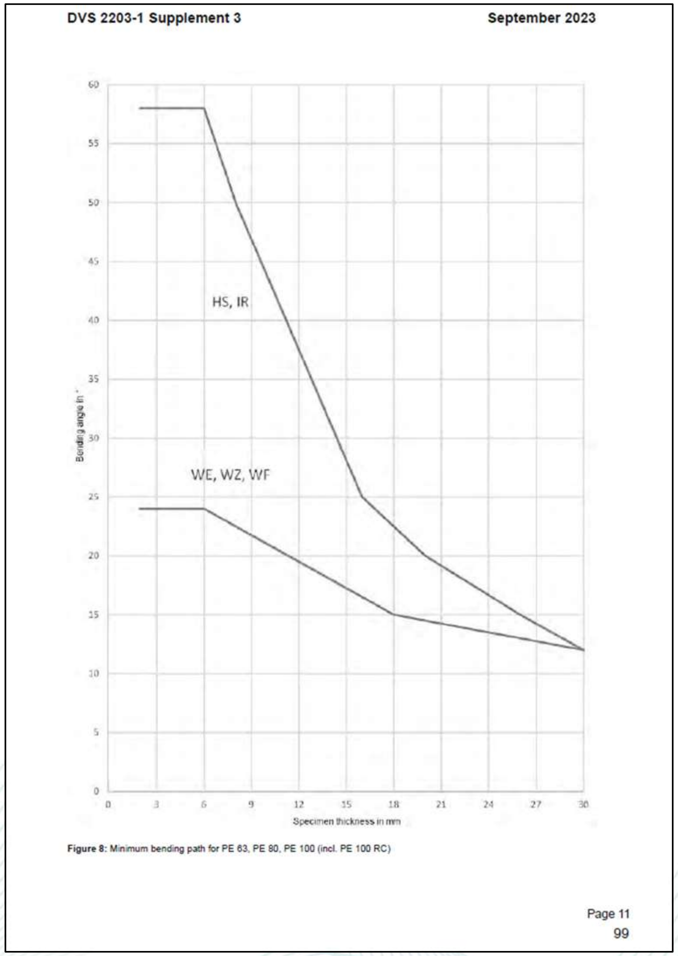


Figure 8: Minimum bending path for PE 63, PE 80, PE 100 (incl. PE 100 RC)

Uppdaterad med IR svetsning samt material
Graferna är uppdaterade

DVS 2204 – PVC-U

August 2024

DVS GERMAN WELDING SOCIETY

Technical Code
DVS 2204

Replaces issue
DVS 2204-3 Edition March 2016,
DVS 2204-4 Edition December 2011 and
DVS 2204-5 Edition March 2013

Technical Code DVS 2204

Adhesive bonding of pipes and piping parts made of thermoplastics – Unplasticised Polyvinyl Chloride (PVC-U), Chlorinated Polyvinyl Chloride (PVC-C) and Acrylonitrile Butadiene Styrene (ABS)

Technical Comittee of the DVS

Working Group W 4 "Joining Plastics"

Subgroup W 4.2 "Adhesive Bonding of Thermoplastics in Pipeline and Plant Construction"

This publication has been drawn up by a group of experienced specialists working in an honorary capacity and its consideration is recommended. The user should always check to what extent the contents are applicable to his particular case and whether the version on hand is still valid. No liability can be accepted by the DVS – German Welding Society and those participating in the drawing up of the document.

Orders to: DVS Media GmbH, P. O. Box 10 19 65, 40010 Düsseldorf, Germany, Phone: + 49 (0) 211/1591- 0, E-Mail: media@dvs-media.info

6. Adhesive bonding instructions

All adhesives and adhesive systems have specific processing conditions. Therefore, only generally applicable information can be given here. Detailed information can be found in the manufacturer's technical data sheet.

6.1. Adhesive bonding prerequisite

Manufacturers or pipe system suppliers deliver the adhesives and the associated cleaners/releasers in a ready-to-use condition. Consumption quantities can be found in the technical data sheets or can be requested from the manufacturer. Dilution and other changes are not permitted. This also applies to the cleaners/solvents. Always follow the adhesive instructions of the adhesive or pipe system manufacturer.

The pipes and fittings must be dry and free of grease and dirt. Remove any condensation or ice, when necessary, for example by using hot air (observe explosion protection). The necessary measures can be found in the manufacturer's installation instructions.

The adhesive must be checked for workability.

Adhesive bonding depends on the ambient temperature and the film thickness of the adhesive. Faster setting can be expected at high temperatures and delayed setting at low temperatures.

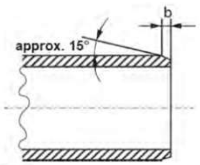
Adhesive bonding should only be carried out at processing temperatures as specified in the manufacturer's data sheets (typically between 5°C and 40°C). In the event of deviations, these processing temperatures should be achieved by additional suitable measures, e.g. special installation techniques, temperature control of the joint surfaces and the adhesive.

Additionally, the safety instructions from the safety data sheets must be observed (see also chapter 8 of this technical code).

6.2. Adhesive bonding preparation

The following procedure is generally used to achieve an optimum adhesive-bonded joint:

- Pipes and fittings must be checked for dimensional accuracy and defects,
- the pipes to be bonded are shortened to the required length (preferably with a pipe cutter),
- the pipes must be cut at right angles to the pipe axis,
- the pipe ends should be chamfered on the outside at an angle of approx. 15° (see **Figure 1** and **Table 1**) using a chamfering tool and deburred on the inside if necessary.



Uppdatering och enklare pedagogisk text

Äntligen tillbaka och uppdaterad

DVS 2205-5 Calculation of containers and apparatus made of thermoplastics – rectangular containers

3. Container types

Figure 1: Containers without reinforcement

Figure 2: Containers with reinforced edges

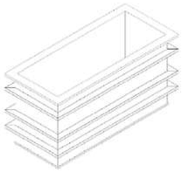


Figure 3: Container with all-around reinforcement

Figure 4: Container with cross-ribbed side walls

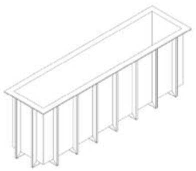


Figure 5: Containers with yoke reinforcement

8. Containers with reinforced edges

In **Figure 7**, the calculated moment curve is shown on a rectangular container with reinforcement. In **Table 4**, the associated calculation formulas for stress and deformation calculations are shown.

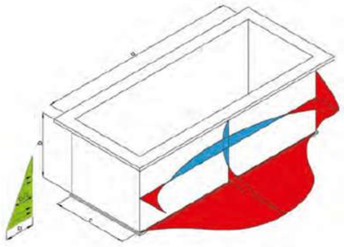


Figure 7: Moment curve for containers with reinforced edges

8.1. Preliminary remarks

The container is stiffened at the top edge by a circumferential profile. A firm, level surface is required for the floor of the container. Its wall thickness must be at least equal to the thickness of the adjacent wall. The weight of the reinforcement beam must not place undue additional stress on the container walls. If necessary, the profiles must be supported separately from the container.

8.2. Calculation of side walls

The stress verification of the side walls must be carried out under γ_F-fold stresses, all deformation verifications must be carried out under characteristic stresses.

The calculation of the walls depends on their aspect ratio.

STANDARDISERINGEN I SVERIGE
SWEDISH INSTITUTE FOR STANDARDS

SVENSK STANDARD SS-EN 12573-3

Handläggande organ: Tryckkärlsstandardiseringen, TKS | Fastställd: 2000-05-19 | Utgåva: 1 | Sida: 1 (1+32)

Welded static non-pressurised thermoplastics tanks – Part 3: Design and calculation for single skin rectangular tanks

The European Standard EN 12573-3:2000 has the status of a Swedish Standard. This document contains the official English version of EN 12573-3: 2000.

Swedish Standards corresponding to documents referred to in this Standard are listed in "Catalogue of Swedish Standards", issued by SIS. The Catalogue lists, with reference number and year of Swedish approval, International and European Standards approved as Swedish Standards as well as other Swedish Standards.

Svetsade stationära icke trycksatta termoplasttankar – Del 3: Konstruktion och beräkning av enkelmantlade rektangulära tankar

Europastandarden EN 12573-3:2000 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN 12573-3:2000.

Motsvarigheten och aktualiteten i svensk standard till de publikationer som omnämns i denna standard framgår av "Katalog över svensk standard", som ges ut av SIS. I katalogen redovisas internationella och europeiska standarder som fastställts som svenska standarder och övriga gällande svenska standarder.

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Tryckt i juli 2000

DVS 2212-1 Uppdatering hur DVS svetsare ska prövas. Betydelsen av övervakning

August 2024

DVS GERMAN WELDING SOCIETY

Technical Code
DVS 2212-1

Replaces issue
December 2016

This text is aimed at men and women equally. For the sake of readability, however, reference is made only to the masculine form and not to the masculine/feminine form.

Technical Code DVS 2212-1

Testing of plastic welders for plant construction (apparatus, tank and pipeline construction)

Education Comittee of the DVS

Working Group "Training and Qualification Testing"

Orders to: DVS Media GmbH, P. O. Box 10 19 65, 40010 Düsseldorf, Germany, Phone: + 49 (0) 211/1591- 0, E-Mail: media@dvs-media.info

9. Attachment: Explanations, tables, images, attachments

This guideline only contains the basic provisions and rules for carrying out the plastics welder test.

In order to assess the test pieces, including their manufacture, the examiner must have extensive experience and knowledge of plastic welding technology and thermoplastic testing techniques. Approval as a recognised examiner according to DVS PersZert is an essential prerequisite.

This version has been prepared taking into account the experience gained in the meantime. For example, the tensile test has been omitted in certain test groups due to its low informative value, but can be used in addition.

The production of the test pieces was included in the assessment for the following reason:

The dependence of the quality of the welding work on the skills and knowledge of the welders applies all the more to plastic welding because – in contrast to metal welding – the long-term mechanical strength, i. e. the safety of the welded joints during the service life of the component, cannot be determined in short-term tests alone. The destructive tests only provide an indication of the long-term load-bearing capacity of the weld seams in terms of strength and deformation behaviour. Therefore, effective quality assurance for plastic welded joints, in this case the quality assessment of the test pieces, must cover as many areas of influence as possible during the production of the test pieces. Only in conjunction with proof of compliance with material- and process-specific welding conditions, required joint preparation and proper handling and execution of the welding work can the results of the mechanical short-term tests provide meaningful evidence of the actual quality of the welded joints.

The above-mentioned requirement for the inspector to have extensive experience and knowledge of the technology of plastic welding and the testing technology of thermoplastics applies all the more.

Welding supervision is also becoming increasingly important. For this reason, a DVS guideline has been drawn up for the plastics welding specialist test (Technical Code DVS 2213). This qualification is a prerequisite for working as a welding supervisor to ensure the quality of plastics welding work and to supervise plastics welders. There are also a number of 'equivalently qualified welding supervisors', such as experts from technical inspection organisations, materials testing institutes and other specialist institutes working in the field of plastics welding and testing technology.

DVS 2213 Uppdatering av utbildnings guideline för DVS svetsspecialist

January 2025

DVS GERMAN WELDING SOCIETY

Technical Code
DVS 2213

Replaces issue
December 2010

This text is aimed at men and women equally. For the sake of readability, however, reference is made only to the masculine form and not to the masculine/feminine form.

Technical Code DVS 2213

Plastics Welding Specialist

Education Comittee of the DVS

Working Group “Training and Qualification Testing”

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3. Knowledge and skills to be taught and tested

3.1. Knowledge (40 lesson units)

3.1.1. Materials (6 lesson units)

- Structure and properties of plastics, recognition of plastics, state ranges
- Plastics important for welding technology: PVC, PE, PP, PA, PVDF and other thermoplastics
- Use limits (temperature, strength, chemical resistance)

3.1.2. Structural design (1 lesson unit)

- Types of joints, joint and seam shapes
- Graphical weld seam representation
- Design for material and weldability

3.1.3. Pre-welding measures (2 lesson units)

- Transport and storage of semi-finished products, molded parts and welding consumables
- Weld protection against environmental influences
- Inspection of semi-finished products, molded parts and welding consumables
- Checking the suitability for welding

3.1.4. Behaviour of plastics during welding (1 lesson unit)

- Technological characteristics
- Welding residual stresses and measures to reduce them

3.1.5. Welding processes and equipment, welding parameters, application limits (14 lesson units)

- Hot gas fan welding and hot gas draw welding
- Butt welding, socket welding, hot wedge welding, hot coil welding
- Hot gas extrusion welding
- Other welding processes, e.g. friction welding
- Requirements for machines, equipment and facilities

3.1.6. Welded plastic joint testing (12 lesson units)

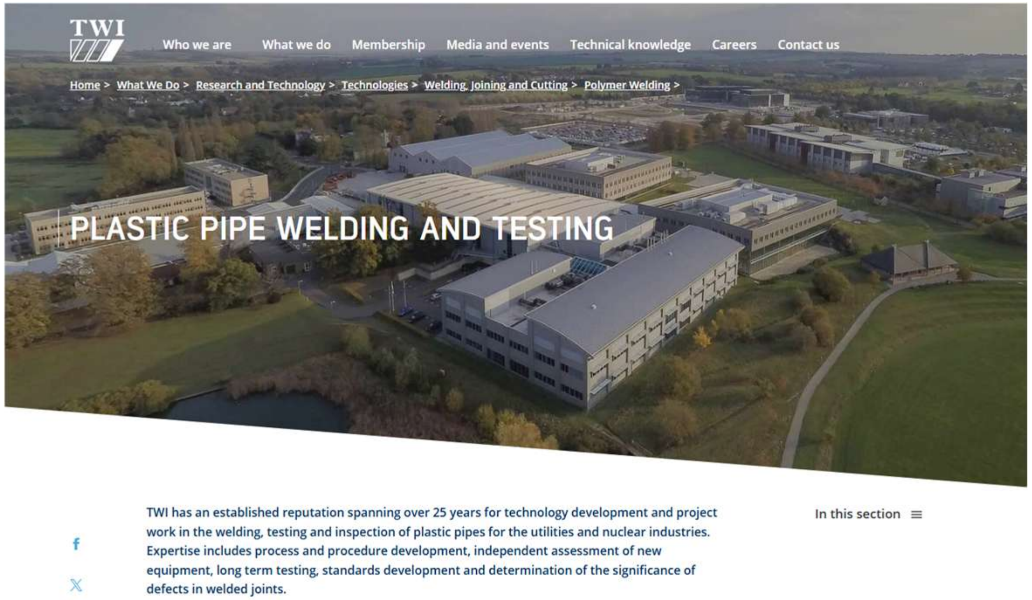
- Non-destructive testing: Visual and dimensional inspection, radiographic testing, ultrasonic testing, high-voltage, pressure and vacuum tests
- Destructive testing tensile test, technological bending test, impact tensile test, notched bar impact test, pin indentation test, creep rupture test, shear/peel test
- Leak test, pressure test

3.1.7. Quality assurance measures (2 lesson units)

- Tasks and responsibilities
- Self-monitoring
- External monitoring
- Welding personnel (training, certification)
- Test equipment monitoring

SMÅTT OCH GOTT

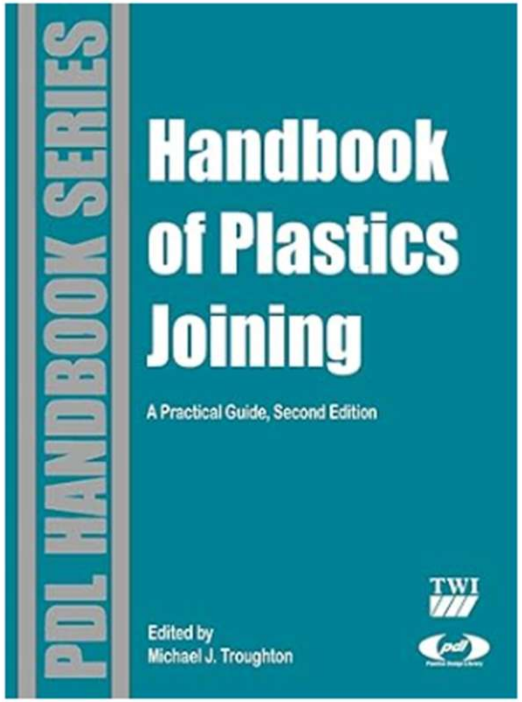
Studieresa AG51 - TWI (The Welding Institute)?



Mike Troughton, TWI's Technology Fellow for Polymer Welding, will be presenting as part of our first-ever Technology Fellows' Day on 15 May, 2025.

He will draw upon over 35 years' research for the plastics industry to describe the historical background to the replacement of coated carbon steel pipework with polyethylene (PE) pipes for safety-related service water systems in the UK nuclear industry, going back to the first installation in 2005 at Sizewell B.

In addition, Mike will provide details of TWI's role since then in the training of PE pipe welders to industry standard and the volumetric non-destructive testing of the welded joints for these systems. He will also speak on the contents of the ASME Boiler and Pressure Vessel Code Section III Appendix XXVI document, which covers the use of PE for essential service water pipework in the USA; a document that TWI has been helping to develop since 2011.



TIPS -SEPTEMBER

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- Government agencies and associations

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- **Prof. Dr. Marcus Hoffmann,** University of Applied Sciences Kempten
- **Andreas Stäblein,** TÜV SÜD Industrie Service GmbH,
- **Marco Stallmann,** SIMONA AG

Conference languages

German and English
A simultaneous translation into English will be provided for all presentations given in German.