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WEBINAR VIII

21-10-2021

Thermoplastic Pipe Systems:

Important aspects to understand and keep in mind during design and specification

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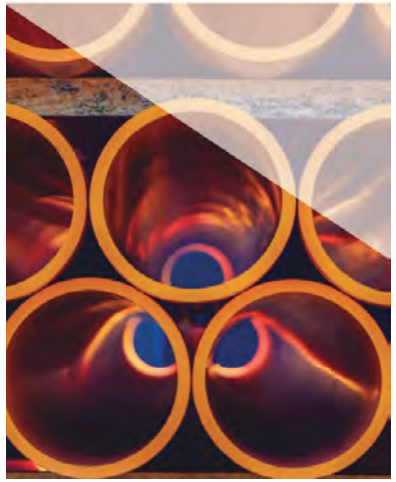

IFPA
Installation and Fabrication Plastics Pipe Association

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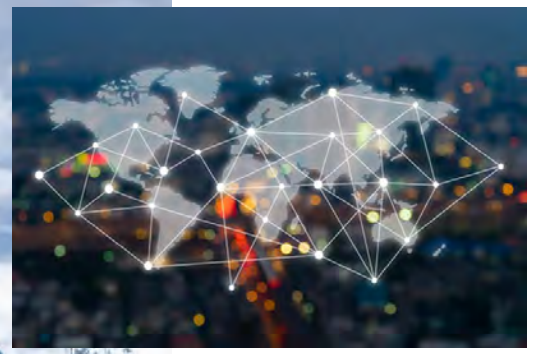
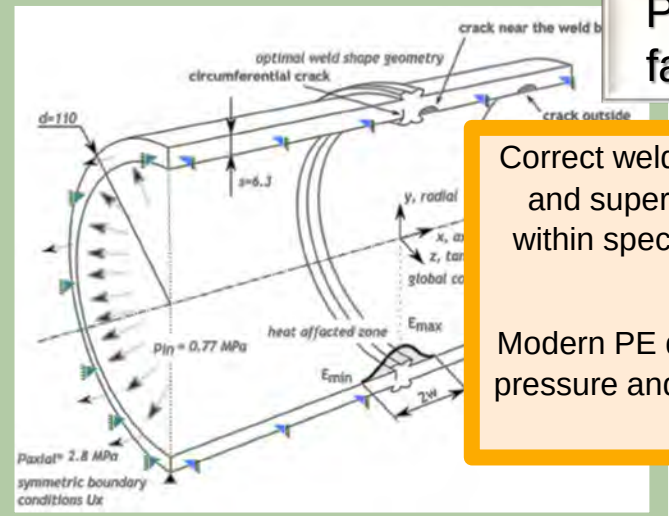
THE FUTURE OF WORK – CHALLENGE OR OPPORTUNITY?

zoom Video Conferencing



SAPPMA Webinar VIII

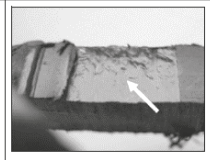
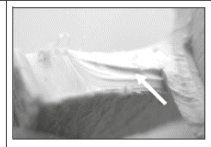
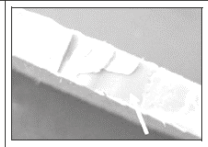
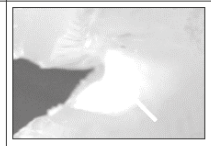
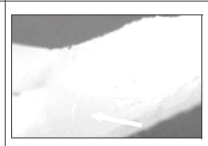
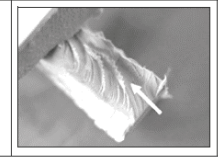
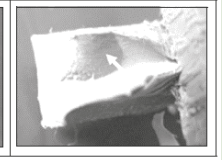
PE Weld Data recording prevents weld failure and Costly Infrastructure Repair



Correct welding parameters for butt welding is imperative. By giving operators and supervisors the ability to clearly see whether a PE weld is being done within specified weld parameters, you are ensuring perfect welds every time and saving your company from costly repairs.

Modern PE data loggers do not only log information, but they also calculate all pressure and time phases of the weld process and clearly instruct the operator in the process of butt welding.

Tabelle 2. Examples of fracture patterns in joints executed by means of heated tool sleeve welding

Material	Ductile fracture (plastic fracture)*	Smooth fracture (brittle fracture)**
PE (PE 80 and PE 100)		
PP		
PVDF		
PB		

DVS Technical Codes on Plastics Joining Technologies

DVS MEDIA

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Darren Poynton

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HDPE Pipe Weld Data Recording

- Ensures pipeline integrity
- Prevents costly infrastructure repair

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- High Density Polyethylene (HDPE) pipe
- Butt welding process
- Electrofusion process
- Welding parameters
- What can cause a weld failure
- Paper based recording
- Electronic Data Recording
- Questions?

What we already Know about HDPE Pipe!

- HDPE Pipe is an exceptional product.
- It's used for Water, Sewage, Gas, Mining, and Irrigation pipelines.
- In Many cases, the pipeline owners expect at least **100 years of service**.
- All welds must have **at least the same strength and durability** as the pipe.
- **Every 1000** meters of pipeline requires **84** welds.

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Pipe jointing

There are basically 2 methods used to weld HDPE Pipe

- Butt Welding

- Electrofusion

Electrofusion Welding

Before starting you must ensure pipe is correct quality, size and ends are clean and cut straight

Peel oxidisation from surface of pipe

Fit coupling on to pipe and clamp into position

Start control unit

Keep clamped for duration of welding and cooling time

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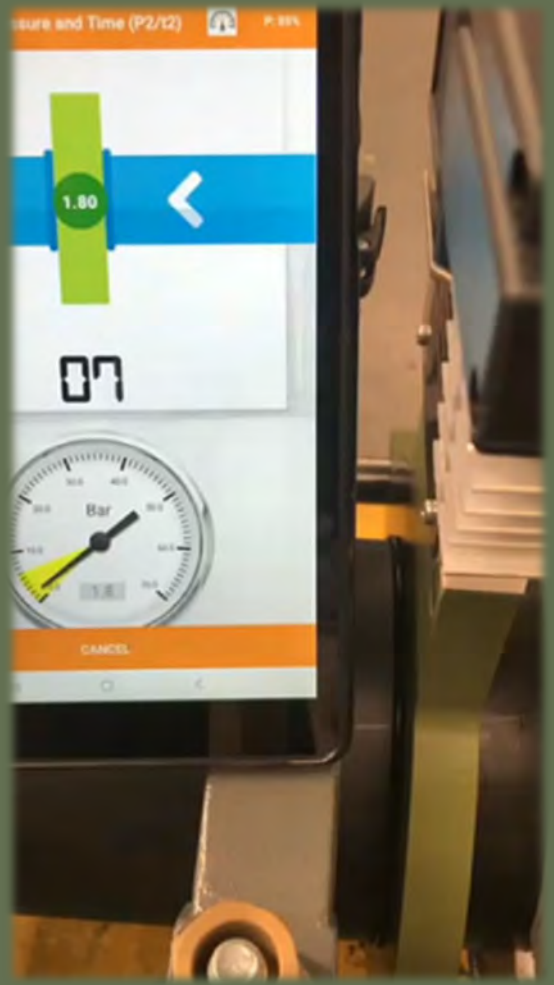
Butt Welding



- Heat the pipe ends.
- Remove heater plate.
- Bring pipe ends together and up to Pressure.
- Hold at pressure until cool.

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Pipeline Projects

HDPE Pipe is used in a diverse range of applications, all with their own level of risks.

However, whatever the project, if there is a weld failure, there is sure to be a financial cost for repair, loss or damages.

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Some Projects are relatively Low Risk

- Mining
- Agricultural
- Aquaculture

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Potentially Higher Risk Projects

- Gas
- Potable water
- Sewer
- Stormwater
- Chemical plants
- Industrial processing
- Food processing

Ultra High Risk Project
Country : Belgium
Pipe Size : 315 & 90mm

Pipe length : 3 kms
Depth : up to 35m

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And what was in the pipe?

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Risks

What are our risks if a weld fails

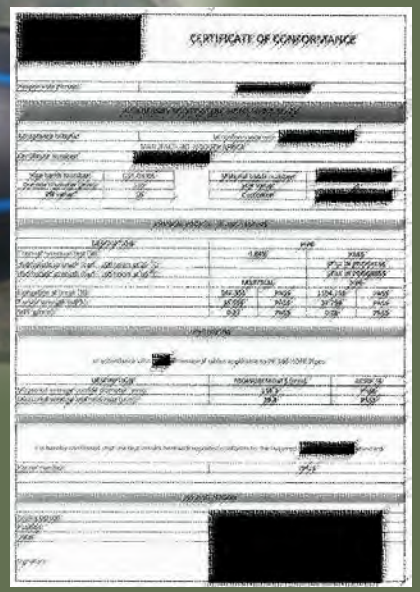
- Always Financial
- Damage to surrounding infrastructure
- Loss of product
- Environmental damage
- Traffic disruption
- Crop loss
- Livestock loss
- Injury or possible fatalities
- Or even worse a Potential Beer shortage

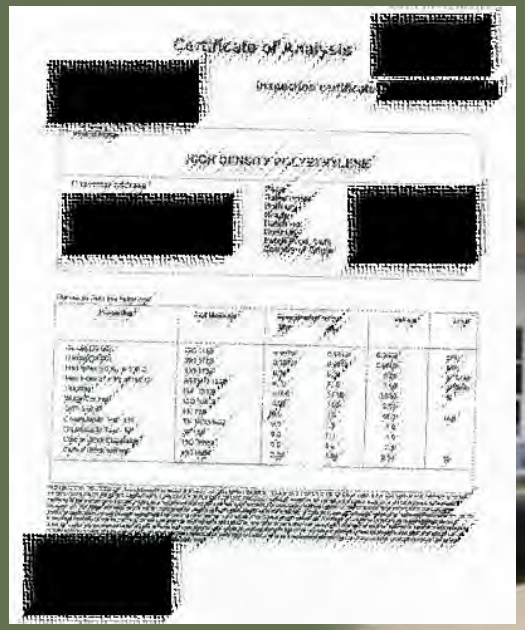
How do we prevent Failures!

To Prevent HDPE Pipe Failure

HDPE Pipe manufacturers around the world must comply to comprehensive pipe testing and supply QA Certificates for every batch of pipe they manufacture.

This obviously helps to ensure longevity of our pipelines and to prevent actual pipe failure.


CERTIFICATE OF CONFORMANCE


Certificate of Analysis

But when welds fail?

Often the first sign is costly damage to assets and infrastructure.

The failed butt weld was cut out and a temporary mechanical coupling was installed.

Failed Butt welds

Too much pressure during heat soak phase

NO RECORDS PROVIDED

Not enough pressure during welding / cool time.

NO RECORDS PROVIDED

Excessive misalignment

NO RECORDS PROVIDED

Failed Electrofusion welds

NO RECORDS PROVIDED

Poor alignment

Poor peeling, poor insertion

Reducer not long enough, this fitting had caught on fire but still installed and passed 2 pressure tests.

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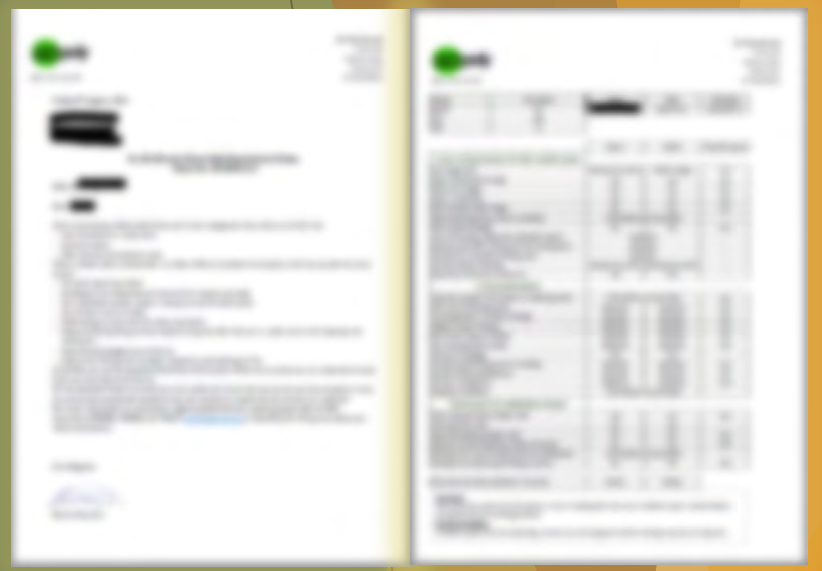
Failed Weld Reports

225mm SDR 11 x 8 Km's Potable Water Main
Butt weld failures

NO WELD DATA SUPPLIED

800mm SDR 26 x 3 Km's Irrigation Water Main
Butt weld failures

NO WELD DATA SUPPLIED



125-280mm SDR 11
Potable Water Main
Electrofusion weld failure

NO WELD DATA SUPPLIED

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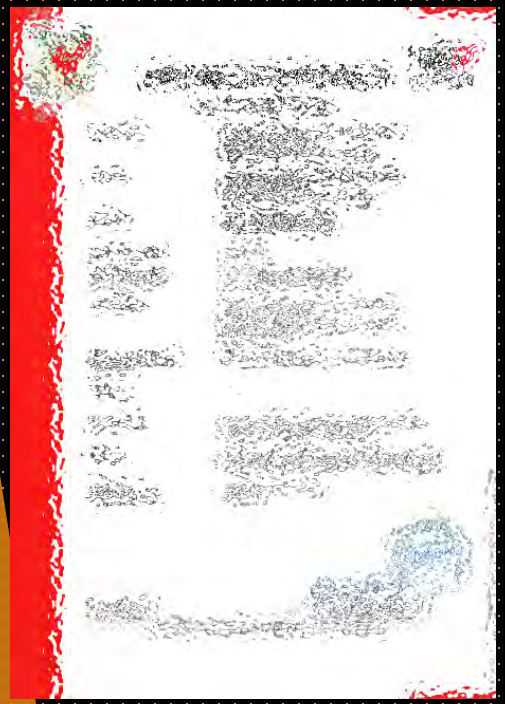
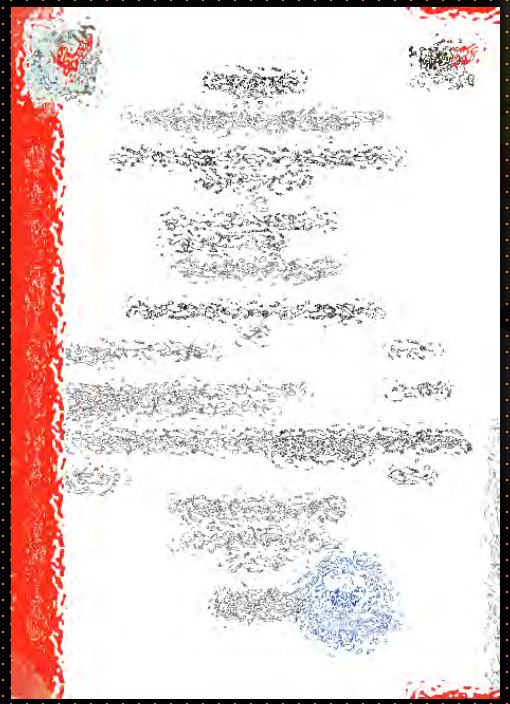
But what can we do to prevent weld failures?

- More Training?

- Training is great but without constant supervision many operators develop bad habits.





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- More Supervision?

- Supervision is very expensive and must be constant.

- Can anyone see some issues here that MUST be improved.

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Data Recording?

But what do we need to record?

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Pressure Vs Time Graph

Insert Heater plate and bring up to "Bead up pressure" 41Bar/1.2mm

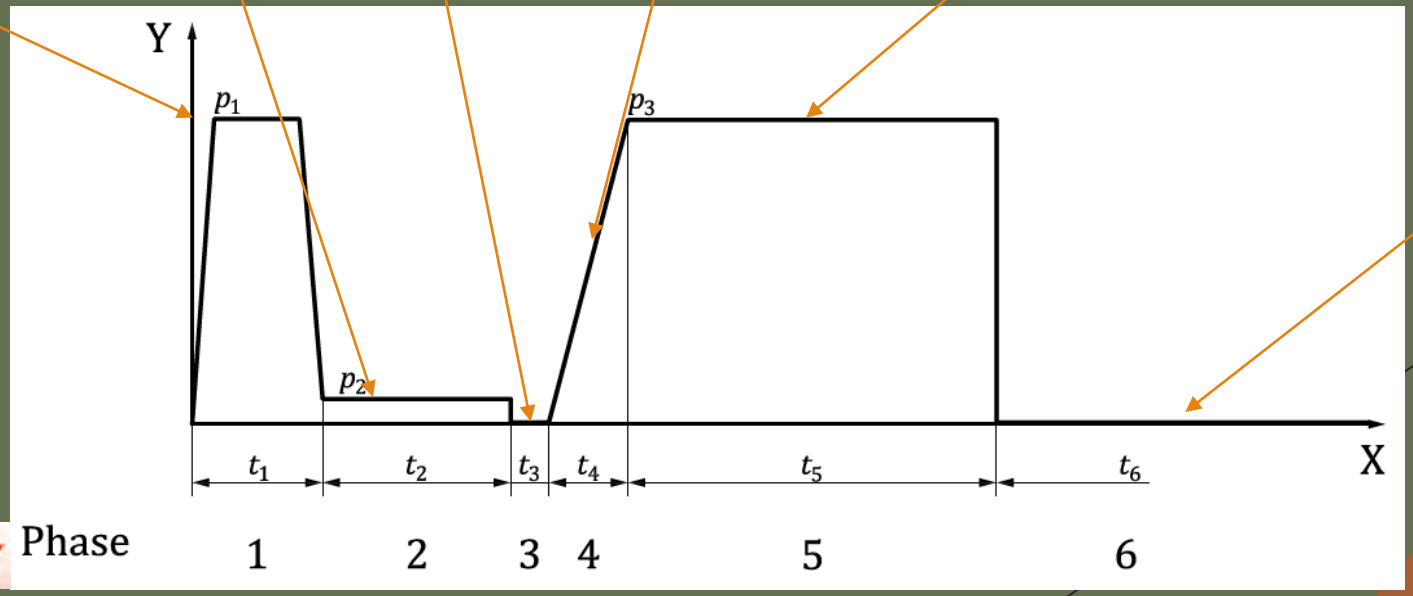
Drop pressure to "Heat Soak Pressure" 0-drag Bar /135 seconds

Remove Heater Plate & bring pipe together 8 seconds

Bring Pipe Ends Up to "Weld Pressure" 7.8 seconds

Maintain "Weld Pressure" 41 bar for cooling time 13 minutes

Posable extended time for "Rough Handling" allowance 13 minutes



Who says we should record the Weld Data?

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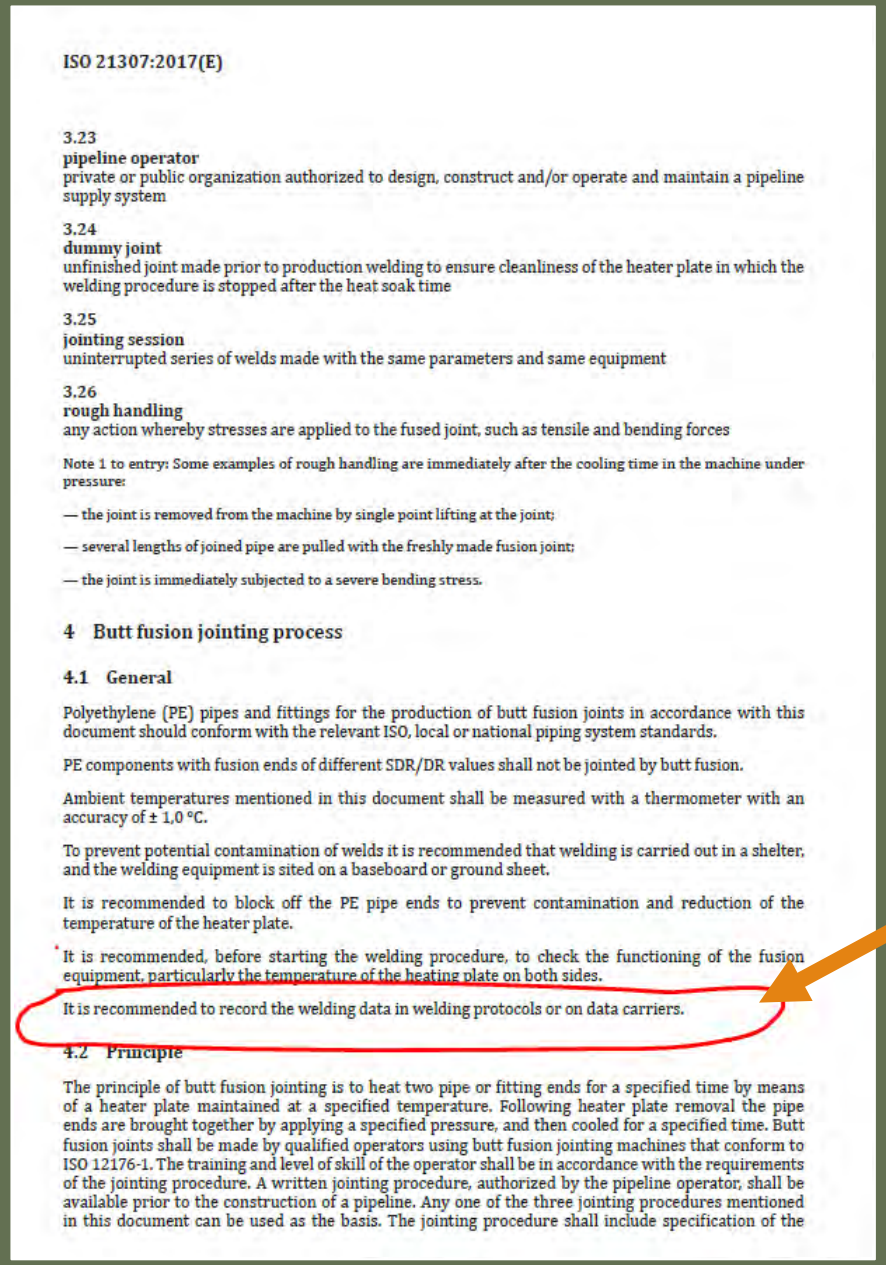
The majority of Welding Standards from around the world call for Weld Data Recording

- ISO 21307
- ATSM F2620
- DVS 2203



ISO 21307:2017(E)

3.23
pipeline operator
private or public organization authorized to design, construct and/or operate and maintain a pipeline supply system

3.24
dummy joint
unfinished joint made prior to production welding to ensure cleanliness of the heater plate in which the welding procedure is stopped after the heat soak time

3.25
jointing session
uninterrupted series of welds made with the same parameters and same equipment

3.26
rough handling
any action whereby stresses are applied to the fused joint, such as tensile and bending forces

Note 1 to entry: Some examples of rough handling are immediately after the cooling time in the machine under pressure:

— the joint is removed from the machine by single point lifting at the joint;

— several lengths of joined pipe are pulled with the freshly made fusion joint;

— the joint is immediately subjected to a severe bending stress.

4 Butt fusion jointing process

4.1 General

Polyethylene (PE) pipes and fittings for the production of butt fusion joints in accordance with this document should conform with the relevant ISO, local or national piping system standards.

PE components with fusion ends of different SDR/DR values shall not be jointed by butt fusion.

Ambient temperatures mentioned in this document shall be measured with a thermometer with an accuracy of ± 1,0 °C.

To prevent potential contamination of welds it is recommended that welding is carried out in a shelter, and the welding equipment is sited on a baseboard or ground sheet.

It is recommended to block off the PE pipe ends to prevent contamination and reduction of the temperature of the heater plate.

It is recommended, before starting the welding procedure, to check the functioning of the fusion equipment, particularly the temperature of the heating plate on both sides.

It is recommended to record the welding data in welding protocols or on data carriers.

4.2 Principle

The principle of butt fusion jointing is to heat two pipe or fitting ends for a specified time by means of a heater plate maintained at a specified temperature. Following heater plate removal the pipe ends are brought together by applying a specified pressure, and then cooled for a specified time. Butt fusion joints shall be made by qualified operators using butt fusion jointing machines that conform to ISO 12176-1. The training and level of skill of the operator shall be in accordance with the requirements of the jointing procedure. A written jointing procedure, authorized by the pipeline operator, shall be available prior to the construction of a pipeline. Any one of the three jointing procedures mentioned in this document can be used as the basis. The jointing procedure shall include specification of the

INTERNATIONAL STANDARD ISO 21307

States:-

"It is recommended to record the welding data in welding protocols or on data carriers"

To check that the correct welding parameters have been used reference should be made to the welding protocols or information held on data carriers

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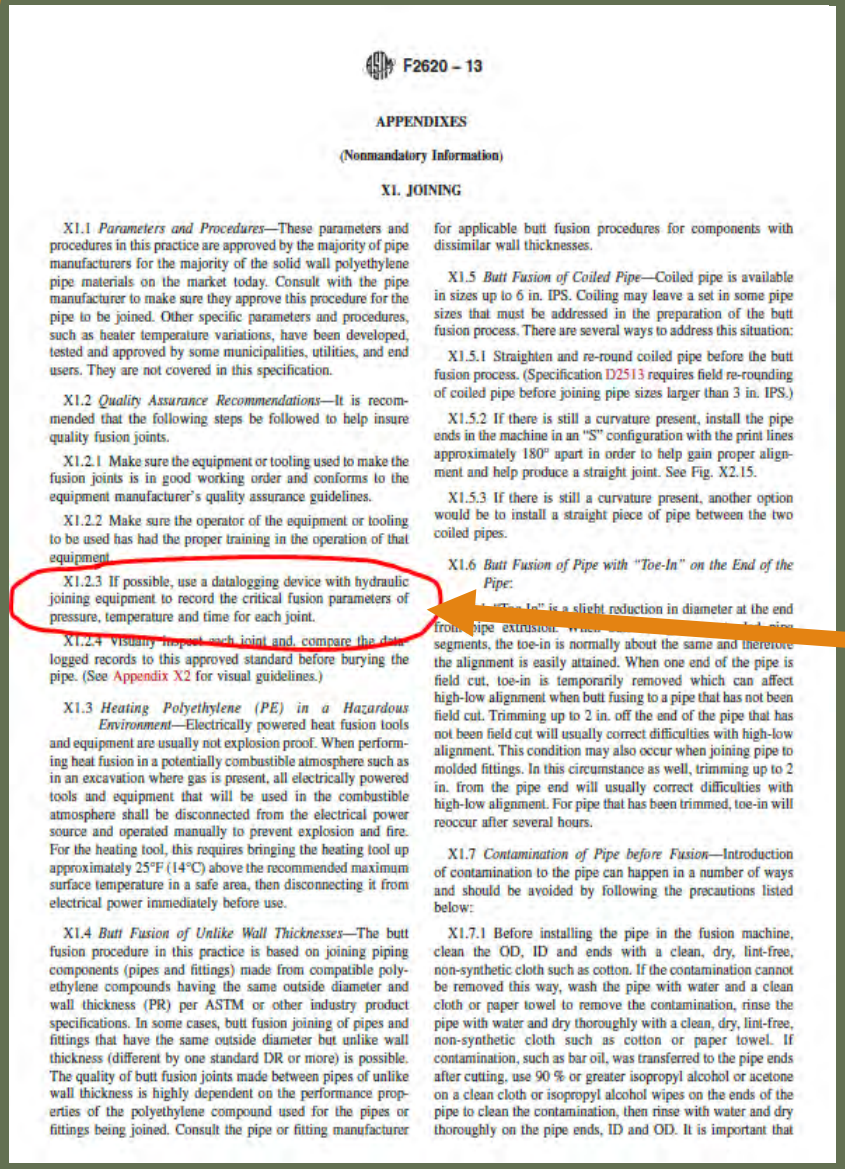

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APPENDIXES

(Nonmandatory Information)

X1. JOINING

X1.1 *Parameters and Procedures*—These parameters and procedures in this practice are approved by the majority of pipe manufacturers for the majority of the solid wall polyethylene pipe materials on the market today. Consult with the pipe manufacturer to make sure they approve this procedure for the pipe to be joined. Other specific parameters and procedures, such as heater temperature variations, have been developed, tested and approved by some municipalities, utilities, and end users. They are not covered in this specification.

X1.2 *Quality Assurance Recommendations*—It is recommended that the following steps be followed to help insure quality fusion joints.

X1.2.1 Make sure the equipment or tooling used to make the fusion joints is in good working order and conforms to the equipment manufacturer's quality assurance guidelines.

X1.2.2 Make sure the operator of the equipment or tooling to be used has had the proper training in the operation of that equipment.

X1.2.3 If possible, use a datalogging device with hydraulic joining equipment to record the critical fusion parameters of pressure, temperature and time for each joint.

X1.2.4 Visually inspect each joint and, compare the data-logged records to this approved standard before burying the pipe. (See Appendix X2 for visual guidelines.)

X1.3 *Heating Polyethylene (PE) in a Hazardous Environment*—Electrically powered heat fusion tools and equipment are usually not explosion proof. When performing heat fusion in a potentially combustible atmosphere such as in an excavation where gas is present, all electrically powered tools and equipment that will be used in the combustible atmosphere shall be disconnected from the electrical power source and operated manually to prevent explosion and fire. For the heating tool, this requires bringing the heating tool up approximately 25°F (14°C) above the recommended maximum surface temperature in a safe area, then disconnecting it from electrical power immediately before use.

X1.4 *Butt Fusion of Unlike Wall Thicknesses*—The butt fusion procedure in this practice is based on joining piping components (pipes and fittings) made from compatible polyethylene compounds having the same outside diameter and wall thickness (PR) per ASTM or other industry product specifications. In some cases, butt fusion joining of pipes and fittings that have the same outside diameter but unlike wall thickness (different by one standard DR or more) is possible. The quality of butt fusion joints made between pipes of unlike wall thickness is highly dependent on the performance properties of the polyethylene compound used for the pipes or fittings being joined. Consult the pipe or fitting manufacturer for applicable butt fusion procedures for components with dissimilar wall thicknesses.

X1.5 *Butt Fusion of Coiled Pipe*—Coiled pipe is available in sizes up to 6 in. IPS. Coiling may leave a set in some pipe sizes that must be addressed in the preparation of the butt fusion process. There are several ways to address this situation:

X1.5.1 Straighten and re-round coiled pipe before the butt fusion process. (Specification D2513 requires field re-rounding of coiled pipe before joining pipe sizes larger than 3 in. IPS.)

X1.5.2 If there is still a curvature present, install the pipe ends in the machine in an "S" configuration with the print lines approximately 180° apart in order to help gain proper alignment and help produce a straight joint. See Fig. X2.15.

X1.5.3 If there is still a curvature present, another option would be to install a straight piece of pipe between the two coiled pipes.

X1.6 *Butt Fusion of Pipe with "Toe-In" on the End of the Pipe*:

"Toe-In" is a slight reduction in diameter at the end from pipe extrusion. When [illegible] segments, the toe-in is normally about the same and therefore the alignment is easily attained. When one end of the pipe is field cut, toe-in is temporarily removed which can affect high-low alignment when butt fusing to a pipe that has not been field cut. Trimming up to 2 in. off the end of the pipe that has not been field cut will usually correct difficulties with high-low alignment. This condition may also occur when joining pipe to molded fittings. In this circumstance as well, trimming up to 2 in. from the pipe end will usually correct difficulties with high-low alignment. For pipe that has been trimmed, toe-in will reoccur after several hours.

X1.7 *Contamination of Pipe before Fusion*—Introduction of contamination to the pipe can happen in a number of ways and should be avoided by following the precautions listed below:

X1.7.1 Before installing the pipe in the fusion machine, clean the OD, ID and ends with a clean, dry, lint-free, non-synthetic cloth such as cotton. If the contamination cannot be removed this way, wash the pipe with water and a clean cloth or paper towel to remove the contamination, rinse the pipe with water and dry thoroughly with a clean, dry, lint-free, non-synthetic cloth such as cotton or paper towel. If contamination, such as bar oil, was transferred to the pipe ends after cutting, use 90 % or greater isopropyl alcohol or acetone on a clean cloth or isopropyl alcohol wipes on the ends of the pipe to clean the contamination, then rinse with water and dry thoroughly on the pipe ends, ID and OD. It is important that

ASTM F2620

States:-

"If possible, use a datalogging device with hydraulic joining equipment to record the critical fusion parameters of pressure, temperature and time for each joint."

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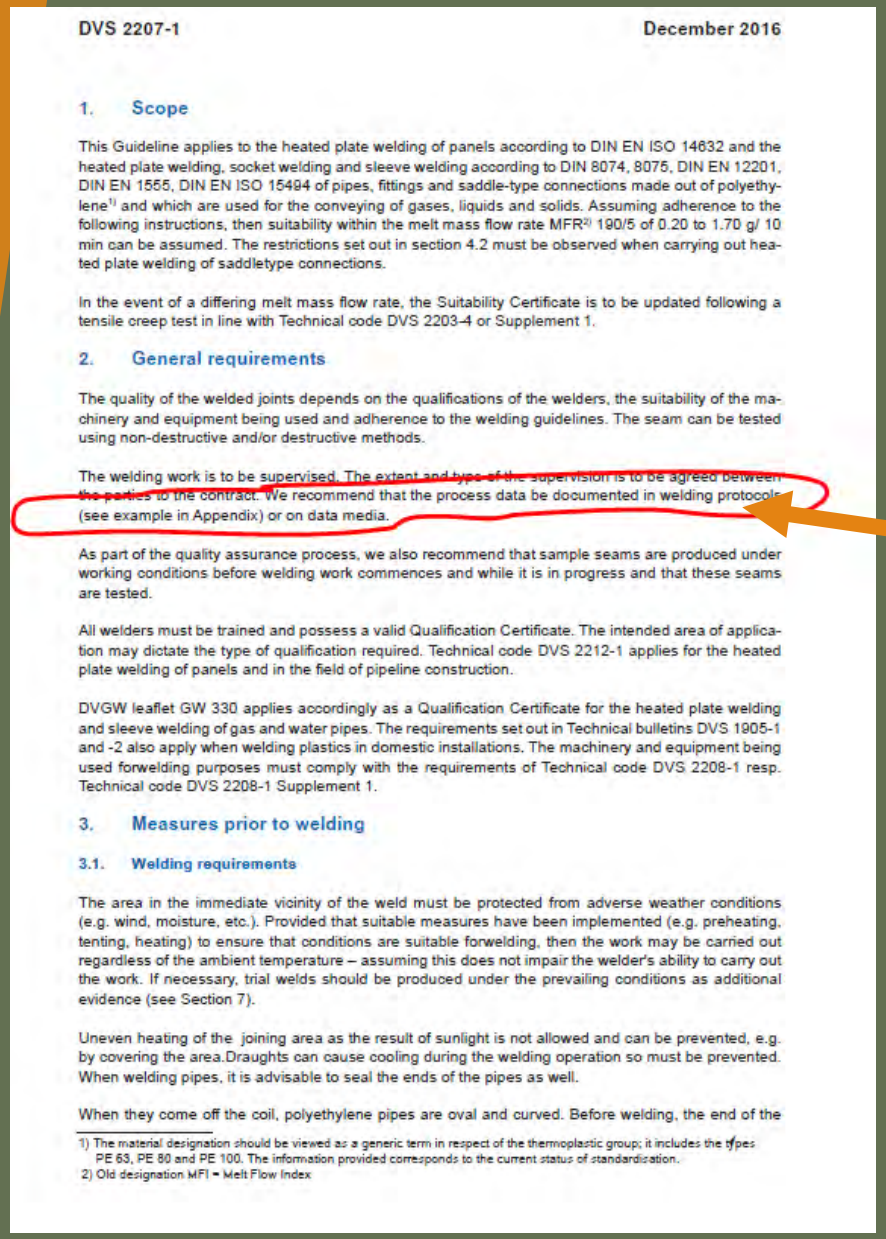

DVS 2207-1 December 2016

1. Scope

This Guideline applies to the heated plate welding of panels according to DIN EN ISO 14632 and the heated plate welding, socket welding and sleeve welding according to DIN 8074, 8075, DIN EN 12201, DIN EN 1555, DIN EN ISO 15494 of pipes, fittings and saddle-type connections made out of polyethylene[1] and which are used for the conveying of gases, liquids and solids. Assuming adherence to the following instructions, then suitability within the melt mass flow rate MFR[2] 190/5 of 0.20 to 1.70 g/ 10 min can be assumed. The restrictions set out in section 4.2 must be observed when carrying out heated plate welding of saddletype connections.

In the event of a differing melt mass flow rate, the Suitability Certificate is to be updated following a tensile creep test in line with Technical code DVS 2203-4 or Supplement 1.

2. General requirements

The quality of the welded joints depends on the qualifications of the welders, the suitability of the machinery and equipment being used and adherence to the welding guidelines. The seam can be tested using non-destructive and/or destructive methods.

The welding work is to be supervised. The extent and type of the supervision is to be agreed between the parties to the contract. We recommend that the process data be documented in welding protocols (see example in Appendix) or on data media.

As part of the quality assurance process, we also recommend that sample seams are produced under working conditions before welding work commences and while it is in progress and that these seams are tested.

All welders must be trained and possess a valid Qualification Certificate. The intended area of application may dictate the type of qualification required. Technical code DVS 2212-1 applies for the heated plate welding of panels and in the field of pipeline construction.

DVGW leaflet GW 330 applies accordingly as a Qualification Certificate for the heated plate welding and sleeve welding of gas and water pipes. The requirements set out in Technical bulletins DVS 1905-1 and -2 also apply when welding plastics in domestic installations. The machinery and equipment being used forwelding purposes must comply with the requirements of Technical code DVS 2208-1 resp. Technical code DVS 2208-1 Supplement 1.

3. Measures prior to welding

3.1. Welding requirements

The area in the immediate vicinity of the weld must be protected from adverse weather conditions (e.g. wind, moisture, etc.). Provided that suitable measures have been implemented (e.g. preheating, tenting, heating) to ensure that conditions are suitable forwelding, then the work may be carried out regardless of the ambient temperature – assuming this does not impair the welder's ability to carry out the work. If necessary, trial welds should be produced under the prevailing conditions as additional evidence (see Section 7).

Uneven heating of the joining area as the result of sunlight is not allowed and can be prevented, e.g. by covering the area.Draughts can cause cooling during the welding operation so must be prevented. When welding pipes, it is advisable to seal the ends of the pipes as well.

When they come off the coil, polyethylene pipes are oval and curved. Before welding, the end of the

1) The material designation should be viewed as a generic term in respect of the thermoplastic group; it includes the types PE 63, PE 80 and PE 100. The information provided corresponds to the current status of standardisation.
2) Old designation MFI = Melt Flow Index

DVS 2203

States:-

"We recommend that the process data be documented in welding protocols or on data media"

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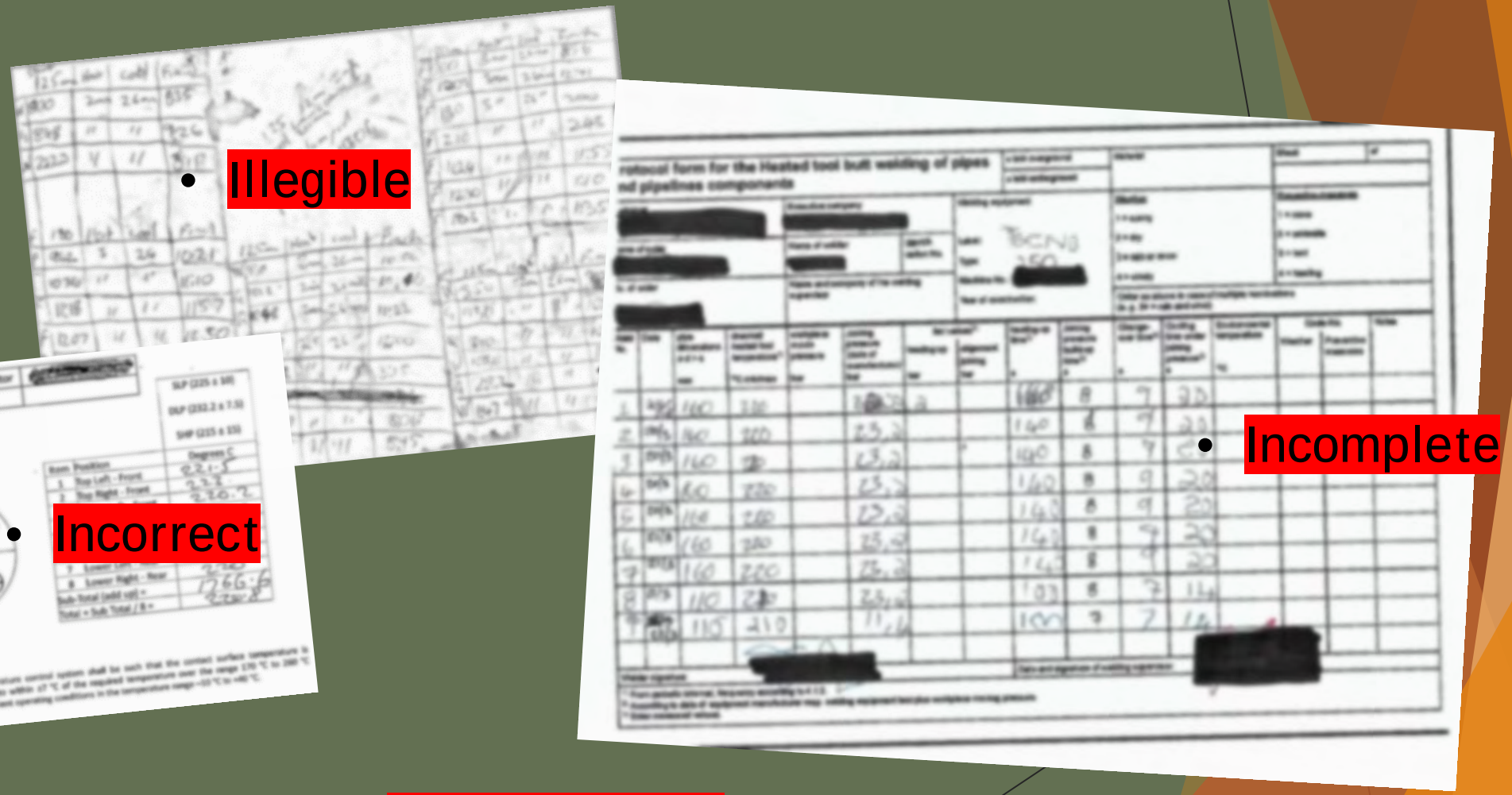
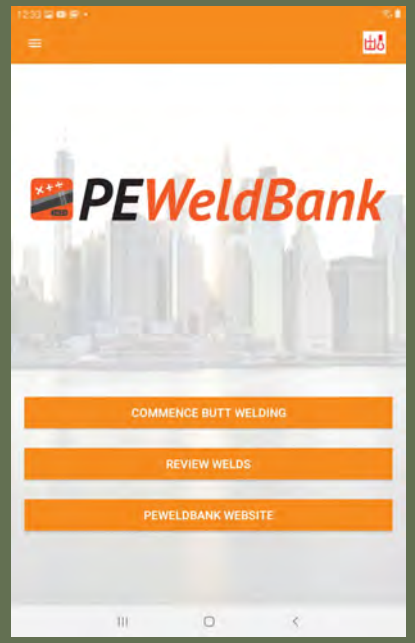
Data Recording



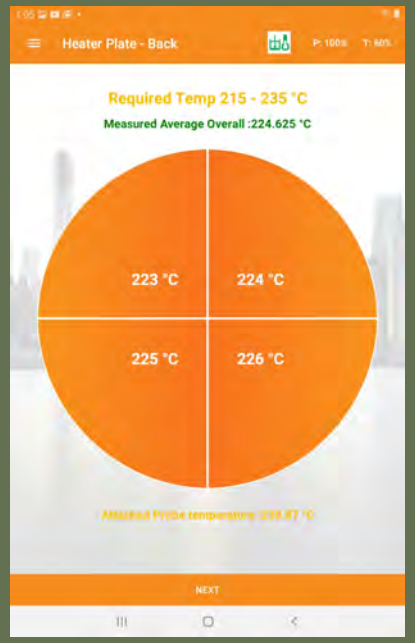
- Illegible
- Incorrect
- Incomplete
- Or just missing

Electronic Data Recorders pick up all the pre weld information

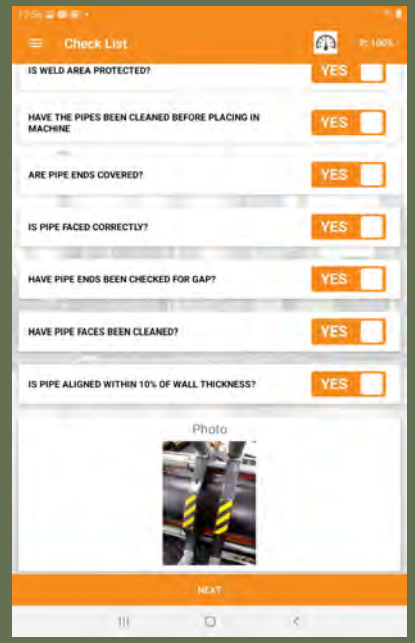


Home screen

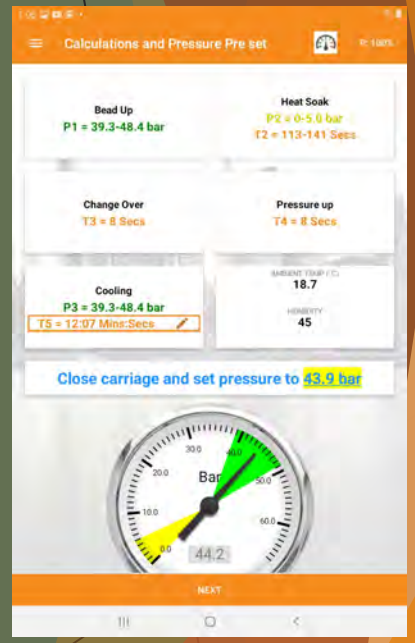
OH&S Checklist



Check heater plate Temperature



Check list



Preset confirmation

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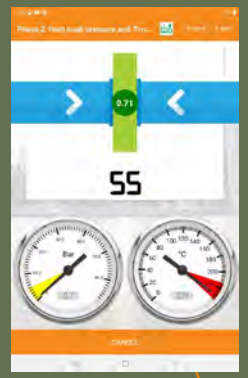
Drop pressure for heat soak

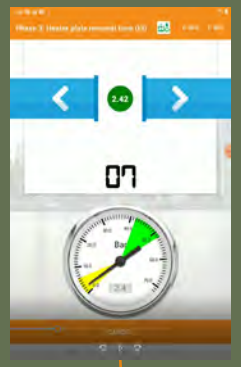
Remove Heater plate

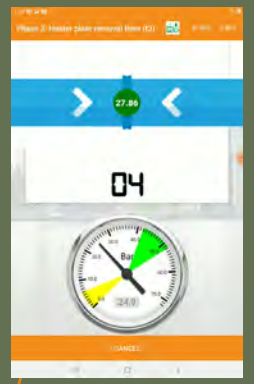
Bring pipe together

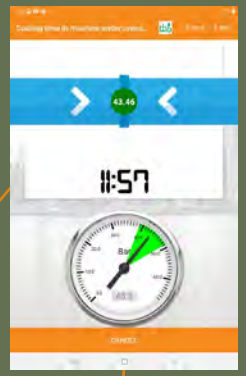
Maintain pressure

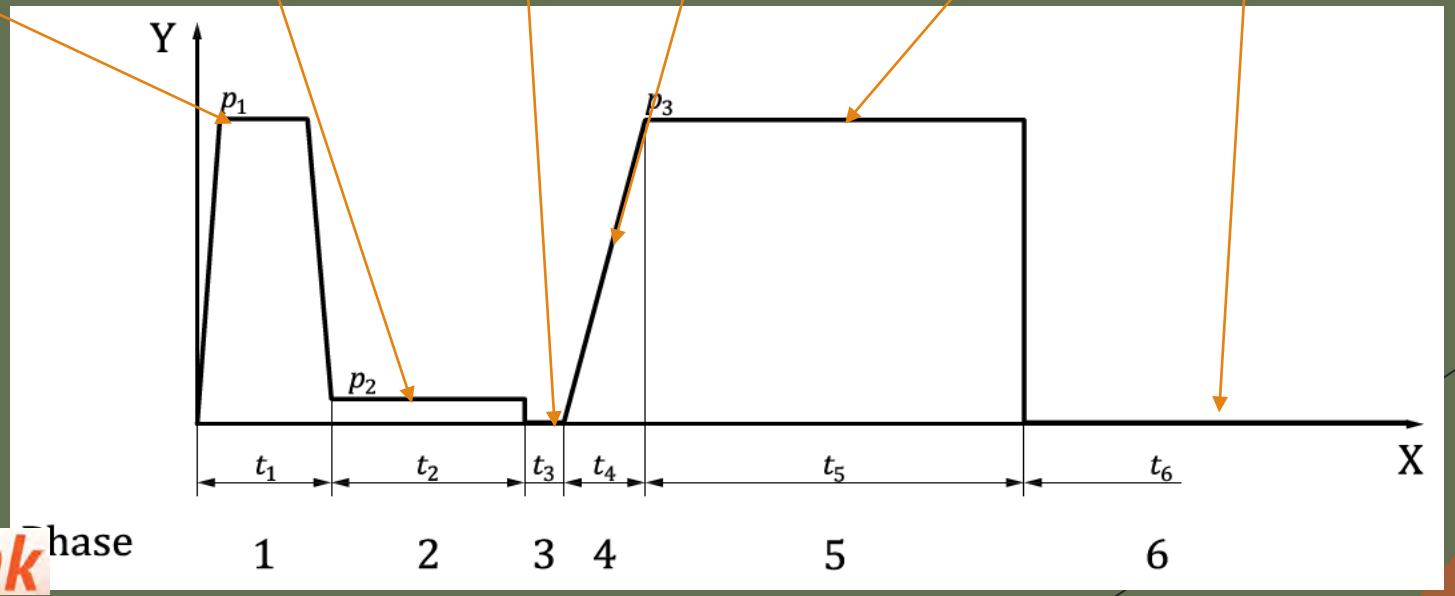
Insert heater plate











Post weld information

Unique weld ID

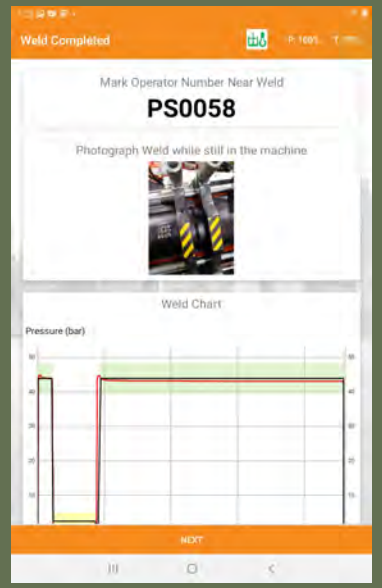
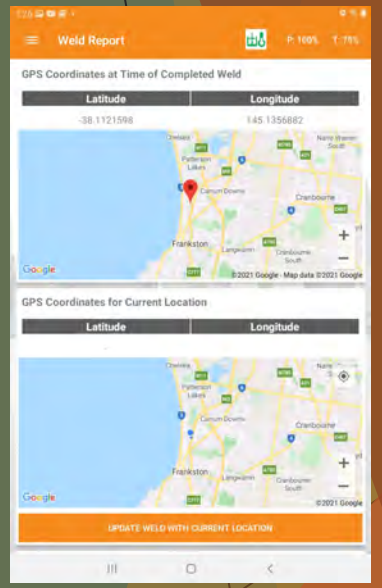


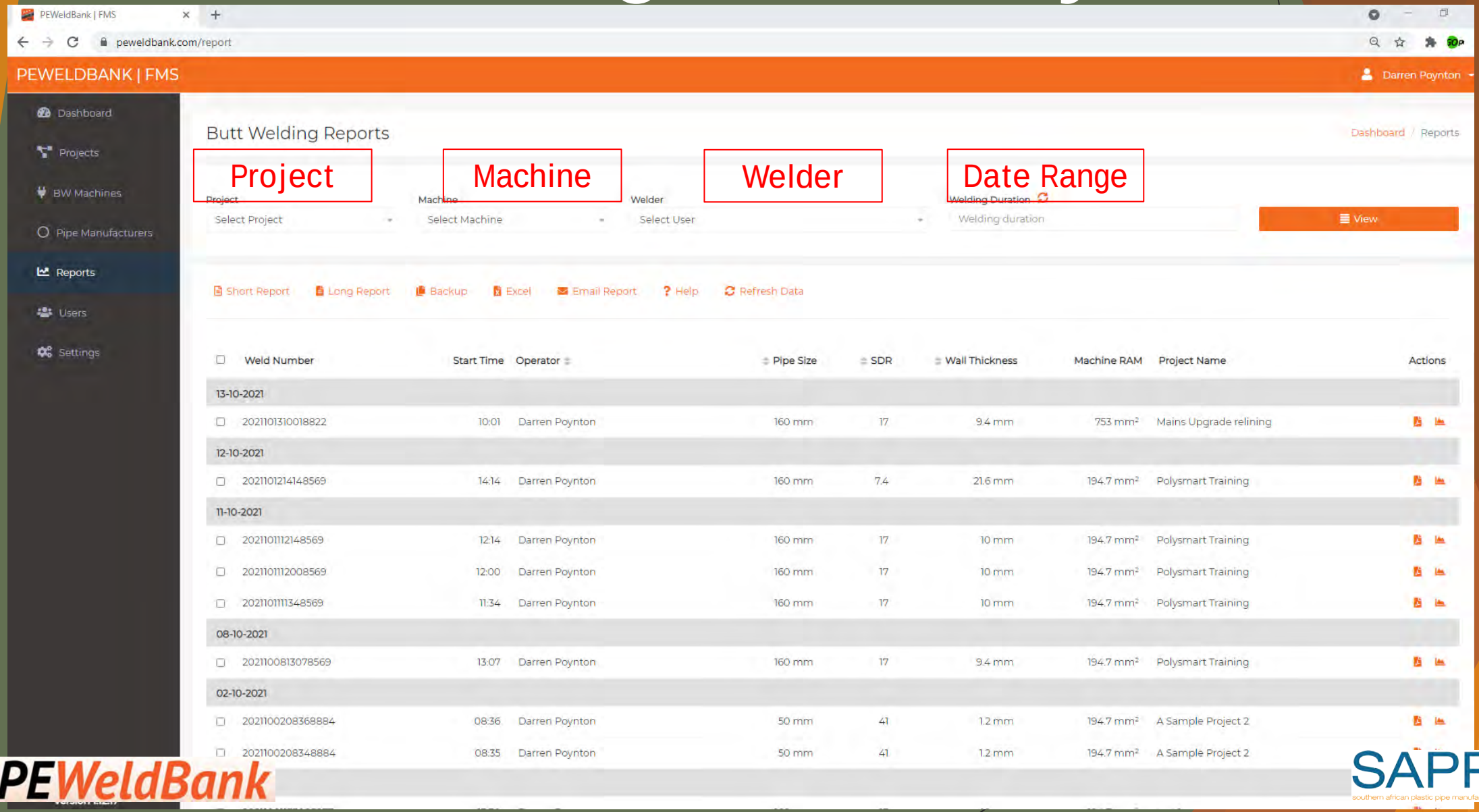
Photo of completed weld and review

GPS Location
Comments
Sketch
Signature



Repositioned GPS Location

Fusion Management System



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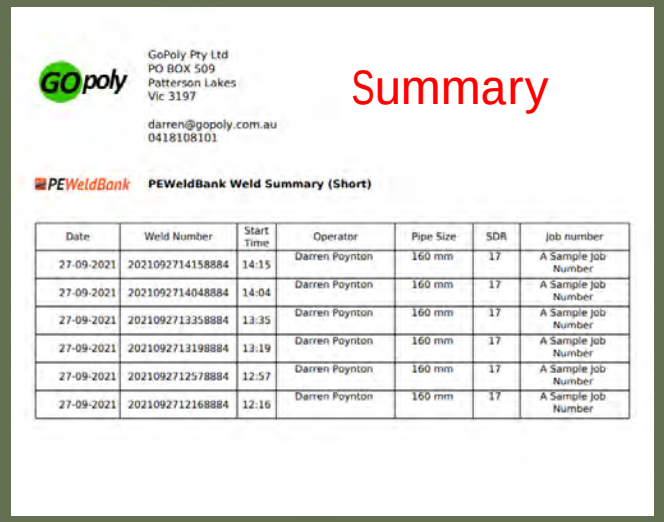
Electronic Weld Data Reports



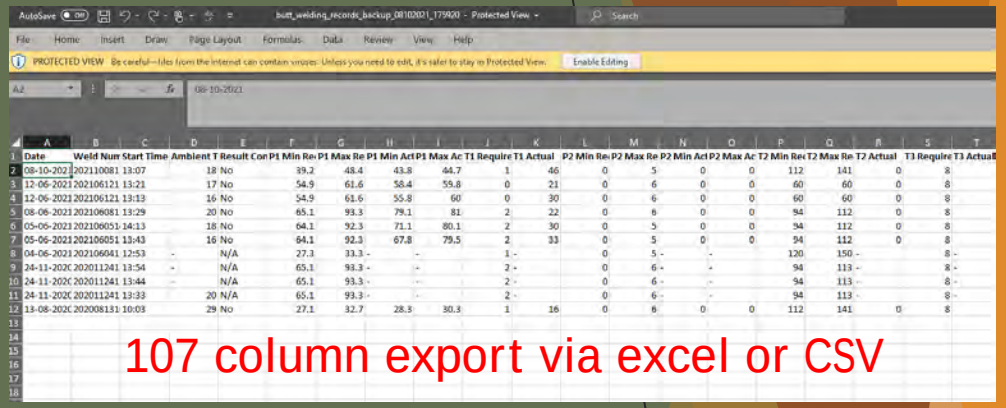
GoPoly Pty Ltd
PO BOX 509
Patterson Lakes
Vic 3197

darren@gopoly.com.au
0418108101

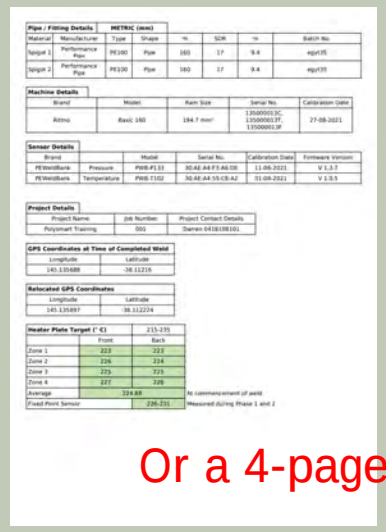
Summary

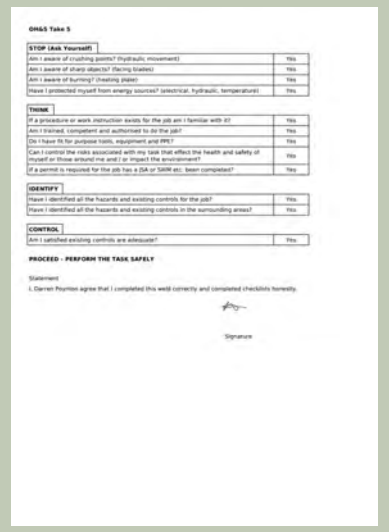
PEWeldBank PEWeldBank Weld Summary (Short)

Date	Weld Number	Start Time	Operator	Pipe Size	SDR	Job number
27-09-2021	2021092714158884	14:15	Darren Poynton	160 mm	17	A Sample Job Number
27-09-2021	2021092714048884	14:04	Darren Poynton	160 mm	17	A Sample Job Number
27-09-2021	2021092713358884	13:35	Darren Poynton	160 mm	17	A Sample Job Number
27-09-2021	2021092713198884	13:19	Darren Poynton	160 mm	17	A Sample Job Number
27-09-2021	2021092712578884	12:57	Darren Poynton	160 mm	17	A Sample Job Number
27-09-2021	2021092712168884	12:16	Darren Poynton	160 mm	17	A Sample Job Number



107 column export via excel or CSV





Or a 4-page report per weld

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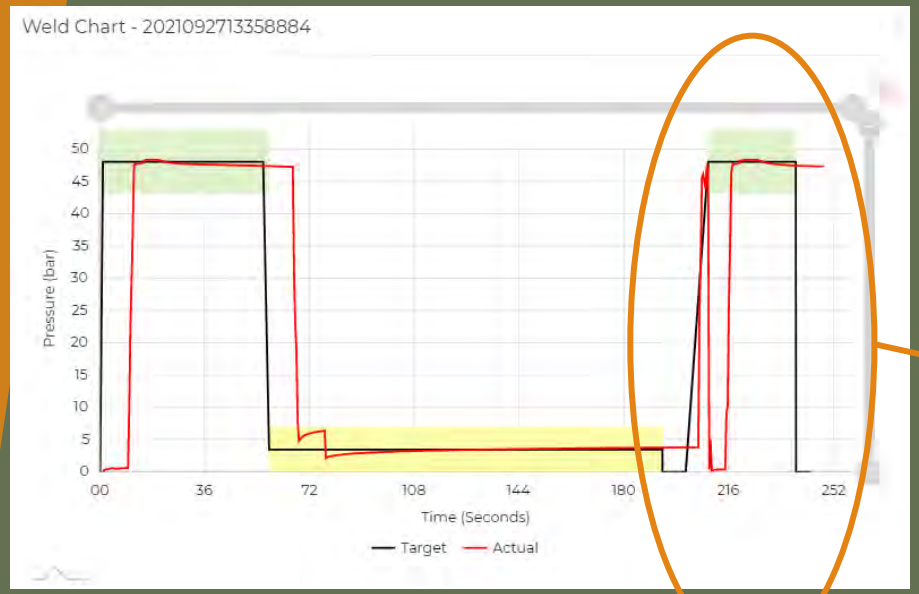
Zoom in to evaluate welds



This report shows where an operator applied pressure before removal of the heater plate, many operators do not report this fault, and this is likely to cause joint failure at a later date.

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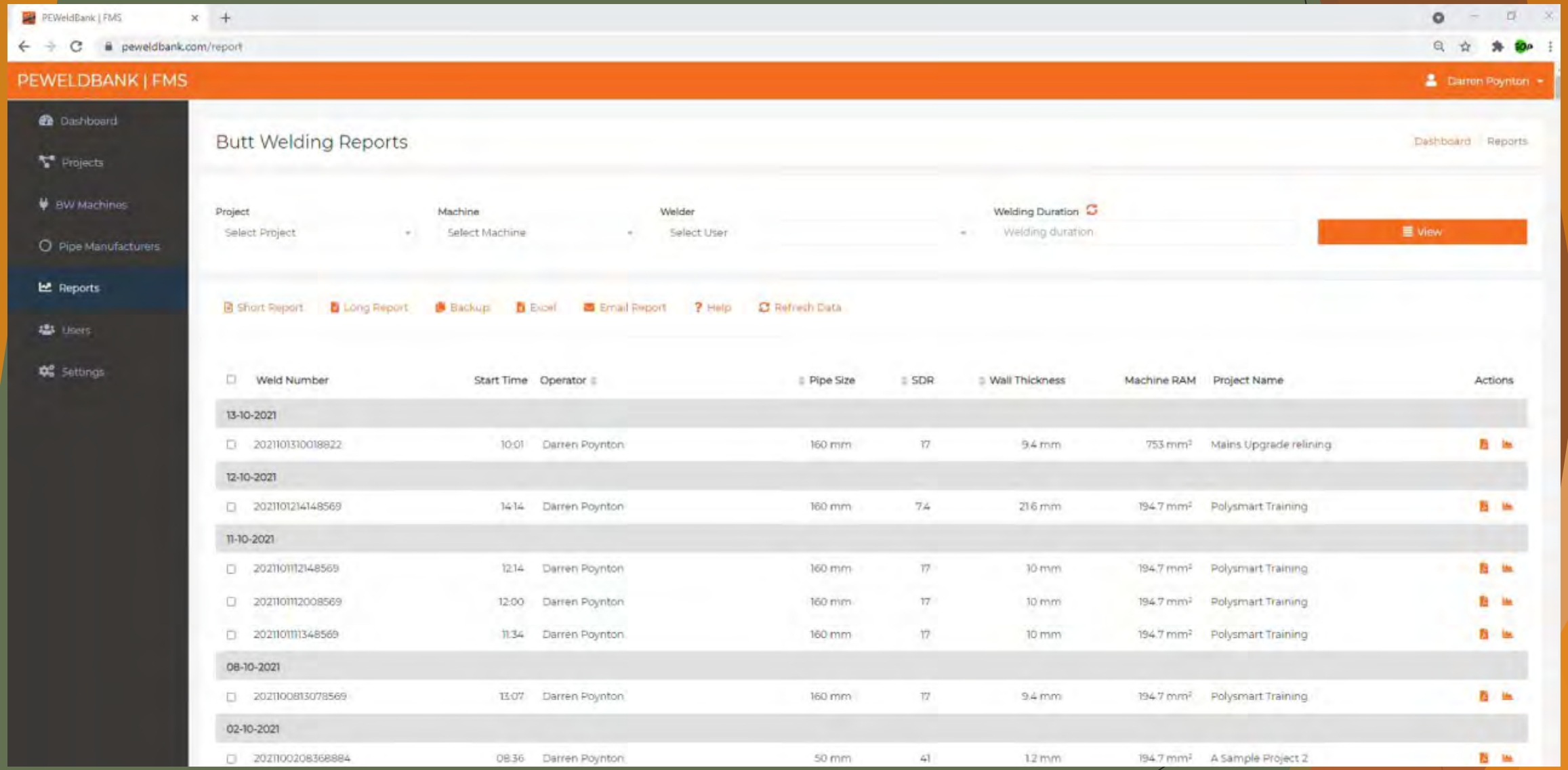
Zoom in to evaluate welds



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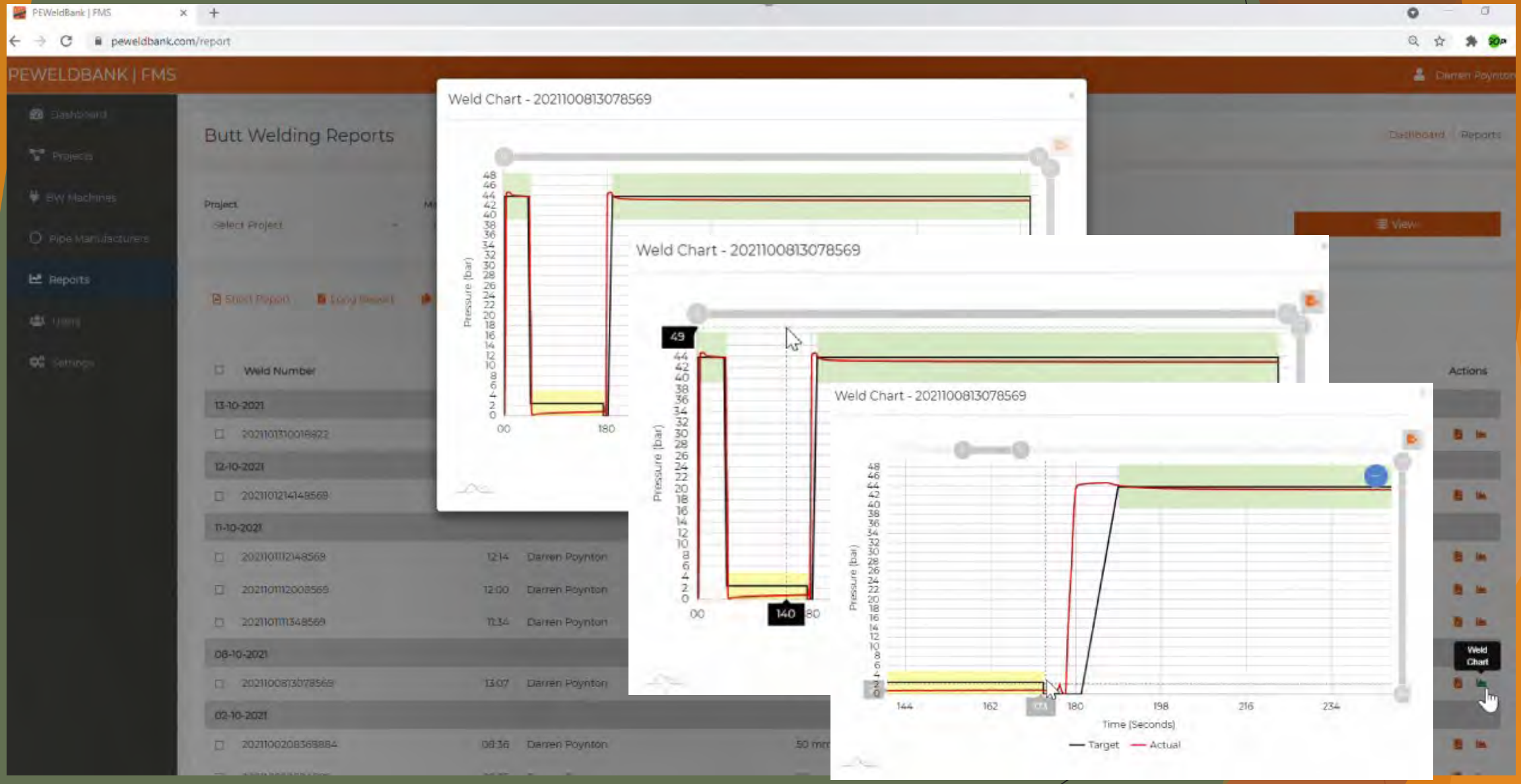
Zoom in to evaluate welds



Live and Accurate Recording

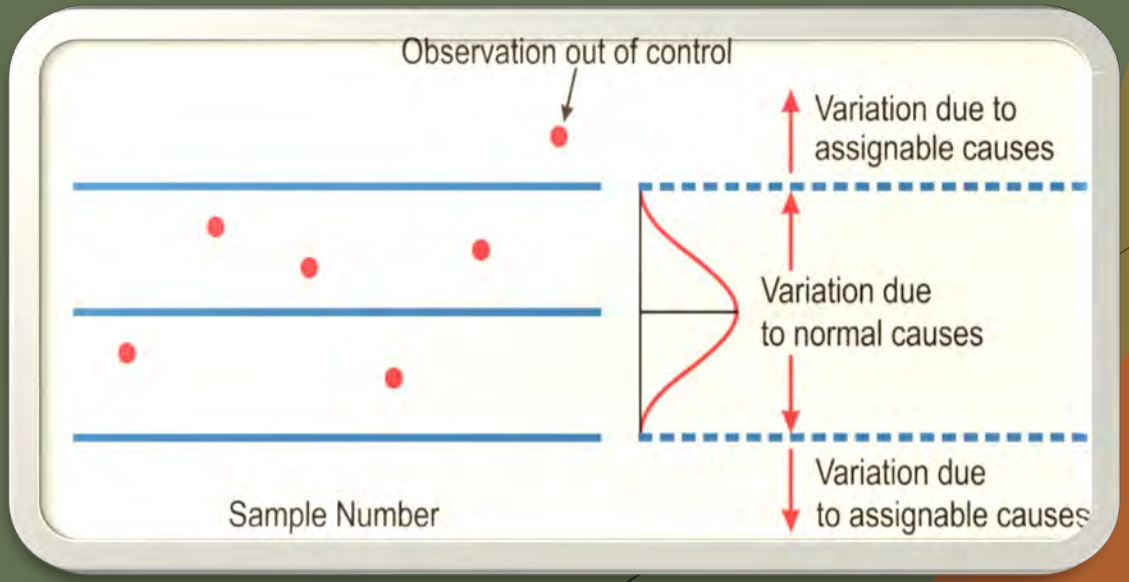
Possible Cause of Butt weld failure	Electronic Data Recording
Misalignment	Checklist & Photo
Contamination	Checklist & Photo
Too much pressure during heat soak time	Pressure monitoring
Poor contact of pipe to heater plate during heat soak time	Final Photo will show undersize bead
Heater plate too cold during Bead up and / or heat soak	Temperature monitoring
Heat soak time too short	Time monitoring
Change over / heater removal too long	Time monitoring
Pressure too high or low during cooling time	Pressure monitoring
Cooling time too short	Pressure / time monitoring

Live and Accurate Recording

Possible Cause of Electrofusion failure	Electronic Data Recording
Misalignment	Checklist & Photo
Contamination	Checklist
Poor Peeling	Checklist & Photo
Poor insertion	Checklist & Photo
Pipe ovality	Checklist
Pipe undersized or cut on angle	Checklist
Incorrect welding time	Time monitoring
Cooling time too short in clamps	Time monitoring & Photo

Advantages of using a Data recording system

- Better quality welding
- Remote supervision
- Less pipeline failures
- Less ongoing maintenance
- Easy storage and retrieval of weld data
- All your records in one location
- OH&S information recorded
- Adaptable to any butt welder



Summary

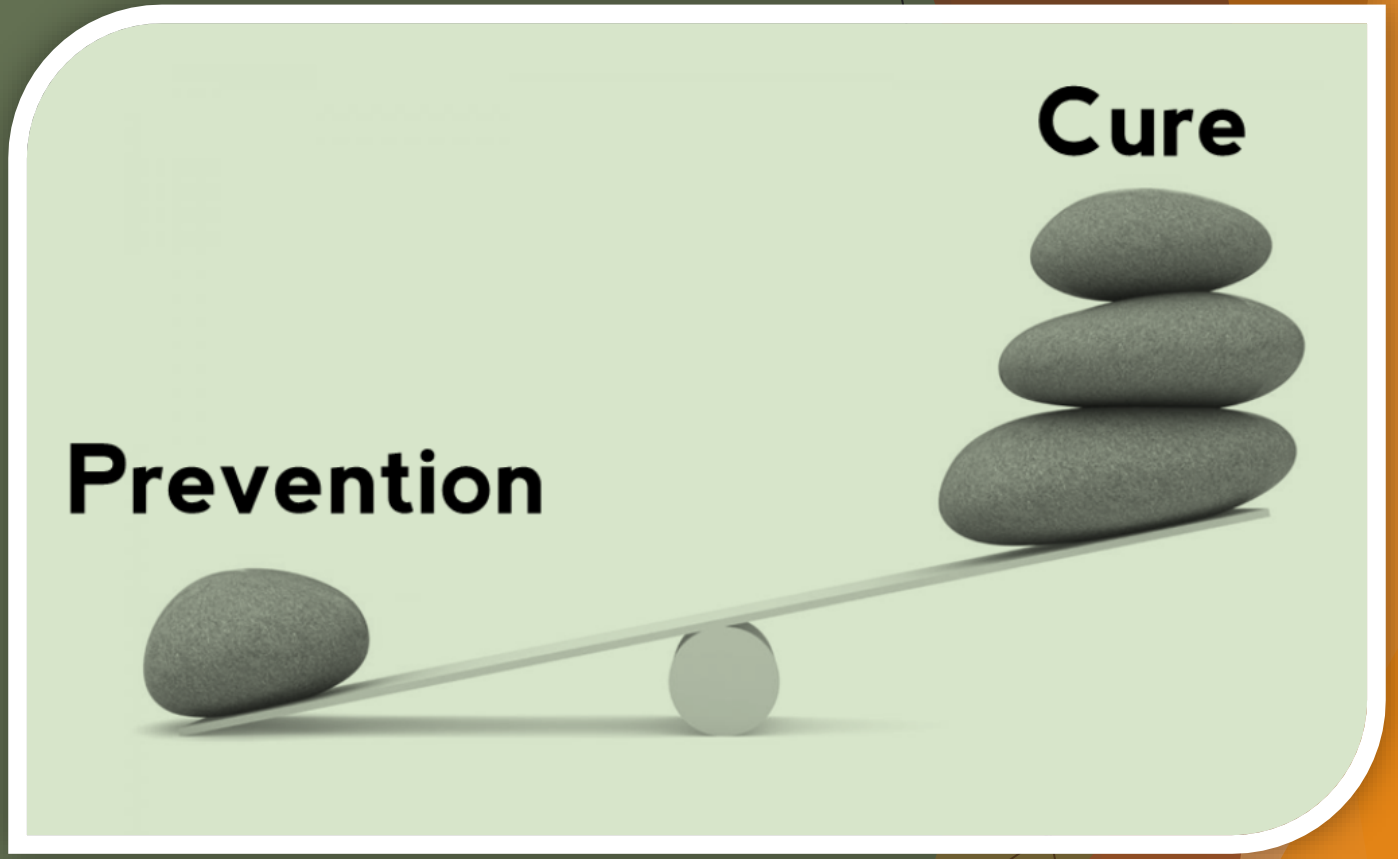
- HDPE Pipe goes through batch testing and quality control to meet the highest quality standards before it is released.
- Every pipe and injection molded fitting has quality data sheets available

- Why don't we insist on the same for the pipe welds?
- A weld done correctly will have the same reliability as the pipe
- A weld done poorly will be your weakest link in the project

- By evaluating the weld data before the pipeline is installed and buried you can make an informed decision about the quality of the weld and take preventative action before you have a serious issue to contend with.

Thank you,

Questions?



I can be contacted by email for further questions
info@peweldbank.com

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Questions and Answers

PEWeldBank

Darren Poynton

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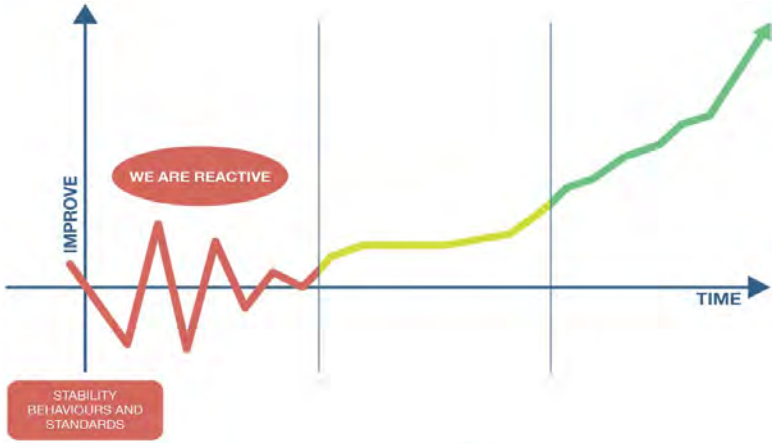
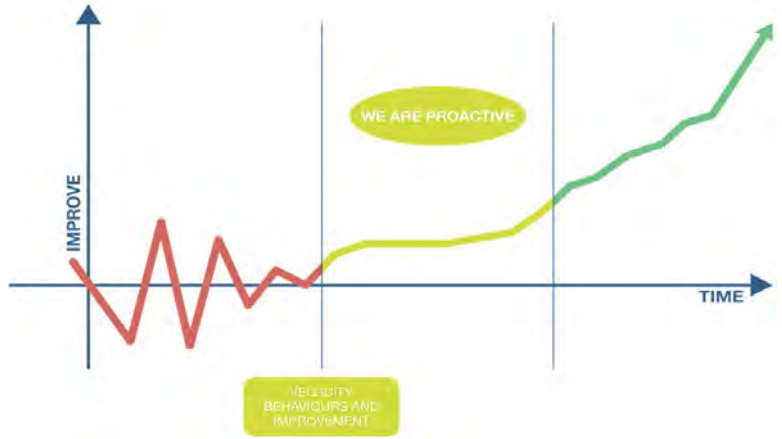
It brings Together

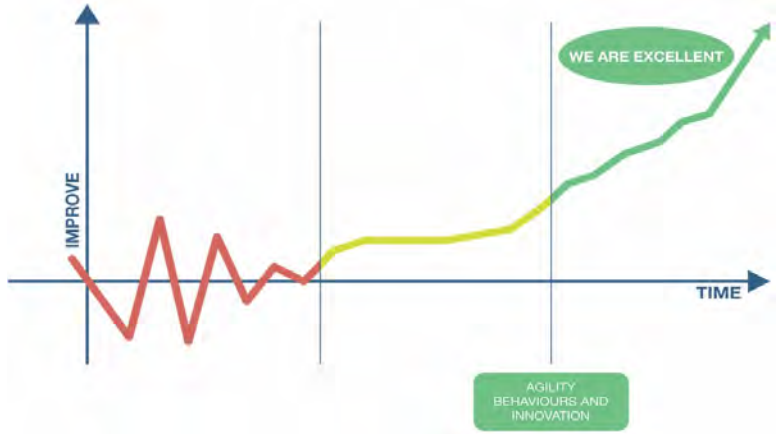
Local Needs

International Support

Satisfied End users







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Let us move together

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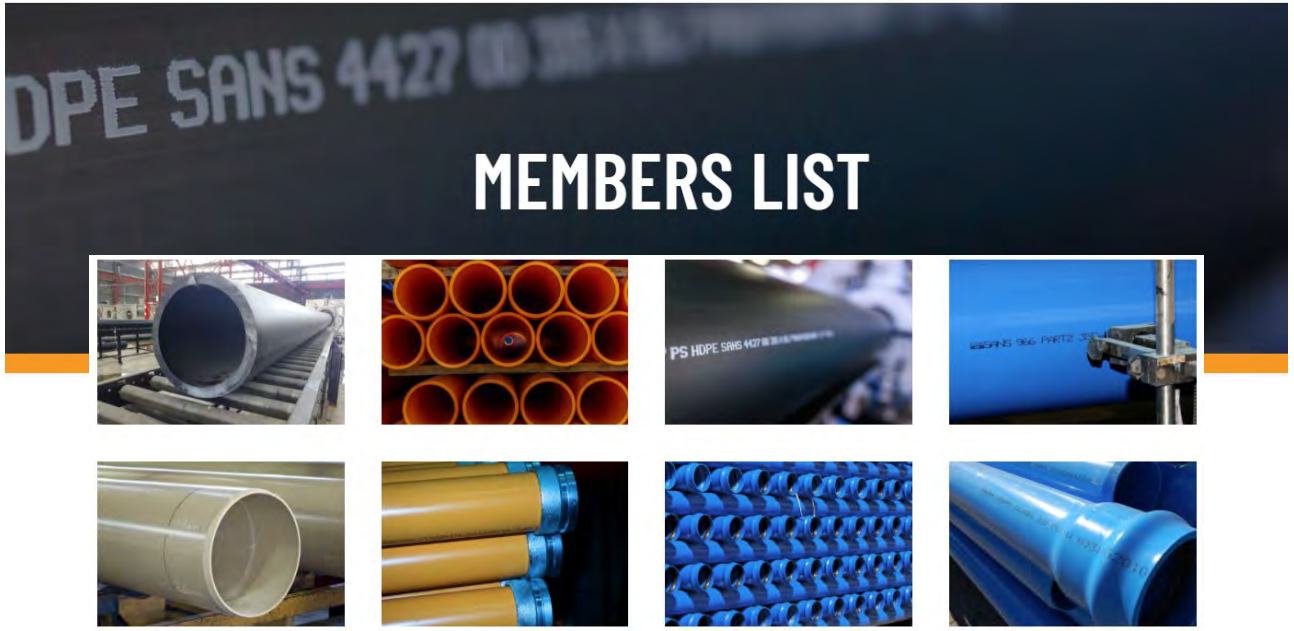

PIPE MANUFACTURERS | POLYMER MANUFACTURERS | SUPPLIERS

CERTIFICATION BODIES | SPECIALISED MANUFACTURERS | INDIVIDUAL MEMBERS

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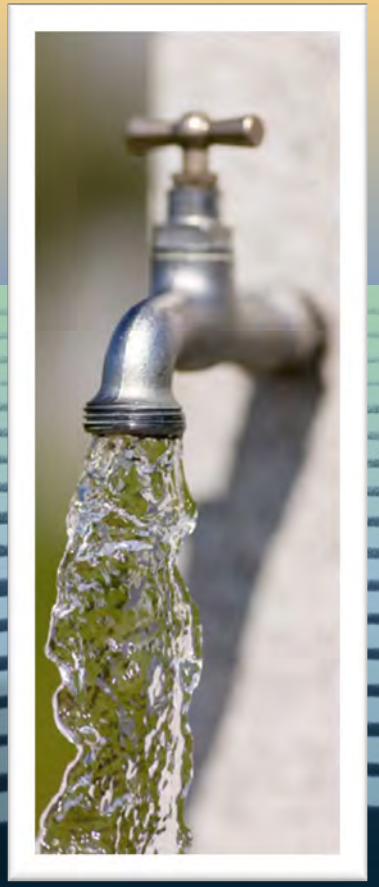
"Someone's sitting in the shade today because someone planted a tree a long time ago."

Warren Buffett



IFPA
Installation and Fabrication Plastics Pipe Association

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Questions and Answers

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admin@sappma.co.za