

**IBC Onshore Pipeline Engineering
Training Course
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**Onshore pipeline welding
and welding control**



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Content

- Site practice - an introduction
- Manual welding - Shielded Metal Arc Welding - (SMAW)
- Welding procedures
- Gas metal arc welding - GMAW

The welding spread

Separate welding stations

- **Front end crew:**
 - Pipe facing
 - Preheating
 - Alignment with internal clamp
 - Root pass
 - Lowering onto support
 - Hot pass
- **Back end crew**
 - Fill to complete
 - Inspection
 - Repair if necessary



Courtesy of Punj Lloyd

Followed by

- Lowering
- Backfill
- Ground restoration

Preparing to fit-up

Note

- Pipeline string
- Alignment clamp
- Joint being moved into position
- Welding shelter ready to be lowered.



Courtesy of Punj Lloyd

Tie-in welds

- Joining separate lengths of line
e.g. River, road and rail crossings to main line

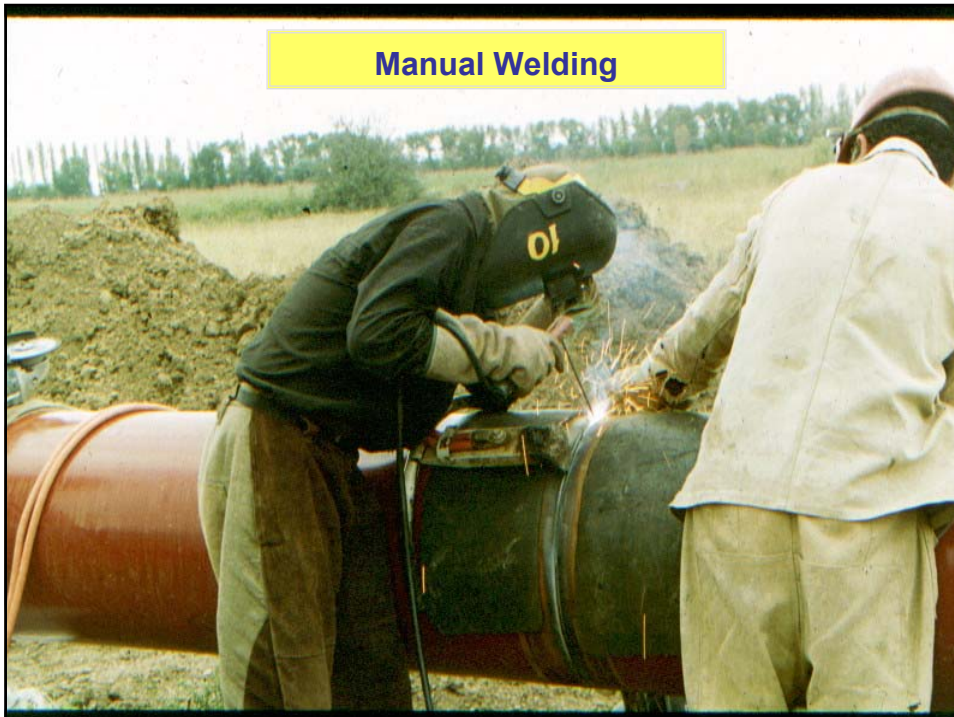


- Carried out in the trench
- Lines aligned next to each other
 - Cut to length
 - Supported
- Aligned with external clamp
- Welded – manual welding.



Courtesy of Punj Lloyd

Manual Welding

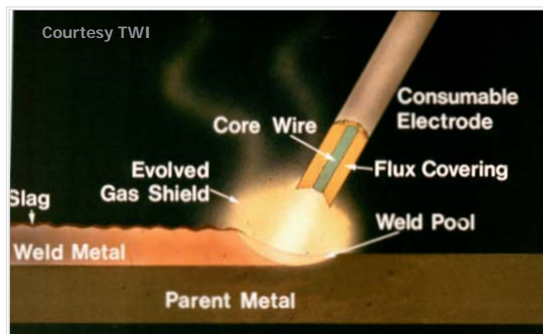


Manual Welding Technique

Most cross country pipelines are welded working from top to bottom –

- The 'stove-pipe' technique
- High welding and fast travel speeds
- Several small beads
- Fast and economical process
- It uses cellulosic coated welding electrodes.
- The first pass is called the root pass
- It requires the most welder skill
- Deposited using stringer bead (no weaving)
- Made using a drag technique - the electrode rest on the bevel and the electrode is dragged downhill around the circumference
- Welding current is set to give a small visible key hole which has to be controlled in size to avoid defects in final weld.
- 2 welders (or more on large diameter pipe) work on opposite sides of the pipe to balance the welding

Equipment



Preparation

Weld preparations may be cut in the field
- this is done by a portable end-facing machine



Line up clamps are used to align the two pipe joints, to hold the pipe in place, maintain root gap and to reduce high-low (mismatch between the pipes). They are obligatory on all pipe over 16inch diameter



Weld defects

Insufficient gap or low welding current can result in:-

- Lack of penetration at the root
- Lack of fusion to the base metal.

Excessive gap or high current can cause:-

- Burn through and globular deposit (grapes) on the inside of the pipe
- Undercut (frequently visible on the x-ray as 'wagon tracks').

API 1104 (Standard for welding pipelines and related facilities) is frequently taken as the applicable Code of Practice.

- X-ray
- Tensile test
- Nick break test
- Root bends
- Face bends
- Side bends

DOC NO:

- The welding process(es)
- Material grades, thicknesses, and configuration
- Weld preparation design and acceptable tolerances
- Preheat to be applied
- Shielding gas mixture and flow rate (where appropriate)
- Welding consumables
- Sizes of wire for each group of passes, (root, hot pass, fill and cap)
- Electrical polarity and range of amps and volts
- Welding position and direction
- Speed of Travel
- Time between passes (where critical e.g. pipelines)
- Use of lineup clamp (where used)
- Cleaning and/or grinding methods and extent
- Post weld heat treatment (where applied)



The welding procedure qualification record (WPQR)

This comprises:-

- The record of each weld run completed
- The non-destructive testing report(s)
- The mechanical test reports
- A macro-section
- Corrosion test reports (where applicable).

Each document includes the signatures of those responsible for the procedure and the witnesses - for example the regulatory body.

The complete document is to be approved prior to the start of production welding.



The move to automatic processes

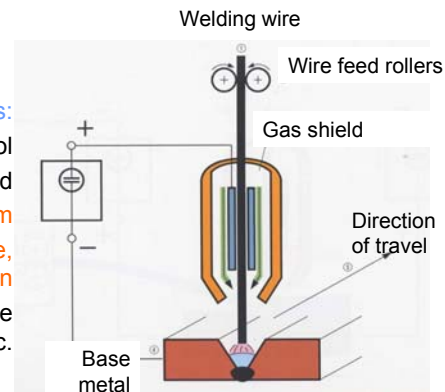
- Cost reduction
- Higher strength of linepipe
- Increasingly severe toughness requirements
- Increasing use of heavy wall pipe
- More severe working environments
- Shortage of skilled pipeline welders
- Increasing use of clad or alloy flowline materials.

Gas Metal Arc Welding (GMAW)

Features:

- Continuous welding wire on spool
 - External gas shield
- Gases used may be inert: **argon, helium**
 - Active gases used: **carbon dioxide, nitrogen**
- Gas or gas mixture selected has vital role in the behaviour of the arc.

Also known as Metal Inert Gas (MIG) welding or Metal Active Gas (MAG)



Picture copyright Krupp VDM

Mechanised GMAW – the features

- State-of-the-art
- High productivity
 - High efficiency
 - Low repair rate
- New developments to boost productivity.

Systems for onshore pipeline welding

- CRC-Evans
- Serimax
- Vermaat
- PWT CWS system
- Autoweld



Mechanised GMAW welding spread



Summary

- Onshore pipeline welding is done using a welding spread, with separate tie-in crews
- Manual welding using cellulosic electrodes is still an important process
- Automated gas metal arc welding is becoming increasingly common for onshore pipeline welding
- Welding is done to Codes of practice and is highly controlled on site
- Advanced versions of GMAW have been developed for increased productivity

THE END

