



Distributor



the good guide to
butt fusion & electrofusion jointing



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A Good Guide to Butt Fusion Jointing



This guide will provide basic information to enable the operative to:

- 1 Understand the principles of PE butt fusion jointing.
- 2 Identify pipe and appropriate fitting markings.
- 3 Site the equipment.
- 4 Carry out pre-jointing machine and equipment checks.
- 5 Make satisfactory butt fusion joints across a range of pipe sizes.
- 6 Inspect for, and identify acceptable quality joints, including de-beading.

Safety Notice

To ensure operator safety and comply with Health and Safety regulations all butt fusion machines must be operated from an effectively earthed supply in accordance with manufacturers operating instructions.

Equipment

- Generator of suitable size to power butt fusion machine - refer to manufacturer's literature for power requirements.
- Butt fusion machine of suitable size and liners (if required)
- Pipe support rollers.
- Welding tent/shelter and ground sheet.
- Bead gauge.
- External/internal de-beading tool.
- Pipe end covers.
- Pipe cutter.
- Indelible marker pen for marking beads.

The butt fusion machine featured is the Gator 250. The principles outlined in the guide are applicable to all butt fusion machines manufactured by Fusion Provida.

Principles

The pipes to be joined are held in clamps which grip and re-round the pipe. Clamps are hydraulically operated by hand pumps or electrically driven pumps. Clamp movement is controlled by the operator in the case of manual/semi-automatic machines; in automatic machines the computer controls clamp movement during the automatic cycle.

Pipe ends are prepared by planing with an electrically driven trimmer, then heated using an electrically powered non-stick heater plate. When molten, the pipe ends are brought together and held under pressure until cooled.

Pipe Selection ID.

Check that both pipes to be joined are of the same size, SDR (standard dimension ratio) and material. Only compatible sizes and materials should be joined together. If in doubt, seek advice from the pipe manufacturer. Pipe information is marked on the pipe at approximately one metre intervals.

Siting Equipment

The butt fusion machine should be placed on a suitable clean, dry base board or ground sheet inside a tent/shelter to minimise contamination and wind chill.

Pre-jointing Checks

Use only equipment which has been regularly serviced and is in good condition. Ensure the correct jointing parameters for the machine and pipe being welded are known and understood. Ensure that the generator has sufficient fuel for the work to be done. Check that the heater plate is clean - wash only when cold with clean water and dry with a clean lint-free cloth or paper towel.

Check that the trimmer is clean and that the blades are not damaged and are in good condition. Ensure clamp liners and securing screws of the correct size are available for the size of pipe to be joined. Liners must be clean and sit fully in the pipe clamps thus ensuring correct alignment. Check that the heater plate is at the correct temperature. Ensure correct parameters are selected for pipe to be joined.



Dummy Weld

To make dummy welds follow the jointing procedures and abort the cycle after the full soak time has elapsed then open the machine and remove the heater. The first print out should read: 'Error 20: Abort during Fusion.' Alternatively, allow the joint to complete and cut out the joint(s) once cooled.

A Good Guide to Butt Fusion Jointing

Making The Joint

AUTOMATIC WELDING PROCEDURE:

The welding procedure detailed below has been summarised from Fusion's comprehensive operating instructions and is only intended as a guide. Always familiarise yourself fully with the manufacturers operating instructions, safety operation and controls before commencing work.

STOP/RESET BUTTON


In an emergency, the red "Stop/Reset" button, when pressed, will immediately stop all automatic cycles and set the machine "Safe" and return to the start of the cycle.

Dummy Welds should be made (to remove any fine particles from the heater plate) before every welding session, after changing from one pipe size to another and also if the heater has been allowed to cool.

CONNECTION AND PIPE SELECTION:

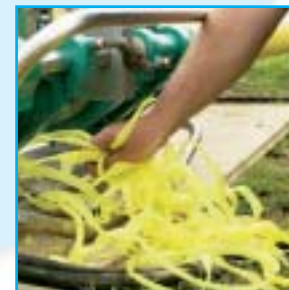
- 1 Connect heater, chassis and trimmer cables to the computer.
- 2 Ensure that hydraulic connections are clean, then connect to the controller.
- 3 Start the generator, then connect the computer to the generator.
- 4 Select the pipe size and type to be joined.
- 5 Confirm data.

PIPE PREPARATION:

- 1 Load and secure trimmer into machine using the fast clamp system. Push down knobs and turn clockwise to lock.
- 2 Place pipes to be joined on rollers to reduce drag.
- 3 Cover pipe ends to prevent draughts.
- 4 Clean pipes ends inside and out (approx. 300 mm) then load and position pipes lightly against trimmer discs. 
- 5 Position toggle lever into place and use adjustment knob (clockwise to tighten and anti-clockwise to loosen). Snap shut the fast clamps around pipe ends.



- 6 Press 'Tick' button on controller. Trimming will continue up to its programmed stop, but as soon as a running swarf strip of full pipe thickness is visible, the 'feathering off' phase can be initiated by pressing the 'Tick' button again. Without operator intervention, the machine will automatically enter the 'feathering off' phase of the trimming cycle.
- 7 When trimming cycle is completed and carriage has opened, remove trimmer and swarf. Be careful not to touch pipe ends.



DO NOT PULL SWARF UP THROUGH TRIMMED PIPE ENDS, AS THIS MAY CONTAMINATE THE PIPE FACES.

- 8 Press 'Tick' button to close carriage then visually check pipe alignment adjust clamps if required then re-check and re-trim if necessary. Only remove one toggle clamp at any one time.



- 9 Visually check pipe ends for completeness of trimming.



- 10 After the 'check' and prior to the 'join' phase, the pipe ends will be separated. If the process was started with a very low heater temperature, the pipes could potentially remain apart for up to 20 minutes. This could result in the pipe ends becoming contaminated and to reduce the likelihood of such contamination during this period, secure the heater onto the chassis and wait until the heater is at the correct temperature before pressing the "✓" key at the above prompt.

A Good Guide to

Butt Fusion Jointing

Making The Weld

- 1 Secure heater on welding machine chassis. Push down knob and turn clockwise to lock.



- 2 Press 'Tick' button on controller (this checks heater temperature).

- 3 Insert the heater into the chassis, push home until fully locked.



- 4 Press 'Tick' again. Fusion cycle will be carried out automatically. Display will give "relevant" information at all times.



- 5 When controller display shows 'JOINT COMPLETE', press 'Tick' button.

- 6 Remove heater, un-clamp pipe and remove carefully.

- 7 Allow pipe to cool properly (in accordance with specification) before installation.

Quality Checks

- Use bead gauge to check that bead width conforms to specification.



- Check visually for excessive irregularity in bead formation and pipe mismatch.
- Externally debead the weld.
- Visually check the underside of the removed bead for contamination, then bend back at several positions and inspect for slit defects.
- Check for cleanliness around joint area.



- Print out the data from the controller using Data Transfer, Data Printer or via the Data Transfer method utilising PC, Psion or PDA. Check the result and verify the details for correct compliance.
- Full 'Data Transfer' training is available through Utilise (see inside cover for details).



A Good Guide to Butt Fusion Jointing

Butt Fusion Do's

- Always weld inside a shelter and on a suitable base board or ground sheet.
- Check size, SDR and pipe material to ensure compatibility.
- Always ensure pipes are aligned correctly and supported on pipe rollers to minimise drag.
- Cover pipe ends to eliminate wind chill of the heater and joint interface.
- Clean pipe surfaces inside and out (approx. 300 mm), clean pipe ends and clamps before inserting pipe in machine.
- Always use equipment that has been regularly maintained and calibrated.
- Position pipes into the clamps with the pipe marking uppermost and aligned.
- Wash the heater plate when cold before every welding session and perform dummy welds when hot to remove fine particles. Carry out one dummy weld on pipe size 180mm or below, and two dummy welds on larger pipe sizes. The first print out should read: 'Error 20: Abort during Fusion.'
- Perform dummy welds after changing from one pipe size to another, also if the heater plate has been allowed to cool.
- Clean trimmer discs before use with lint-free cloth (see safety notes).
- Ensure that, when trimming, a continuous ribbon of material of pipe wall thickness is produced from both pipe ends before commencing the feathering operation.
- Replace the trimmer in the stand provided.
- Remove swarf from underneath pipe ends and chassis.
- Check visually that both pipe ends are completely trimmed.
- Always check pipes for alignment and gaps around the entire circumference of the abutted pipes.
- On completion of satisfactory alignment checks, proceed with the welding cycle without delay.
- Number/code the joint and bead using an indelible marker.

Butt Fusion Don'ts

- Attempt to use equipment unless trained to do so.
- Attempt to weld pipes of incompatible materials or SDR.
- Leave swarf inside pipe or on chassis.
- Introduce dirt onto trimmed pipe ends whilst removing swarf.
- Touch trimmed pipe or fitting ends.
- Remove pipes from machine before the cooling time has elapsed.
- Cut corners in any part of the welding cycle.
- Attempt to install pipe until fully cooled.

Safety Notice

Although we make every effort in the design of our equipment to ensure operator safety, it is worth bearing in mind the following precautions:

- Do not touch heater plate (except for cleaning).
- Never allow molten or semi-molten polyethylene to come into contact with the skin. In the event of such an occurrence it is recommended that cold water should be used to flush the affected area and expert medical advice sought.
- **DO NOT UNDER ANY CIRCUMSTANCES ATTEMPT TO PULL THE MATERIAL FROM THE SKIN AS THIS WILL INVARIABLY REMOVE THE SKIN AS WELL.**
- Avoid contact with the trimmer blades when cleaning discs and especially when in motion. These can be sharp and cause cuts to fingers etc.

- Do not attempt to operate the trimming device whilst out of the machine chassis or attempt to by-pass the safety switch.
- Keep fingers/hands away from the pipe ends, chassis, trimmers and heaters whilst operating the machine.
- Do not attempt to lift heavy equipment or long lengths of pipe without assistance or mechanical aid.
- An audible alarm is fitted to automatic butt fusion machines to warn of impending movement.

- Remove all traces of polymer from the heater face(s) to prevent the production of fumes from degraded residues (at normal jointing temperatures the production of fumes will be slight, however, these will be more pronounced at higher temperatures). Advice regarding Health & Safety in reference to the pipe material can be obtained from the pipe supplier.
- Normal precautions should be observed when handling electrical equipment and, for safety reasons, all 110v portable generator sets should be "Centre Tapped" for site use +55/0/-55 volts.
- To afford protection against unforeseen circumstances occurring during jointing, it is advisable to wear protective workwear such as gloves, safety glasses and safety boots.

A Good Guide to Electrofusion Jointing



This guide will provide basic information to enable the operative to:

- 1 Understand the principles of electrofusion jointing.
- 2 Identify pipe and compatible fittings.
- 3 Siting the equipment.
- 4 Carry out pre-jointing equipment checks.
- 5 Make satisfactory electrofusion joints from compatible pipes and fittings.
- 6 Inspect for, and identify acceptable quality joints.

Safety Notice

To ensure operator safety and comply with Health and Safety regulations all electrofusion control boxes must be operated from an effectively earthed supply in accordance with manufacturers operating instructions.

Equipment

- Generator of suitable size to power control box - refer to manufacturer's literature for power requirements.
- Electrofusion control box with appropriate leads.
- Restraining and alignment equipment.
- Welding tent/shelter and ground sheet.
- Scraping equipment.
- Pipe cutter.
- Indelible marker pen.

Principles

Electrofusion is a method of joining PE pipes using fittings with integral heating elements. Sockets are used to join mains and service pipes and saddle fittings are used to connect services to mains.

The pipe to be joined must be prepared by removing the outer surface layer to a depth of around 0.2 mm, then pipe and fitting are clamped together to prevent movement. A voltage is applied across the fitting terminals via a control box.

An electric current is passed through the wire which heats the wire and melts the polymer, fusing the fitting to the pipe. After welding, the joint is allowed to cool before removing the restraining clamps.

Pipe/Fitting Selection

Check that both pipe(s) and fitting to be joined are compatible, only compatible materials should be joined together. Check PN and SDR rating marked on fitting and compare with that of the pipe. If in doubt, seek advice from the pipe or fitting manufacturer.



Siting Equipment

Wherever possible, the electrofusion equipment should be placed on a suitable clean, dry base board or ground sheet inside a tent/shelter to minimise contamination.

Pre-Jointing Checks

Accept only equipment which has been regularly serviced and is in good condition.

Check that restraining clamps, and liners if used, are correct and are clean. Advice on the appropriate clamps is available from all fitting manufacturers.

Check that scrapers are clean and that the blade is not damaged and is in good condition.

Making Socket Joints

SOCKETS JOINT ASSEMBLY PREPARATION

Cut or check that the pipe ends are square to the centre line.



Wipe loose dirt from pipe ends with a clean, dry, lint-free cloth or paper towel.



Scrape one pipe end using a prescribed tool, for more than half the fitting length. Ensure the whole surface area has been scraped.



DO NOT TOUCH THE PIPE ENDS OR ALLOW SURFACES TO GET DAMP OR CONTAMINATED PRIOR TO CONTINUING.

Place prepared pipe into restraining clamp.

A Good Guide to

Electrofusion Jointing



Prepare the second pipe as previously described.

N.B. It is important that, once scraped, pipe surfaces must be kept clean and dry. If the pipe is scraped and left open to the atmosphere for any length of time, the pipe ends should be cut off and rescraped.

Remove the bag and push the second pipe home. Mark the penetration depth on the pipe and tighten the restraining clamp.

Open fitting bag, check the fitting is clean and immediately place over pipe end and push up to centre stops.

Mark the penetration depth on the pipe, leaving bag over fitting for temporary protection.

DO NOT TOUCH THE FITTING BORE. ALL ELECTROFUSION FITTINGS SHOULD BE KEPT SEALED IN THEIR BAGS UNTIL WELDING. IF CONTAMINATION OF EITHER PIPE OR FITTING JOINTING SURFACES OCCURS, WET WIPES CAN BE USED IN ACCORDANCE WITH THE PROCEDURE AT THE REAR OF THIS BOOK. REJECT THE FITTING IF CLEANING FAILS TO REMOVE DIRT AND CONTAMINATION.



Check fitting penetration - using previously marked lines on pipe. Visually check pipe alignment in all planes. Rotate the fitting to ensure no excessive forces are present.

N.B. Spigot fittings i.e. saddle outlets, spigot outlet on tees, stub flanges should be scraped and restrained as with pipes.

Making the weld

Check generator has sufficient fuel. Start the generator and then plug the control box input lead into the generator output socket.

Connect the control box output leads to the fitting terminals - if automatic fittings and control box are being used, connect the red lead to the fitting terminal with the red pin,

connect black lead to plain pin. Check that the weld time marked on the fitting is displayed on the control box display. For manual fittings, check the weld time marked on the fitting and enter this figure into the control box.

For 'barcode' fittings weld parameters are selected by scanning the barcode with the barcode scanner.



Respond to prompts from the box. Press 'START' and hold down until display begins countdown. The weld cycle is complete when the timer reaches zero and the control box 'CYCLE FINISH' indicator shows. Check fusion indicators have risen. Allow weld to cool for the full time stated on fitting before removing clamps and moving the assembly.

Making Saddle Joints

The fittings used to illustrate this section are Multi-Seal tapping tees.



SADDLES

When locating tapping saddles ensure that the tapping process will not be impaired by other service pipes, cables etc.

JOINT ASSEMBLY PREPARATION

Expose pipe to which saddle is to be welded. Remove loose dirt from the pipe with a clean, dry, lint-free cloth.



With the fitting still in its protective bag, place over required position on pipe.

Mark pipe surface 10mm clear all round contact area.

A Good Guide to

Electrofusion Jointing



Scrape the marked area, ensuring that each stroke of the scraper overlaps the preceding one, keeping hand clear of the scraped surface at all times.

Remove fitting from bag immediately and attach to pipe using suitable clamping equipment.



N.B. Always bring the clamp to the located fitting, do not slide the fitting under the clamp.

DO NOT TOUCH EITHER PREPARED PIPE SURFACE OR THE ELECTROFUSION SURFACE OF THE SADDLE.

Repeat procedure for "Making the Weld". (See page 12).

Making Saddle Outline Joints

JOINT ASSEMBLY PREPARATION



Scrape outlet of tapping tee and service pipe following the procedure described previously for sockets, (see page 10) using an appropriate mechanical scraper.



Align service pipe and fittings with restraining clamp and make the weld as before. (See page 11).

PRESSURE TESTING OF JOINT

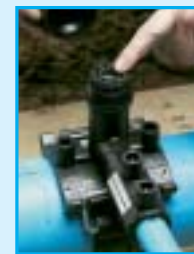
Once the tapping tee has been fused to the pipe and connected to the service pipe, a pressure test can be carried out using a test cap in accordance with the appropriate industry guidelines. It is recommended that a pressure no greater than 1.5x the working pressure be used to test the joint integrity.

Carry out quality checks as detailed on p16.

CUTTING THROUGH

Unscrew cap and, using cutter key, insert into integral cutter, tap the main, retract cutter until top is flush with slack and refit cap.

Pressure test before back filling in order to check for possible leaks. Once test has been successfully completed, hand tighten cap.



DO NOT USE SPANNERS TO TIGHTEN CAP. THIS MAY DAMAGE THE THREADS AND CAUSE LEAKAGE.



Special Note

MULTI-SEAL TAPPING TEE

When installing any type of Multi-Seal Tapping Tee, the following guidelines should be followed:

ADDITIONAL EQUIPMENT REQUIRED:

12mm cutter key (min length 150mm) & drive

Stack load version:

If using G Clamp, G Clamp E or G Clamp SL an adaptor will be required (Part no. 34213) which will be supplied on request through the usual outlets.



Underpart version:

63 & 90 fittings - 12mm extended socket/spanner.

110+ fittings - No tooling required.



No extra clamping equipment is required.

A Good Guide to Electrofusion Jointing



PREPARATIONS

Prepare pipe as previously described and attach fitting to pipe using recommended equipment.

Once in position connect the fusion box leads to the fitting and fuse using the appropriate method for the control box (ie. barcode / autopin / manual).

When the fusion cycle has completed, leave the clamping equipment in position for a minimum of the recommended cooling time.

After the cooling time has elapsed, the service pipe can then be fused to the outlet. Always scrape the outlet.

PRESSURE TESTING OF JOINT

Once the Multi-Seal Tapping Tee has been fused to the pipe and connected to the service pipe, a pressure test should be carried out using a test cap (Part no. 32865) in accordance with the appropriate industry guidelines.



CUTTING THROUGH ON LIVE OR DEAD MAINS

Before cutting through the pipe, carry out quality checks as detailed on p16.



The Multi-Seal Tapping Tee offers two cutting options for 'live' and 'dead' mains situations.

'LIVE' (PRESSURISED) MAINS

- 1 Retract the cutter until its top surface is level with the top of the tapping tee stack.
- 2 Insert the tube into the cutter by pushing and twisting around 1/4 of a turn. There should be no gap between the cutter and the step on the tube.
- 3 Insert the 12mm cutter key ensuring it is located at the bottom of the cutter drive.

- 4 Screw the cutter down and cut through the pipe as with standard tapping tees. Once the cutter has gone through the pipe wall, retract the cutter until the top of the cutter is once again level with the top of the tapping tee stack



N.B. DO NOT REMOVE THE CUTTER KEY FROM THE TUBE UNTIL THE CUTTER HAS FULLY RETRACTED.



- 5 Once the cutter is in the fully retracted position, remove the cutter key and then remove the tube. The cap can then be hand tightened on the tapping tee. Please note that once the cap has been fully tightened down it cannot be removed.

'DEAD' (UN-PRESSURISED) MAINS

The cutter should be used as with the standard tapping tee, the tube is not required.

N.B. The cutter must be fully retracted to be level with the top of the tapping tee stack.

Quality Checks

- Check that fusion indicators have risen (where fitted).
- Check that no melted material or wire has exuded from the fitting.
- Check that the pipe(s) has not moved during welding.
- Check for cleanliness around joint area.
- Check for evidence of scraping.
- Check that saddles are square on pipe.
- Take print out from control box and check result.

If the weld fails any of the above checks then:

- a for sockets - cut out the joint and use another fitting.
- b for saddles - do not tap the main but carry out a repeat weld using a new fitting at least 200mm from the failed joint.

A Good Guide to

ElectroFusion Jointing

Electrofusion Do's

- Use a shelter and ground sheet in wet or dry conditions.
- Always use equipment that has been regularly maintained and calibrated.
- Ensure control box voltage compatible with fitting.
- Always use alignment/restraining clamps.
- Cut pipe ends square for electrofusion sockets.
- Scrape pipe and/or spigot surfaces fully.
- Keep scraped pipe and/or spigot surfaces and fittings clean.
- Ensure correct fusion and cooling times are adhered to.
- Assemble joint and fuse immediately after scraping pipe.
- Carry out quality checks before cutting through pipe.
- Remove joint from clamps until the full cooling time has elapsed.
- Remove integral cutter from the saddle once the main has been drilled.

Safety Notes

Although we make every effort in the design of our equipment to ensure operator safety, it is worth bearing in mind the following precautions:

- Never allow molten or semi-molten polyethylene to come into contact with the skin. In the event of such an occurrence it is recommended that cold water should be used to flush the affected area and expert medical advice sought.

DO NOT UNDER ANY CIRCUMSTANCES ATTEMPT TO PULL THE MATERIAL FROM THE SKIN AS THIS WILL INVARIABLY REMOVE THE SKIN AS WELL.

- Do not attempt to lift long lengths of pipe without assistance or mechanical aid.
- Normal precautions should be observed when handling electrical equipment although, for safety reasons, all 110v portable generator sets should be "Centre Tapped" for site use +55/0/-55 volts.
- To afford protection against unforeseen circumstances occurring during jointing, it is advisable to wear protective workwear such as gloves, safety glasses and safety boots.

Ensure that equipment is serviced on a regular basis as recommended by the equipment manufacturer.

Electrofusion Dont's

- Do not start the joining process unless it can be completed in one go.
- Leave fittings out of protective bags.
- Use dirty fittings.
- Touch prepared pipe surfaces or fusion areas.
- Allow assemblies to get damp prior to joining.
- Touch fusion indicators during the welding cycle.

Additional Information

STANDARD DIMENSION RATIO (SDR)

The SDR is calculated by dividing the minimum (nominal) outside diameter (OD) by the minimum wall thickness (WT) i.e.

$$\text{SDR} = \frac{\text{OD}}{\text{WT}} = \frac{125}{11.4} = 11$$

From 25mm PE pipe and above the ratio between the outside diameter and the wall thickness remains constant for specific pressure ratings of the pipe.

TRANSITION FROM PE PIPE TO OTHER PIPE AND FITTINGS

Various transition fittings are available to connect to metallic valves, hydrants and pipework, one common method is the use of PE flanges.

It is important to follow manufacturers recommendations for tightening the necessary bolts. Bolt torque details are supplied with the flanges. It is also important to support any equipment independently of all PE pipework (ie. valves to be mounted on concrete blocks).

SADDLES

The term "saddle" covers branch saddles and tapping tees.

THIS BROCHURE HAS BEEN PRODUCED AS A BASIC GUIDE TO GOOD JOINTING TECHNIQUES, HOWEVER, USERS SHOULD FOLLOW THE CODE OF PRACTICE RELATING TO THEIR PARTICULAR INDUSTRY AND IF IN ANY DOUBT CONSULT THE MANUFACTURER CONCERNED.

THIS GUIDE IS NOT A SUBSTITUTE FOR COMPREHENSIVE OPERATOR TRAINING.

IMPORTANT NOTICE - WET WIPES

"The preferred position is to make Electrofusion joints without the use of wet wipes. This is provided that the pipes are freshly scraped, the fitting has just been debagged and the assembly and fusion of the joint follows immediately.

If any deviation from the above occurs, which may result in contamination of either the scraped pipe or the debagged fitting, then prescribed wet wipes shall be used. Separate fresh wet wipes shall be used for the scraped pipe and debagged fitting if both are contaminated. Whether wiping both scraped pipe and fitting or just one of them, then wiped surfaces must be allowed to visibly dry (do not touch the wet surface), then the joint assembled and fused. Failure to allow the jointing surfaces to visually dry will increase the risk of voids on the weld interface.

N.B. In Butt Fusion jointing wet wipes are not used for cleaning pipes that have already been machined / trimmed."

Uponor Ltd/Durapipe-S+LP/Fusion/PDL
- April 1998



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Automatic Butt Fusion Machines
250mm - 630mm



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Automatic, Manual and
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200 - 500 Titan



DUOSCRAPE
Two Pipe Scrapers in One
20mm/32mm - 20mm/32mm



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