WARNING

- Only competent and trained personnel to maintain the product.
- This procedure should be reviewed by the customer before any work is executed.
- Should there be any conflict between the user’s safe working practices and any of the published technical data, a resolution in writing shall be made before using the device.
1. Introduction

The Internal Dart Valve is an eDART descriptor for the tri- and i- dart valve product ranges. Both of these valves are located internal to a vessel.

The Tri/iDart Slurry Valve is designed for use as an isolation valve or control valve depending on the plug fitted to the valve. The Tri/iDart is designed to either be bolted to the outlet or pushed into the outlet of a vessel. The TriDart Valve is a self-contained valve and therefore can be removed from the vessel if maintenance is required.

Two icons are used in this document to draw the reader’s attention to pertinent information.

A warning sign to indicate where the reader should pay particular attention for safety critical items,

And note symbol for additional information.

Chapter two encourages the reader to analyse the risks associated with installing and operating the unit. The issues the manufacturer believes should be included in a minimal HAZOP study are highlighted here. Chapter three examines the product in more detail. The material of construction and general arrangement are explored. Chapter four outlines the procedure for installation. Chapter five makes suggestions regarding routine maintenance and inspection of the valve. The final chapters offer assistance to troubleshoot and who to contact when difficulties arise. The revision table may be found at the end of the manual.
2. Main Safety Issues

The purpose of this chapter is to help prescribe the major health and safety risk involved with the installation, operation and maintenance of the internal dart valve. The purpose is to guide the reader in the construction of their own HAZOP study and is not meant to be a complete and final analysis.

2.1. Installation Safety Issues

2.1.1. Welding operations

Should any welding be required for the valve support structure or for any ports or stubs, please note the following points:

- Always ensure that the line/vessel has been "locked out" before any welding is done.
- Ensure that the welder/boilermaker is aware of the contents of the line they are working on.
- Correct PPE and lock out permits shall be used.
- Equipment used shall be inspected and signed off by a competent person to be safe for use.

When working on hazardous lines, ensure that First Aiders and Fire Equipment are readily available and that there are spill kits to absorb any spillages that may occur. The correct PPE shall be used.

2.1.2. Rigging operations

Please be aware of the weight of the unit beforehand and use appropriate lifting and rigging equipment.

2.1.3. Fitting operations

All fasteners used to bolt the valve into place must be inspected for any defects and once tightened, they shall be inspected regularly to ensure they have not vibrated loose while in operation.
2.2. Maintenance Safety Issues

2.2.1. Actuator operates unexpectedly

As this equipment is under pressure, ensure that the systems have been disconnected and is depressurised before any work commences. The power supply shall be disconnected to prevent the system from being powered up accidently.

2.2.2. Pinch points

Fingers and loose clothing shall be kept away from any moving parts. With the equipment being under pressure, serious injuries, broken bones and even amputation should a body part or clothing get in contact with the moving parts may occur.

2.2.3. Spillages

When work is to be performed, please ensure that the line have been properly isolated and is safe before any work commences if required.

When working on hazardous lines, ensure that the correct prescribed PPE is used at all times. Ensure that spill kits are readily available and that the employees have been trained in the use of the equipment.

Ensure that first aid kit and fire equipment with trained personal is on site to ensure prompt medical attention in case of an emergency.
3. Product Description

3.1. Product Overview

The eDART range of internal dart valves may be a combination of the following:

<table>
<thead>
<tr>
<th>Variation</th>
<th>Options</th>
<th>Distinguishing feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valve Type</td>
<td>iDart</td>
<td>Single shaft and head guided cage with bolt down seat</td>
</tr>
<tr>
<td></td>
<td>TriDart</td>
<td>Self-contained valve with seat connected to the bonnet with guide bars</td>
</tr>
<tr>
<td>Actuation</td>
<td>Pneumatic</td>
<td>Actuator Cylinder atop valve</td>
</tr>
<tr>
<td></td>
<td>Manual</td>
<td>Handwheel</td>
</tr>
<tr>
<td>Flow Characteristic</td>
<td>Quick Opening</td>
<td>Short and squat plug shape ; On off typically controlled with a solenoid valve</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>Longer conical shaped plug; typically has a positioner</td>
</tr>
</tbody>
</table>

![Diagram of iDart and TriDart valves]
3.2. Internal Dart Valve Naming

3.2.1. Naming Convention

The internal dart valve model number takes the form of

{Model} – {Size} {Relative Seat Size} – {Variation}

Where:

<table>
<thead>
<tr>
<th>{Model}</th>
<th>ID</th>
<th>yDart</th>
</tr>
</thead>
<tbody>
<tr>
<td>TD</td>
<td>Poly yDart</td>
<td></td>
</tr>
</tbody>
</table>

{Size} {Relative Seat Size} {variation} Described in detail below

3.2.2. Model

The iDart has a bolt down cage to guide the plug into the seat and is suitable for deep vessels; the TriDart has a clamp down seat and is suitable for shorter vessels and has the advantage of being supplied to site fully calibrated.

3.2.3. Size and relative seat size

eDART names the seats according to the nominal flange size and a suffix letter to designate the relative seat diameter:

- "A" is full bore
- "B" is one size reduction and
- "C" is a 2x size reduction.
### Sizes

<table>
<thead>
<tr>
<th>Sizes</th>
<th>A (Full Bore, mm)</th>
<th>B (reduced Bore, mm)</th>
<th>C (2x reduced Bore, mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>80 NB</td>
<td>80</td>
<td>65</td>
<td>50</td>
</tr>
<tr>
<td>100 NB</td>
<td>100</td>
<td>80</td>
<td>65</td>
</tr>
<tr>
<td>150 NB</td>
<td>150</td>
<td>100</td>
<td>80</td>
</tr>
<tr>
<td>200 NB</td>
<td>200</td>
<td>150</td>
<td>100</td>
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<tr>
<td>250 NB</td>
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<tr>
<td>900 NB</td>
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</tr>
<tr>
<td>1000 NB</td>
<td>1000</td>
<td>900</td>
<td>800</td>
</tr>
</tbody>
</table>

### 3.2.4. Variation

The variations are generally in the following order should multiple characters be used.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q</td>
<td>Quick Opening</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>Sealed topworks</td>
<td>has bellows seal</td>
</tr>
<tr>
<td>M</td>
<td>Manually operated</td>
<td>handwheel</td>
</tr>
<tr>
<td>X</td>
<td>Special</td>
<td></td>
</tr>
</tbody>
</table>
3.2.5. Product Variations

The major variations are shown pictorially below.

![Internal Dart Valves](image)

- Standard iDart
- Standard TriDart
- Sealed Tridart
- Pedestal for third party valves

3.3. Additional Notes

3.3.1. Plugs

The eDART plug typically matches the actual seat size, so a 150NB plug will be used with a 200B seat. This rule may be violated in certain circumstances: sometimes on the smaller sizes and sometimes when an upgrade project is anticipated.

3.3.2. Shaft/Guide bar lengths

These lengths are customised to the application.
### 3.4. Materials of Construction

<table>
<thead>
<tr>
<th>Component</th>
<th>Standard Material [Option]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestal/Bonnet</td>
<td>Phenoline painted S355JR/304/316/2205</td>
</tr>
<tr>
<td>Plug</td>
<td>Polyurethane 90A shore with S355JR/304/316/2205 steel inserts</td>
</tr>
<tr>
<td>Seat</td>
<td>304/316/2205</td>
</tr>
<tr>
<td>Guides Bars</td>
<td>Polyurethane 90A shore or TC spayed shaft</td>
</tr>
<tr>
<td>Shaft</td>
<td>HDPE/UHMWPE</td>
</tr>
<tr>
<td>Shaft Guard</td>
<td>StSt 304/316</td>
</tr>
<tr>
<td>Shaft Guide</td>
<td>StSt 316/Aluminium</td>
</tr>
</tbody>
</table>
4. Installation Guidelines

4.1. Rigging and Lifting

When lifting the valve, care must be taken so as not to damage the actuator or positioner. The valve can be slung from under the actuator mounting plate or, preferably, using the lifting lugs.

! WARNING
The valve must under no circumstances be lifted by the actuator as this will damage the actuator and valve.

4.2. Installation

4.2.1. General

1. The valve shall be installed into the vessel following the plant layout drawings and the tag number on the valve. Each valve is supplied with a data tag indicating the serial number (and tag number if supplied).
2. The valve shall be bolted into the vessel using suitable bolts, nuts and washers.
3. The bolts shall be tightened sufficiently so that the seat seals with the base of the vessel, if supplied with a gasket ensure that the gasket is located in the correct position. In certain circumstances, may be useful to use a polyurethane-based sealant (for example Sikaflex 11FC+) to ensure a proper seal with the vessel.
4. Sufficient clearance above and below the valve is to be left clear for stripping and removal. Please refer to the GA Drawings for valve dimensions.
4.2.2. TriDart installation

It is important to correctly match the triDart valve length to the depth of the vessel – the distance between the vessel’s seating surface at the bottom and the mounting frame at the top. Because the triDart is a one-piece unit, placing the mounting frame too high will allow flow between the seat and the vessel (see Figure 1) and by mounting the frame too low will cause the guide bars to bend and excessive pressure between the plug and seat in the closed position (see Figure 2).

**Figure 1:** Mounting frame installed too high. Note the gap that will allow flow between the vessel and the valve even when the valve is in the closed position. Apart from the obvious resulting process errors, the guide bars will oscillate with flow and ultimately lead to mechanical failure.

**Figure 2:** Mounting frame installed too low. Note the pressure has resulted in bent guide bars. When the valve is in the closed position, the actuator will force the plug too far into the seat which will cause mechanical failure. Additionally, in mid stroke positions the plug will not be guided properly.
For correct installation, please follow the steps below:

1. Check the measurements on the drawings; measure from the bottom of the valve seat to under the bonnet.
2. Install the top of the valve mounting bracket to the valve’s length and allow 3–5 mm for clamp down purpose (the poly and rubber compress to form the seal between the valve and the vessel).

For example:

If the valve is 1,000mm then the installed frame height should be 995–997 mm

---

**Frame Installed Too High**  
**Frame Installed Too Low**

---

![Figure 3: valve length measurement](image)

1,000 mm

997 min
995 max

![Figure 4: seat to frame depth measurement](image)
5. Routine Maintenance and Inspection

To ensure optimum life and performance from the valve, the following routine inspections are recommended:

1. During operation observe the valve movement.
2. During a plant shut or maintenance stop, visually inspect the plug, seat, shaft guides and bar guides for wear and damage.

**NOTE**
Before inspecting the valve, ensure that the vessel has been safely isolated and locked out; for details on how to safely isolate the valve refer to Section 5.2 – Isolating the Valve.

3. The following are indications that the valve needs attention:
   - Poor controllability.
   - The valve action is no longer smooth.
   - When closed the valve is passing excessive product downstream.
   - There are air leaks from the actuator, positioner or piping.

5.1. Expected Wear Items

There are five items that are located in the wetted area of the valve which are subject to the line material erosion and therefore may be damaged. These should be visually inspected periodically.

Furthermore, eDART advises that the following parts are stocked on site:

<table>
<thead>
<tr>
<th>Component</th>
<th>Inspection</th>
<th>Stock description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plug</td>
<td>All the Polyurethane/HDPE/UHMWPE must be checked for wear and damage, ensure that these are replaced before any major damage is visible.</td>
<td>Polyurethane coated</td>
</tr>
<tr>
<td>Seat</td>
<td>Polyurethane coated</td>
<td>StSt/ tungsten Carbide coated</td>
</tr>
<tr>
<td>Shaft</td>
<td>HDPE</td>
<td></td>
</tr>
<tr>
<td>Shaft Guide</td>
<td>Visually inspect for leakage</td>
<td>Rubber</td>
</tr>
<tr>
<td>Bellows(sealed version only)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**WARNING**
If any other components appear to be damaged or worn please contact the manufacturer immediately.
5.2. Isolating the Valve

WARNING
Only suitably trained personnel are to work on the eDART Valve.

1. Drain the vessel containing the valve, flush out any excess slurry remaining in the vessel.
2. Ensure that the correct lock-out procedures are followed and that the valve and vessel are safely isolated.
3. Disconnect the air and signal from the positioner and actuator.

5.3. Replacing of Components

WARNING
Only suitably trained personnel are to work on the eDart Valve. Before any maintenance is done the valve must be safely isolated.

The major sub-assemblies of the dart valve are shown below.

- Actuator (green)
- Positioner (yellow)
- Bonnet/Pedestal (blue)
- Seat Cage (red)
- Plug (purple)
5.3.1. Replacing the plug

1. Ensure that the valve has been safely and correctly isolated.
2. Remove the nuts and bolts on the removable bonnet (Blue Assembly), the bonnet with actuator (Green Assembly) and plug (Purple Assembly) still attached can now be pulled out of the valve body (leaving behind the seat cage (Red Assembly)).
3. Place the bonnet in a suitable area to safely work on it, take care not to damage the actuator or positioner.

---

**Note:**

If the plug has a soft rubber coating, the plug and shaft will need to be replaced, if this is the case please refer to Replacing the Guides and Packing for details on how to remove the shaft. If the plug is not coated with rubber continue with instructions.
4. Depending on the size of the valve there are two styles of plugs:
   a. For Small Plugs, remove the bung in the plug protecting the cap screw, the cap screw can now be removed and new plug fitted.
   
   ![Illustration of a small plug]

   b. For Large Plugs

   ![Illustration of a large plug]

   i. Loosen the cap screws in the collar holding the plug cap down.
   ii. Lift up plug cap and loosen four bolts which hold the four half-washers in place. The plug can then be removed from the shaft.
   iii. Replace plug cap on shaft if necessary
   iv. Realign new plug and/or shaft. Position the four half-washers so the top two are 90 degrees from the first. Tighten bolts.

5. Reassemble in reverse order.

**NOTE**

Stroking and calibration will be required to seat the plug correctly. See eDART Installation and Maintenance Manual - Actuator for further instructions if necessary.
5.3.2. Replacing the Seat

1. Ensure that the valve has been safely and correctly isolated.
2. Remove the nuts and bolts on the removable bonnet (Blue Assembly), the bonnet with actuator (Green Assembly) and plug (Purple Assembly) still attached can now be pulled out of the valve body (leaving behind the seat cage – Red Assembly).

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>The larger valves may require that the bonnets be supported by rigging</td>
</tr>
</tbody>
</table>

3. Place the bonnet in a suitable area taking care not to damage the actuator or positioner.
4. Replace the worn component

<table>
<thead>
<tr>
<th>iDart</th>
<th>TriDart</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="iDart Diagram" /></td>
<td><img src="image2.png" alt="TriDart Diagram" /></td>
</tr>
<tr>
<td>Replace the seat cage assembly</td>
<td>Remove the capscrews; replace the seat</td>
</tr>
</tbody>
</table>

5. Reassemble in reverse order.

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroking and calibration will be required to seat the plug correctly.</td>
</tr>
</tbody>
</table>
5.3.3. Replacing the guides and or bellow seal

1. Ensure that the valve has been safely and correctly isolated.
2. Unbolt and remove the bonnet from the valve.
3. Disconnect the actuator shaft from the valve shaft by loosening the stem clamp (shown in below)

A variation may take this form, but the principle is the same.
4. Remove the stem clamp

5. Loosen the bottom bolts attaching the guide (and saddle if applicable) to the bonnet as indicated.
6. The plastic guide can now be removed by lifting it over the end of the shaft.
7. Replace the bellows if necessary.
8. Re-assemble in reverse order, remember to put all spacers and washers back as they were removed.

NOTE

Stroking and calibration will be required to seat the plug correctly.
5.4. Replacing the Shaft

Note the oring/gasket between the top of the shaft and the bellows plate:

5.5. Replacing the Feedback Mechanism

Note which holes are used before disassembly:

The other holes are for actuators with stroke reductions and ensure that feedback remains linear. Please contact yours sales representative for more information.
5.6. Setting Pre-Compression and Stem Clamp Assembly

Once a repair has been carried out, the valve needs to have the pre-compression reset.

1. Locate the plug on the seat.
2. With the stem clamp removed, screw out the threaded bar from the valve shaft until it just touches the top of the threaded bar on the Actuator/Handwheel stem.
3. Screw back the threaded bar into the end of the Valve approximately 5 mm, and lock in place with the locknut provided. See figure below.
4. Replace the stem clamp and tighten fast.
5. Extend the actuator/handwheel as if to close the valve and check that the plug seats properly in the seat. This can be done by using a torch below the seat and looking for light between the plug and seat.
6. If you see light shining through between the plug and seat then revert to step 3 and an increase the pre-compression 1 – 2 mm.
6. eDART Safety

1. The eDart is to be lifted using the lifting lugs on the pedestal, taking care not to damage the actuator, positioner or feedback mechanism.

**NOTE**
Older models might not be fitted with the pedestal and lifting lugs. In this case the eDART valve is to be lifted using a soft sling under the body, taking care to support the actuator so as not to damage the actuator, positioner or feedback mechanism. **Do not lift from the eye bolt on the actuator as this will damage the actuator.**

2. Due consideration is to be given to the weight of the components before dismantling.
3. Rigging equipment and procedures are to be followed to service the eDart.
4. Safety procedures for the use of compressed air are to be followed.
5. Only suitably qualified persons to work on or maintain eDart valves.
6. All local safety rules and regulations with respect to safety clothes applicable, tools and equipment used and methods of operation are to be adhered to.

7. Trouble Shooting

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possibility</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor controllability</td>
<td>Plug and seat worn</td>
<td>Inspect and replace if necessary</td>
</tr>
<tr>
<td>Action not smooth</td>
<td>Guides worn</td>
<td></td>
</tr>
<tr>
<td>Valve closed and still passing flow</td>
<td>Plug and seat worn</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Valve not seating properly</td>
<td>Remove blockage</td>
</tr>
</tbody>
</table>

8. Problems

For any problems please contact eDART Slurry Valves directly on –

Tel.+27.(0)11.823.6620, or
 email: maintenance@edart.co.za

9. Document Revision Table

<table>
<thead>
<tr>
<th>Issue</th>
<th>Date</th>
<th>Edited</th>
<th>Changes</th>
<th>Approved</th>
<th>Date</th>
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</thead>
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<tr>
<td>01</td>
<td>2016-05-24</td>
<td>NS</td>
<td>Edits for complete revision</td>
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<tr>
<td>02</td>
<td>2016-05-30</td>
<td>NS</td>
<td>More items</td>
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