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DT Core Overview
Collapsing Cores

- Developed in 1968 by George Roehr
- Roehr Tool has been the industry leader in c-cores technology
- Manufactured in Boston, MA, USA
- Progressive purchased Roehr Tool in 2006
- Added standard line of Dove Tail Cores in 2009
- Purchased by Dave Helenius and Keith Edwards in 2016
- Added the DT SUB-10 for very small undercuts and threads in 2015
- Expanded the Dove Tail standard core to include 23 available sizes in 2016
DT Core Overview

Styles of Collapsing Core

Spring / Flexing Steel Type

Mechanical / Dovetail Type
Industry perception of C-Cores in the past, “Option 3” behind

- Jump or strip thread molds: Simplest method but limits part design and can create part quality issues
- Unscrewing molds: Complex tooling and high maintenance molds

Game has changed

- Tough economic times: people are challenging traditional methods
- Dove Tail Core: mechanical compliment to product line that overcomes many misconceptions and limitations

Result: increased profits and optimized part design
Collapsing Segments
*Material: A-2, 54-57 HRC*
- Designed to mechanically collapse when the center pin is withdrawn
- The fit between the segments is controlled to permit flash-free molding

Center Pin
*Material: D-2, 59-61 HRC*
- Serves to expand the segments of the core to their molding position
- The pin may be flush to the core face
- Integrated cooling line

Carrier Assembly
*Material: D-2, 59-61 HRC*
- Mounts DT Core assembly to the mold carrier plate
- Provides guided and anti-rotational segment movement
Eleven Piece Assembly
Standard Sizes

Note: All dimensions and tolerances are in millimeters.

<table>
<thead>
<tr>
<th>CATALOG NUMBER</th>
<th>D Maximum Outer Diameter</th>
<th>B Minimum Inner Diameter +3&quot;/Side</th>
<th>ML Maximum Molding Length</th>
<th>C Maximum Collapse</th>
<th>CD Carrier Diameter +0.00 - 0.05</th>
<th>CT Carrier Assembly Thickness +0.05</th>
<th>L Core Length +0.01 - 0.00</th>
<th>SL Shaft Length</th>
<th>SD Shaft Diameter +0.00 - 0.02</th>
<th>BD Cooling Hole Diameter</th>
<th>BH Distance to Cooling Hole</th>
<th>BC Mounting Screw Bolt Circle</th>
<th>T Mounting Screws</th>
<th>S Maximum Collapse Stroke</th>
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<td>17</td>
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<td>16</td>
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<td>40</td>
<td>M5 x 25</td>
<td>34</td>
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<tr>
<td>DT28</td>
<td>33</td>
<td>25</td>
<td>28</td>
<td>1.6</td>
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<td>8</td>
<td>8</td>
<td>47</td>
<td>M5 x 25</td>
<td>38</td>
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<tr>
<td>DT38</td>
<td>42</td>
<td>33</td>
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<td>M6 x 35</td>
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<td>DT48</td>
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<td>12</td>
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<td>78</td>
<td>M8 x 40</td>
<td>62</td>
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</table>
RTS offers the largest range of standardized components for thread and undercut release as well as engineered customs.

Our standards allow for easy selection with documented supporting data, including mold base specifications and operating guidelines.

Repairs and replacements are more readily available keeping the customers’ molds running more efficiently.

With the DME/Roehr partnership, customer support is industry leading around the world to say the least.
• The Sub-10 DT Cores make it possible to release very small threads and undercuts in molded caps, connectors and small medical parts.

• Allows molding of parts with 7-10mm ID.

• Simpler alternative to unscrewing molds.

• Reduces cycle time and maintenance requirements.
DT Core Overview

Customs & Semi-Standards

- Range from 10mm-200mm
Value Proposition

• Capable of doing parts many other technologies can’t do.

• DT Cores provide advantages to customers over Jump Thread and Unscrewing Molds.

• Primary benefits to OEMs & Molders;
  – Increasing profits through faster cycle time & simplified tooling
  – Part design optimization to gain advantage over competition
Advantages vs Unscrewing Molds;

- Simplified Mold Design
- Easier Mold Set-Up
- Sequencing Options
- Less Maintenance
- Better Part Quality
- Improved Part Design
- Reduced Cycle Time
## Cost Savings Calculation

### Comparison: Collapsing Cores vs Unscrewing or Jump Thread

**Instructions:**
1. Fill in all grey boxes (except those marked optional) for a typical unscrewing or jump thread mold application.
2. Estimates have been provided but can be replaced with your input.
3. Review Savings Summary at bottom and contact Progressive / Roehr with questions.

*This IS NOT a quote. Designs can be submitted to Roehr Tool at information@roehrtool.com or call 978-562-4488.*

*For animations or more information, please visit [http://www.roehrtool.com/Demo/](http://www.roehrtool.com/Demo/)

#### Project Overview:
- Customer Name: [ ]
- Project Description: [ ]
- Date: [ ]
- C-Core vs Unscrewing Mold: [ ]

#### Part/Project Data:
- Part OD (in): [ ]
- Resin Type: [ ]
- Part Cost Est ($): [ ]
- Annual Volume: [ ]
- Expected Life of Mold (yrs): [ ]

#### Mold Data:
- Cavities: [ ]
- Threaded Core Cost: [ ]
- C-Core Cost (optional): [ ]

#### Production Data:
- Run Hours/Day: [ ]
- Run Days/Year: [ ]
- Press Rate: [ ]
- Toolroom Rate: [ ]
- Productivity Est (Unscrew): [ ]

**Savings Summary:**

<table>
<thead>
<tr>
<th>Notes</th>
<th>Cycle Time Reduction (sec)</th>
<th>Mold Capacity: C-Core (units)</th>
<th>Increased Capacity</th>
<th>Smaller Mold Base (in)</th>
<th>Mold Cost Variance</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>1.8</td>
<td>23,563,636</td>
<td>2,827,636</td>
<td>3</td>
<td>-$24,400</td>
</tr>
</tbody>
</table>

**Annual Savings:**

- Smaller Press Req, Savings = $0
- TOTAL Part Savings = $9,300
- TOTAL Maintenance Savings = $2,408
- TOTAL Secondary Ops Savings = $10,000

**Savings (year 1):**

- $2,692
- Savings (years 2, 3, etc) = $21,708
- TOTAL Savings over Life of Mold = $84,140
- ROI (yrs) = 1
Primary Markets

- Packaging, caps and closures
- Medical caps and fittings
- Plumbing fittings
- Irrigation products
- Electrical connectors and fittings
Materials and Temperatures

- From simple Olefins & ABS to more demanding resins like PVC & GF Nylon
- Yes we can make cores for high temperature resins!
Part Optimization
Part Design Advantages

- **A** Solid shut-offs
- **B** O-ring groove
- **C** Retention features for liners, inserts, and more are possible
- **D** Slots, holes or tamper evident serrations are possible
- **E** Strong, reliable snap fit designs
- **F** Threads only where you need them, allowing for better steel conditions
- **G** Thinner wall sections possible because anti-rotation feature is not needed
Part Optimization

Unscrewing Thread

Undercut Profile

- Threads can be made with more aggressive profiles

Stripped Snap Bead

- Snap features that normally require large radii for release can now be flat

DT Core Thread

DT Core Snap Bead
Eliminating Thin Steel Condition

- Many threaded applications are designed to be unscrewed out of the mold which requires the thread be run out the top of the core creating a thin steel condition.
- DT cores allow for threads only where you need them and it’s common to recommend taking advantage of this through a part design change.

Unscrewed Thread Design

DT Core Thread Design
Face to face and side shutoffs

- DT cores can be shutoff onto each other face to face and side actions may be shutoff against the side of the core segments.
Protruding Features

• Parts with features like seals on closures typically can’t be done with collapsing cores.

• Exceptions include designs where the core, at the end of its collapse stroke, has resulting “Free Space” between the core and the protruding feature.
Undercuts

- Full diameter undercuts are common for; Threads, O-ring Grooves, Snap Features
- Segmented undercuts and internal features are possible as long as they are positioned on the core correctly and drafted so that they release in the direction of the six collapsing segments.
Collapse Range

- Rule of Thumb – 6% per side (.060” per side for every 1” of diameter)
- Part Diameter – 10mm – 400mm
- Max collapse area. (Mid section of wide segments)
- Min collapse points. (Intersection of wide segment edges)
Calculating required collapse vs undercut depth

• Undercut + Shrink + Clearance = Total Collapse Req’d
Dove Tail Collapsing Core, Quick Review

<table>
<thead>
<tr>
<th>Part Information:</th>
<th>mm</th>
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<tbody>
<tr>
<td>Moulding Length:</td>
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<tr>
<td>Part Major:</td>
<td></td>
</tr>
<tr>
<td>Part Minor:</td>
<td></td>
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<tr>
<td>Features on Side Wall?</td>
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<tr>
<td>Features on Top of Core?</td>
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<table>
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<tr>
<th>Part Analysis:</th>
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<tr>
<td>U/C Depth:</td>
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<tr>
<td>% of Diameter:</td>
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<td>Max U/C per side:</td>
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<table>
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<th>Result:</th>
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<table>
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<th>Part Design Chgs:</th>
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<tr>
<td>Undercut Depth:</td>
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<tr>
<td>Moulding Length:</td>
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<tr>
<td>Side Wall Features:</td>
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<tr>
<td>Top of Core Features:</td>
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</table>

** Estimate only, please send applications to Roehr Engineering for complete review and quote. **

www.roehrtool.com  information@roehrtool.com  877-563-1912
Part Height Influence

- Part height and undercut depth determine collapse stroke and overall core height.
- Roehr Engineering will determine optimal collapse angle and provide customer with max allowable undercut depth.
Prototyping Options
ProtoBridge

- Pre-engineered 4 cavity molds, designed for convertibility and capable of production volumes.
- Intended for the customer looking to trial DT Cores to prove out part and mold design and production capabilities.
- Roehr’s existing molds can be inserted to trial your application.
Mold Design
Mold Sequence

- Staging methods;
  - Press KO with latch lock
  - Hydraulic cylinders
  - Press open and close

1 - Mold Open
2 - Collapse
3 - Eject
Mold Design ‘Wizard’

- Roehr Engineering can supply 4 view layouts for most applications with quotes!
- Full mold design services (new and retro-fit) are also available.
Part Retention: Retention Sleeve (patent pending)

- Some designs require a feature to prevent part from ‘riding’ one of the segments during collapse, which leads to damage.
- Retention sleeve is integrated into the DT core and is independent of the stripper so the part is secured during collapse but then easy to eject.
Part Retention: Other

- “10x10” step in stripper ring or cavity block
- Robot assisted ejection
Attachment methods: Quick Lock (patent pending)

Makes DT’s removable from parting line for maintenance or conversion.
Attachment methods: Split Ring

Cores are attached to the mold base at the bottom of the shaft with a split ring or quick lock plate and also at the carrier assembly with cap screws.
Pancake Core, pg 1

- Use for seal ring applications and witness line free parts.
Pancake Core, pg 2

- Use for seal ring applications and witness line free parts.
- Pancake diameter must be smaller than the undercut diameter for ejection.
Side Action

- Cam or hydraulic actuation is possible.

Molding Position

Collapse and Retract
Mold Design

Front half actuated

- Actuate similar to 3-pate runner split before main parting line opens.

Molding Position
Reverse Gate

- Gating through the Center Pin of the DT Core can be done with either a Hot Runner or 3 Plate Runner.
Coatings and lubricants

• DT Cores are capable of running dry in some applications, but coatings are recommended

• Coating options
  – DLC & XADC have been successfully used
  – Other options can be considered, however, application process must not result in any build up in corners

• Lubricants
  – A little goes a long way
  – Factory supplied with Setral grease which is food grade and does not migrate to the part surface
Mold Build & Assembly
Core alignment and mold base machining

- Two points of alignment.
  - Stripper ring
  - Shaft diameter
Pin protrusion

- Top of center pin MUST be flush or above the height of the segments.
- This provides and air gap for the segments to collapse into.
Machining molding details

- Fixture cores securely with grinding fixtures for machining.
- Cylindrical grinding and sinker EDM processes are acceptable.
- DO NOT turn in details on a lathe. Core damage will result.
Maintenance & Repair
Preventative Maintenance Plan

- Regular Maintenance Plan for DT Cores should be established and followed.
- The following page is a recommended for proper care and maintenance of DT Cores.
- The performance of the DT Core is dependent on efficiency of the mold. We strongly recommend a thorough preventative maintenance plan be established and adhered to for the mold itself.
  - ToolingDocs (www.toolingdoc.com) is a recommended resource for PM planning and training of tool room personnel.

Key Performance Indicators (KPI) Summary

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<th>Indicator</th>
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<th>3</th>
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<td>*Systemized maintenance practices (8 Stages)</td>
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<td>*Shop metrics (design, machines, tech skills, etc)</td>
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<td>Efficiency, improvement, goal setting, internal KPI’s</td>
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MCA Final Score & Shop Level

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<tr>
<td>*TD Shop Designation Level</td>
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</table>

Sample Key Performance Indicator (KPI) Summary.
In Service Maintenance Plan
- Mold vents should be cleaned regularly to avoid build up.
- DT Core center pin can typically be accessed from the press and should be inspected and lubricated lightly as needed.

Full Maintenance Plan
- Proper maintenance plan for DT Cores must be established, followed and all activities documented.
- Recommended maintenance frequency (using Setral grease);
  - New mold PM after first 50k and 100k cycles
  - 100-250k cycles between PM’s
- To prevent damage of cores when removed from the mold, a cleaning rack is recommended.
- DT Core must be fully disassembled and cleaned, preferably in an ultrasonic tank.
- Lubrication should be used unless otherwise approved at start of project.
- Minimum of 10% spares is recommended to maintain optimum mold efficiency.
Precautions

• Maintenance schedule should be adhered to and documented.

• Don’t over-stroke DT Cores when out of the mold (could damage edges of segments).

• Be careful of sharp edges (recommend Kevlar gloves).

• Mold assembly, center pin must be flush to proud of surface.

• Proper sequence must be confirmed and followed in production to avoid premature wear.
Disassembly process

- Note: all core pieces are numbered for proper alignment. It’s recommended to keep individual core pieces together to avoid mixing with parts from other cores.

1. Place DT on solid surfaces so clamshell and center pin are supported

2. Remove 3 bolts from clamshell
Disassembly process

3. Remove top clamshell plate or retention sleeve

4. Remove center clamshell plate
**Disassembly process**

5. Remove all 3 wide segments first

6. Remove all 3 small segments next

7. Remove center pin and bottom clamshell plate from stand
Cleaning the Cores

- Ultrasonic bath is recommended for all DT components
- Alternative is to spray down with degreaser and wipe thoroughly
- Use Q-Tips to get into smaller areas including the corners of the Dove Tail
Lubrication

- **Lubricants**
  - Segments and Center Pin: Setral grease is applied during core construction and is recommended after all maintenance
  - Clamshell Plates: Setral or Super Grease are recommended

- **Application**
  - Apply Setral to center pin surfaces but stay away from top of pin by about 20% of the core height to avoid grease on parts
  - Apply grease to segment tails; top/bottom & left/right surfaces
Assembly process

To ensure correct assembly each segment is numbered / marked to match the coinciding location of the core pin.

1. Set bottom clamshell plate and center pin on fixture
2. Place alignment pins (gauge, dowel, etc.) in bottom plate
3. Set center clamshell plate
Assembly process

4. Install all 3 small segments first

5. Install all 3 wide segments next

Notes:
- Ensure segments are being placed in proper position on center pin.
- Install segments from the top and slide down.
- Work each segment up and down several times to help spread lubrication and confirm there is no binding.
Assembly process

6. Install top clamshell plate
7. Tighten clamshell bolts
8. Remove alignment pins
Repairing or Modifying Cores

- Core components can be welded and repaired using laser or micro-tig welding technology.
Quick Reference Checklists
Part Design Checklist

- Confirm undercut depth allows for proper collapse and ejection
- Features on top of DT are either in line of collapse or on center pin with enough clearance to avoid damage from collapsing segments
- Undercut profile optimized
- Thread run-out to stop short of top of DT to avoid thin steel condition
- Part retention feature in place on ID of part
- Features on ID wall must be drafted in line of DT segments collapse
- If exact shrink rate is unknown, recommend diameters formed by DT core be designed steel safe for first trial
Mold Design Checklist

- Confirm proper sequence; method, collapse and eject strokes
- Recommend machine KO’s tie in for positive return
- Part retention method defined
- Attachment method defined
- If shutting off on top of DT; don’t design preload and DT must be fully expanded before shut off comes into position
- Good venting is essential at the parting line and leading to atmosphere
- Positive stops required for collapse and eject strokes
- DT center pin to be designed with positive pin protrusion
- Provide adequate cooling lines to DT center pins, avoiding looping of lines
- Confirm clearances per Roehr design standards
Mold Assembly Checklist

- Confirm stack heights and clearances for DT fit
- Alignment of plates is critical to avoiding premature wear or galling
- Confirm correct collapse and eject strokes and positive stops in place
- All components must be moving freely on the bench
- Confirm DT center pin has positive protrusion
- Confirm shut off heights and no preload on DT
- Confirm proper water flow through all DT center pins
- Proper venting must be in place from PL to atmosphere
- Make sure all cores are cleaned and lubricated before installation
Mold Set-Up

- If using machine KOs, tie into the mold for positive plate return
- Confirm DT center pin has positive protrusion
- Confirm balanced cooling to all cores, avoid jumping water lines.
- MUST use proper sequence as determined by mold builder.
- Dry cycle mold for a minimum of 1hr on first sample
- Heat soak the mold prior to start up
- Inspect cores in press by staging forward to view Segments & Center Pins.
- At start up, make sure short shots are removed before setting core or shutting press.
- If more than one eject stroke is needed for part removal, then only stage stripper plate for additional required strokes. DT Cores are to be collapsed only once per cycle. **Expanding DT’s into molded parts can cause damage to Cores!**
Maintenance Checklist

- Maintenance schedule should be adhered to and documented. For questions on best practices contact www.ToolingDocs.com.

- For detailed guidelines on assembly, disassembly and proper maintenance, download DT Training Manual at www.RoehrTool.com

- DT’s must be fully disassembled and cleaned at all PMs

- Lubrication is recommended on center pin and segment tails, per DT Training Manual

- DT’s must move easily without binding after reassembly

- For repair or modifications questions, contact Roehr Tool
Troubleshooting
**Issue: damaged undercut or threads**

- **Possible Causes:**
  - Inadequate stroke for collapse
  - Part falling on core
  - Sequence is wrong, ejecting before fully collapsed
  - Cavity finish pulling part off core

- **Solutions:**
  - Confirm proper collapse stroke
  - Confirm proper ejection stroke
  - Confirm part is retained on stripper ring or sleeve during collapse
  - Polish or add draft to cavity to ensure release
Issue: shavings or flash at threads

• Possible Causes:
  – Damaged edge of segment
  – Burrs on edges of segments from grinding or handling
  – Clamshell pocket depth or split ring position is incorrect causing segment to segment stepping

• Solutions:
  – If edges are damaged, return to Roehr for repair
  – If edges are sharp or have burrs, use a polishing stone to lightly break edges or remove burrs on all surfaces
  – Confirm heights and positive center pin protrusion
Troubleshooting

Issue: shavings on top of part

• Possible Causes:
  – Center pin recessed below top of segments
  – Burrs on edges of segments from grinding

• Solutions:
  – If edges are sharp or have burrs, use a polishing stone to lightly break edges or remove burrs on all surfaces
  – Confirm heights and positive center pin protrusion
Issue: galling between segments and center pin

• Possible Causes:
  – Mold base bores and pockets are not concentric or perpendicular to PL, causing misalignment between center pin and clamshell plates
  – Not following pre-determined maintenance plan
  – Water not running through the mold and/or DT Cores as designed

• Solutions:
  – Confirm plates are flat and all bore diameters and heights are correct
  – Implement maintenance plan at scheduled intervals and document
  – Confirm proper water flow through DTs and mold base plates
Issue: damaged or chipped dovetail features.

• Possible Causes:
  – Closing up on molded parts
  – Incorrect sequencing

• Solutions:
  – Ensure short shots and full parts have proper ejection from mold, establish mold start up procedure, or install vision system on mold
  – Confirm proper collapse and ejection strokes
  – Confirm part is retained on stripper ring or sleeve during collapse
RTS Web Links
RTS Web Links

Roehr Website:  http://www.roehrtool.com/

- Animations
- Monthly Newsletter
- Resources Page

YouTube:  http://www.youtube.com/RoehrTool

Facebook:  https://www.facebook.com/pages/Roehr-Tool-Corporation/450487311670767

LinkedIn:  http://www.linkedin.com/company/roehr-tool-corporation