tru seal technologies

SUPPLEMENT TO

DURASEAL™ AND DURALITE™

APPLICATION MANUAL

FOR

TRIPLE GLAZED IG PRODUCTION

DEC 2009

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Pg

Basic Use of Truseal Dura-Products in Triple Glazing:

When utilizing Duraseal or Duralite to manufacture triple-glazed IG units, most aspects of application and process follow very closely to those used to manufacture dual glazed units. From the process viewpoint, many aspects regarding the basic features and performance elements of Duraseal™ and Duralite™ are unchanged.

Examples of these are as follows:

- Stock rotation.
- General equipment elements already in place for duals.
- Corner sealing techniques.
- Optional dual sealing.
- Good glazing details for the finished IG in a sash.
- Racking and shipping.

Triple-Glazing IG Design Considerations:

Areas that require detailed planning and preparation are centered on three key issues:

- Airspace cavity design and spacer sizing as key driver to all downstream decisions:
  - *Duralite spacers* provide the best spacer solution in a thermally-superior triple-glazed IGU.
  - *Asymmetric airspace selection* allows for a wider, value-added selection of muntin bars and enhanced design opportunities for gas-filling and acoustics.
  - *Exterior Lite:* Clear glass provides for best muntin visuals, but advanced designs rely on this lite to carry a second LoE-coated surface in high performance windows such as the US-DOE's R5 window program.
  - *Interior Lite:* Given triples use in heating dominant climates, place LoE coating on surface #5 as a minimum.
  - *Muntins* should be considered for the exterior airspace gap, as this best reduces the effect of the bars on indoor glass surface temperatures and has better curb visuals.
  - *A minimum 3mm glass/muntin clearance* provides for no thermal penalty (NFRC 100 4.2.4.3B).
  - *Fill gases* can be argon, krypton, xenon or blends, but the gas having lower thermal conductivity should be in the smaller, interior gap.
    - For Ar filling, U values are optimized when pane spacings are in the range of 7/16" to 5/8" (or 11 to 16mm).
    - For Kr filling, U values are optimized when pane spacings are in the range of 5/16" to 1/2" (or 8 to 12 mm).

- *Thermal:*

  The key driver for consideration of triple-glazed IG is the increased thermal benefit to create energy savings and comfort for the owner. In some cases the unit's Overall Thickness (OAT) will need to be dimensioned to match the dominant dual-glazed IG within the same sash family, as an option within a window family. In other cases the OAT can be optimized for increased thermal benefit, usually by increasing the OAT to a 25%-to-50% larger dimension. Our recommendation is to consider the design opportunity to create a larger glazing cavity through use of a narrower stop or system redesign, in order to gain performance leverage for a longer period into the future. We encourage modeling the many options available to allow you to make the best choices for your company.

- *Airspace Specifics:*

  After the overall IG unit thickness dimension and range is established, the next key design decision is to determine the glass thicknesses to be utilized. The added lite in combination with load-sharing of the individual panes will mean that glass thickness might be different than what was used to manufacture like-sized dual-glazed IG. Most manufacturers will choose to use three lites of the same nominal thickness glass, leaving the residual dimension as the total airspace cavity that will be divided into ***like*** or ***asymmetric (off-set) airspaces.***

  - *Like Airspaces:*

    Choice of like airspaces is a simple process, but creates limitations in some conditions. The spacer size is simply: [OAT- (glass total of 3 lites)]/2. Once this nominal spacer size is chosen, an analysis around the upper and lower limits of the OAT specification, and what you can expect for your inbound nominal glass thickness should be undertaken to choose the best Dura-Platform spacer size for your application.

    Example in Imperial units:

    - Nominal 1" OAT triple IGU (w/actual glazing tolerances of -0.015", + 0.045") as the starting point assumption of what is needed.
    - DSB glass: Noted as 1/8", but runs reliably from vendor at 0.118", ±0.001"
    - Resultant airspace could quickly be looked at as 5/16", but "tolerance analysis" yields another choice:
      - Target OAT should be 1.015" = [1.045" (plus) + 0.985" (minus)]/2.
      - Glass subtraction yields -0.354" = [3*0.118", given range of 0.117" to 0.119"].
      - Total Airspace should be 0.661" = (1.015" – 0.354"), or 0.331"/side.
      - Conclusion is to choose a 33H (.333" nominal) and not a 31H size.
        - Tolerance for each cavity is +0.010", -0.008".

Example in metric units:

- Nominal 26mm OAT triple IGU (w/actual glazing tolerances of -0.38mm, + 1.14mm) as the starting point assumption of what is needed.
- 3mm glass: Noted as 3mm and runs reliably from vendor at 3mm, ±0.02mm
- Resultant airspace could quickly be looked at as 8.5mm, but "tolerance analysis" yields another choice:
    - Target OAT should be 26.38mm = [27.14 (plus) + 25.62 (minus)]/2.
    - Glass subtraction yields -9.0mm = [3*3mm].
    - Total Airspace should be 17.38mm = (26.38 – 9.0), or 8.69/side.
    - Conclusion is to choose a 35H (9mm nominal) and not a 33H size.
        - Tolerance for each cavity is +0.25, -0.20mm.

- *Asymmetric (Off-set Airspaces):* Choice of offset airspaces on first thought might add unwanted complexity in the management of another size, but this degree of freedom is very simple with the pre-formed/pre-sized Dura-Platform spacers from Truseal. If you are confined to fit a triple-glazed IG into a glazing cavity that is shared with a dual-glazed offering, then this option might give flexibility in unit configuration that otherwise would just not be there. Options of fitting a heavier/wider and more attractive muntin into the larger cavity and being able to offer krypton in the smaller cavity are some common design choices that are enabled by this approach.

  For example (in Imperial units):

  - Nominal 0.950" OAT must work for dual AND triple IGU, w/actual glazing tolerances of -0.015", + 0.015" as the starting point assumption of what is needed.
  - SSB glass: Runs reliably from vendor at 0.088", ±0.001".
  - Resultant "like-airspace" spacer selection would be as follows:
    - Target OAT should be 0.950", as glazing tolerance is evenly split.
    - Glass subtraction yields -0.264" = [3*0.088", given range of 0.087" to 0.089"].
    - Total Airspace should be 0.686" = (0.950" – 0.264"), or 0.343"/side.
    - Conclusion if split as *like-sizes* is to again choose 33H (0.333" nominal, but width's plus tolerance is 0.010" per cavity).
  - This eliminates the 8mm x 25mm Contour muntin that is offered in the premium dual-glazed IG today, and also the 0.343" krypton-filled cavity will cost 25% more for the krypton over a ¼" airspace.
  - ***An alternate "asymmetric" solution of ¼"/25H spacer (adds the possibility of Kr at a controlled cost), coupled with a 7/16"/43H space (allowing the contour bar) yields another solution for enhanced market offerings.***

Example in metric units:

- Nominal 25mm OAT must work for dual AND triple IGU, w/actual glazing tolerances of -0.4mm, + 0.4mm as the starting point assumption of what is needed.
- 3mm glass: Runs reliably from vendor at 2.95mm, ±0.03mm.
- Resultant "like-airspace" spacer selection would be as follows:
    - Target OAT should be 25.0, as glazing tolerance is evenly split.
    - Glass subtraction yields -8.85 = [3*2.95, given range of 2.92 to 2.98mm].
    - Total Airspace should be 16.15mm = (25 – 8.85), or 8.07/side.
    - Conclusion if split as *like-sizes* is to again choose 31H (7.95mm nominal).
- This eliminates the 8mm x 25mm Contour muntin that is offered in the premium dual-glazed IG today; also the 8.07mm krypton-filled cavity will cost 25% more for the krypton over a 6.4mm airspace.
- ***An alternate "asymmetric" solution of 6.35mm/25H spacer (adds the possibility of Kr at a lower cost), coupled with a 9.8mm/37H space (allowing the contour bar) yields another solution for enhanced market offerings.***

- Aesthetic and performance design elements w/ triple glazing
    - Aesthetics of spacer color: Black is always recommended, given the very dark shadow box formed where the center lite is captured between the two adjacent spacers. It always looks dark, and a black spacer looks best.
    - Aesthetics of spacer alignment: This is tied to spacer color; the "all black: option with Dura avoids the potential for "gray-black-gray" transitions altogether.
- Awareness of effects on your IG failure rate: If starting from a well managed and very low failure rate, triple-glazed IG will increase a very small risk. In general, the risk of failure about doubles, as each lite has twice the bondline perimeter to seal.

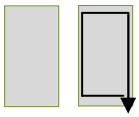
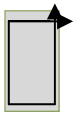
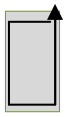
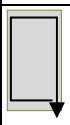
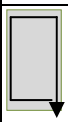
Considerations when Designing Your IG Line for Triple Glazing

- *Process and Accessory Equipment:* After the design elements of U-value, OAT and spacer size selection are complete, what remains is to utilize the best assembly process and layout your equipment to meet those needs. Several assembly sequences and layouts exist, especially with hand-tool spacer application. There are positives and negatives associated with each, many times tied to modest capital needs. The decision on the selection of a method will dictate:

    - Standard hand-tool, versus a second specialized left hand tool
    - One or two active spools of spacer material in use
    - Typical "clockwise" application, versus optional second trace that is "counterclockwise"
    - Fourth Corners being located at the same corners and "pattern-aligned" or not
    - Possibility of many manual methods and associated layouts (at least six) to create and assemble. Truseal will guide you through this selection process.

- *Major Application Equipment Elements:*

    - Glass Washing For Triple Glazing: The basic techniques used in fabricating dual glazed IG remain, but the addition of the center lite introduces the new requirement that both surfaces, rather than just one, must be clean and dry. This usually involves having a washer that is more regularly maintained in terms of air knife cleanliness and adjustment, and will involve flipping glass to enable spot cleaning if needed.
    - Spool stands that give access to two airspaces concurrently may be required depending on the fabrication sequence selected, when asymmetric spacer selection is chosen. This will allow quick access to the second active spool, and maximize design flexibility.
    - Air Float Equipment may need to provide for increased float or lift via 5 HP blower motors. The application table will need floatation and suction capabilities if topping is done at this station for the second lite. Grid lines will be needed if muntins are to be installed in cavity #1. Pop-up stops are needed for assembly as well
    - Compression Equipment: The heated rolled press is recommended to have at least seven pairs of rollers to provide a smooth and even compression taper. This is referenced in technical bulletin E006.

Method	Description of Method	View of bottom lite #1	View of center lite prior to assembly to first lite	View of Step Three	View of Final IG and tail	Negatives of Method	Positives of Method
Method A (using two strips of spacer)	"Two RH tools, but one at second application height"	 Std RH trace for lite #1	 Top w/clear as middle, then trace on stack w/taller tool	 Top lite #3		-Second trace requires a second, special "taller" Pro Tool -Accuracy of topping clear lite dictates appearance of second trace -Dissimilar airspaces require two active spools -Requires non-marking casters and cleanest table surfaces -Method is not compatible w/Quik-Dose at this time	-Tails and corners align -Center lite can be flipped, topped & wiped before second, elevated trace -Ease of gas filling -Easiest access to seal 4th corner -Aesthetics are best
Method B (using two strips of spacer)	"One standard RH tool for both traces, then "flip and top with crossed tails in single corner"	 Std RH trace for lite #1	 Top w/clear	 90° start, std. RH trace, then flip & top		-Corners together, but crossed -Aesthetics not as clean as A, D, & E, and not recommended with gray spacer -Corner alignment not as good as A, D & E	-One tool -Center lite can be flipped, topped & wiped -Easy access to seal 4th corners -No new casters needed over typical "duals" installation -Method is compatible w/Quik-Dose, but requires IG to be both rotated and flipped
Method C (using two strips of spacer)	"One standard tool for both traces, then "flip & top Lite #3 with tails in two corners"	 Std RH trace for lite #1	 Top w/clear	 Std RH trace, then flip & top		-More difficult access to seal one 4th Corner -Aesthetics not as clean as A, D, & E, and not recommended with gray spacer -Corner alignment not as good as A, D & E	-One tool & works with all table brands -Center lite can be flipped, topped & wiped -No new casters needed over typical "duals" installation -Lends itself to two fill gases -Method is compatible w/Quik-Dose, but requires IG to be flipped
Method D (using two strips of spacer)	"Use both RH & LH tools, then flip & top to match tails"	 Std RH trace for lite #1	 Top w/clear	 *LH* trace, then flip & top		-Second trace requires a second, special "left hand or counter-clockwise" Pro Tool -Second trace requires space for spool of spacer to the right of second application operator -Requires one counter-clockwise trace so it doesn't work with Billco tables -Method is not compatible w/Quik-Dose at this time	-Center lite can be flipped, topped & wiped -Tails and corners align -Ease of gas filling -Easiest access to seal 4th corners -Aesthetics are best
Method E (using two strips of spacer)	"One standard RH tool for both traces, but then stack and top for matching tails"	 Std RH trace for lite #1	 Std RH trace	 Top w/clear		-Cleaning bottom of second traced lite needs process -Requires non-marking casters and cleanest table surfaces -Method is not compatible w/Quik-Dose at this time	-Tails and corners align -Ease of gas filling -Easiest access to seal 4th corners -Aesthetics are best

Triple-Glazing Production Process Analysis: The details that follow correspond to the graphic above, and also the corresponding layouts

Method A – "TRIPA1"

Pros:

A. Good aesthetics as tails and corners align.
B. Applied center lite can be flipped and cleaned.
C. Gas-filling at the same location.
D. Easiest access to close corners.
E. Good for a combination of doubles and triples.

Cons:

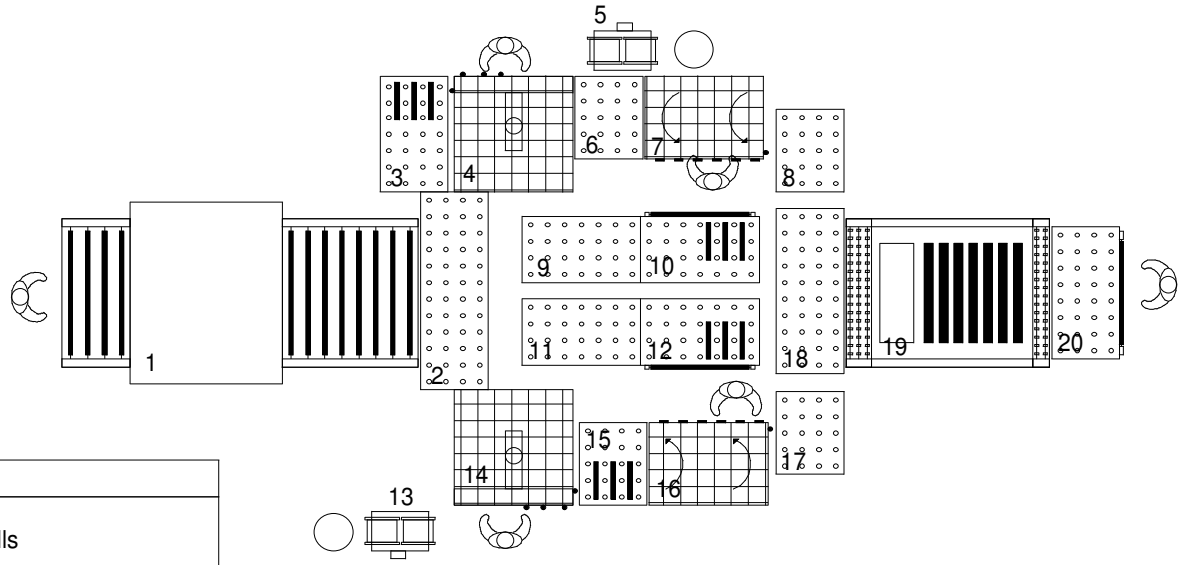
A. Requires two like tools set at the two heights.
B. Stacking large lites more difficult than flipping. Send to air float topping table and return. Keeping clean a bit more difficult.
C. Dura application of second lite dependent on topping accuracy.

Estimated UPMH:

80 second cycle time = 12.0 UPMH @85% (2' x 3' units) =287 IG per table, 575 per line per shift

Glass Flow:

A. First lite is sent to table 3 for table 4 and table 15 for 14 if the unit can be topped by one person.
B. If the unit requires two people to top, then the first lite is sent to table 10 for table 4 and table 12 for table 14.
C. The next lite is sent to either table 4 or 14 for the first spacer application.
D. After application, the operators at tables 4 or 14 will place the first applied lite into squares on their application table and flip and top the first applied lite with the lite from their adjacent table, 3 or 15 or install the grid assembly and then flip and top the unit. If the unit requires two people to top, the first applied lite will be sent to table 7 for table 4 and table 16 for table 14. The center lite from table 10 for table 4 and table 12 for table 14 will be flipped and topped on their respective topping tables. Grids are inserted on tables 7 and 16 if required. The partially assembled unit is then returned to table 4 or 14 for the second application of spacer.
E. The applicators then return the partially assembled unit back to the suction cup on their application table for the second application of spacer.
F. In all cases, the third and final lite is sent to table 10 for table 4 or table 12 for table 14 to be flipped and topped after the second spacer application.



Equipment Legend
1. 84" C-84MID Washer - 24FPM
2. 48" x 144" Caster Table - u channel - black paint - non marking rolls
3. 48" x 84" Caster Table w/1 set topping boards - non marking rolls
4. 84" x 84" Deluxe Application Table
5. Dual Horizontal Spool Stand w/liner remover
6. 48" x 60" Caster Table
7. 60" x 84" Tilting Air Float Table
8. 48" x 60" Caster Table
9. 84" x 48" Caster Table - non marking rolls
10. 84" x 48" Caster Table w/1 set topping boards, non marking rolls & off load roller
11. 84" x 48" Caster Table - non marking rolls
12. 84" x 48" Caster Table w/1 set topping boards, non marking rolls & off load roller
13. Dual Horizontal Spool Stand w/liner remover
14. 84" x 84" Deluxe Application Table
15. 48" x 60" Caster Table w/1 set topping boards & non marking rolls
16. 60" x 84" Tilting Air Float Table
17. 48" x 60" Caster Table
18. 48" x 120" Caster Table
19. 84" 7 Roll Press
20. 48" x 96" Caster Table w/off load roller

Customer Name: Triples - Method A	
Location:	Drawing Name: TRIPA1
Drawn By: Joe Almasy	Date: 2/8/09

Method B – "TRIPB1"

Pros:

1. One tool.
2. Good for two different airspaces.
3. Center lite can be flipped and cleaned, best assurance of a clean center lite.
4. 2nd applied lite can be flipped and cleaned.
5. Lowest cost of equipment change/upgrade.
6. Good option for large lites.
7. Good for doubles and triples in combination.

Cons:

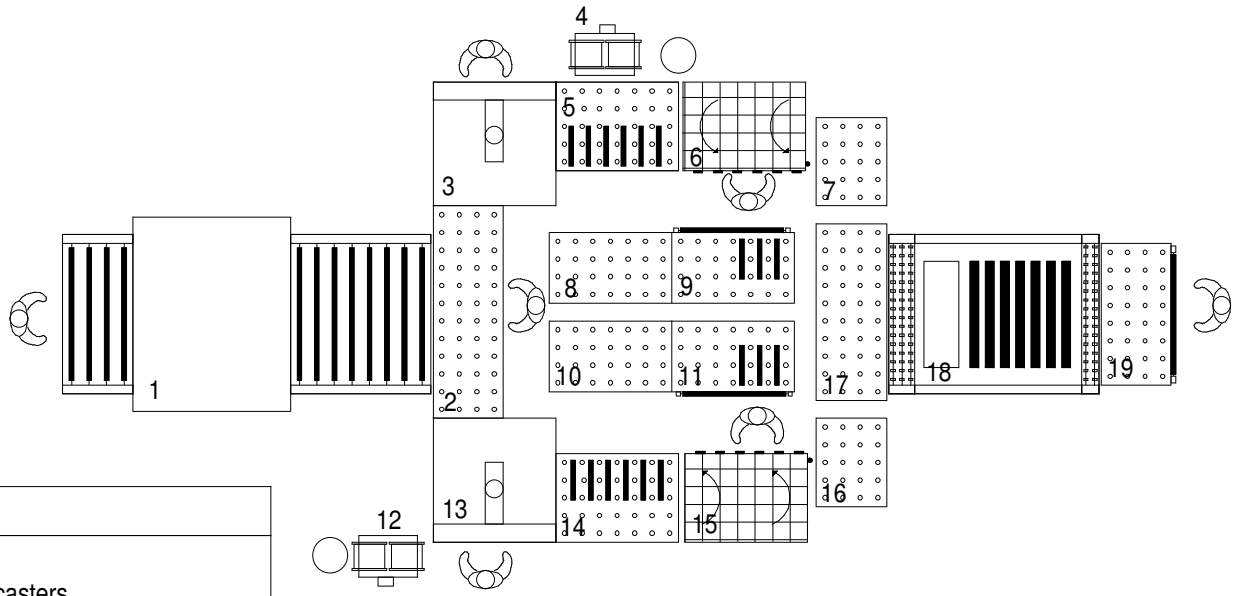
1. Aesthetics not as good as A, D & E, (crossed corners).
2. Not as good as A & D for gas filling (crossed corners).

Estimated UPMH:

60 second cycle time = 13.7 UPMH (2' x 3' units) = 380 units/table, 760 IG per line, per shift

Glass Flow:

A. The first lite is sent to table 3 or 13 for spacer application.
B. The second lite (center lite) is sent to table 9 for table 3 or table 11 for table 13.
C. After spacer application to the first lite is completed, the operator at table 3 sends the applied lite to table 6 and the operator at table 13 sends the applied lite to table 15.
D. The operators at tables 6 and 15 place the first applied lite into squares and insert grids if required then flip and place the center lite. The top of the placed center lite can then be cleaned if necessary.
E. The third lite is sent to table 3 or 13 for the second spacer application.
F. After the second spacer application, the applied lite is sent to table 5 from table 3 and table 14 from table 13. The operators at tables 6 or 15 will flip and place the second applied lite onto the partially assembled unit on their respective tables.
G. The dealer assists with large lites.



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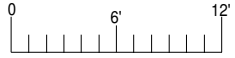
3. 84" x 84" Application Table
4. Dual Horizontal Spool Stand w/liner remover
5. 84" x 60" Caster Table w/2 sets topping boards & non marking casters
6. 60" x 84" Tilting Air Float Table
7. 48" x 60 Caster Table
8. 84" x 48" Caster Table - non marking casters
9. 84" x 48" Caster Table - 1 set topping boards, non marking casters & off load roller
10. 84" x 48" Caster Table - non marking casters
11. 84" x 48" Caster Table - 1 set topping boards, non marking casters & off load roller
12. Dual Horizontal Spool Stand w/liner remover
13. 84" x 84" Application Table
14. 84" x 60" Caster Table w/2 sets topping boards & non marking casters
15. 60" x 84" Tilting Air Float Table
16. 48" x 60" Caster Table
17. 48" x 120" Caster Table
18. 84" 7 Roll Press
19. 48" x 96" Caster Table w/off load roller



Customer Name: Triples - Method B	
Location:	Drawing Name: TRIPB1
Drawn By: Joe Almasy	Date: 2/8/09

Method C – "TRIPC1"

Pros:

1. One tool.
2. Center lite can be flipped and cleaned.
3. Opposing open corners may be advantageous to filling with two different gases with systems positioned to leave a corridor for harp racks
4. Existing proven process.

Cons:

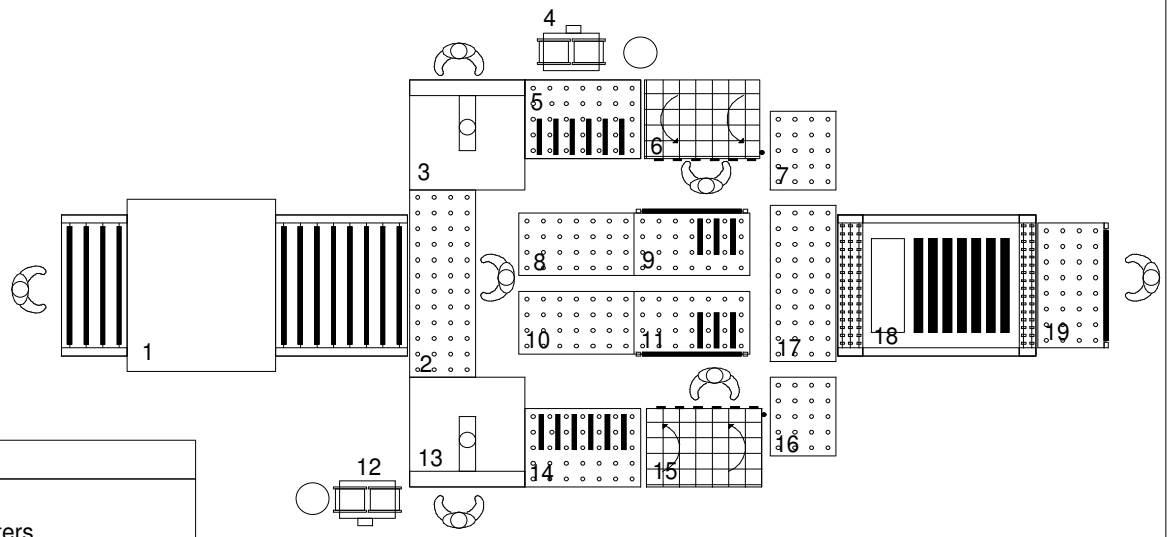
1. The opposing corners that would hinder gas filling and corner sealing if only one fill station is used
2. Aesthetics not as good as A, D & E (opposing corners).

Estimated UPMH:

60 second cycle = 13.7 UPMH (2' x 3' unit) = 380 units/table, 760 IG per line, per shift

Glass Flow:

A. The first lite is sent to table 3 or 13 for spacer application.
B. The second lite (center lite) is sent to table 9 for table 3 or table 11 for table 13.
C. After spacer application to the first lite is completed, the operator at table 3 sends the applied lite to table 6 and the operator at table 13 sends the applied lite to table 15.
D. The operators at tables 6 and 15 place the first applied lite into squares and insert grids if required then flip and place the center lite. The top of the placed center lite can then be cleaned if necessary.
E. The third lite is sent to table 3 or 13 for the second spacer application.
F. After the second spacer application, the applied lite is sent to table 5 from table 3 and table 14 from table 13. The operators at tables 6 or 15 will flip and place the second applied lite to the partially assembled unit on their respective tables.
G. The dealer assists with large lites.



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3. 84" x 84" Application Table
4. Dual Horizontal Spool Stand w/liner remover
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6. 60" x 84" Tilting Air Float Table
7. 48" x 60 Caster Table
8. 84" x 48" Caster Table - non marking casters
9. 84" x 48" Caster Table w/1 set topping boards, non marking casters & off load roller
10. 84" x 48" Caster Table - non marking casters
11. 84" x 48" Caster Table w/1 set topping boards, non marking casters & off load roller
12. Dual Horizontal Spool Stand w/liner remover
13. 84" x 84" Application Table
14. 84" x 60" Caster Table w/2 sets topping boards & non marking casters
15. 60" x 84" Tilting Air Float Table
16. 48" x 60" Caster Table
17. 48" x 120" Caster Table
18. 84" 7 Roll Press
19. 48" x 96" Caster Table w/off load roller

Customer Name: Triples - Method C	
Location:	Drawing Name: TRIPC1
Drawn By: Joe Almasy	Date: 2/8/09

Method D – "TRIPD1"

Pros:

1. Clear center lite can be flipped and cleaned.
2. Good aesthetics, corners and tails align.
3. Gas filling from the same location
4. Easy access to seal 4th corner.
5. Good for two different airspaces.

Cons:

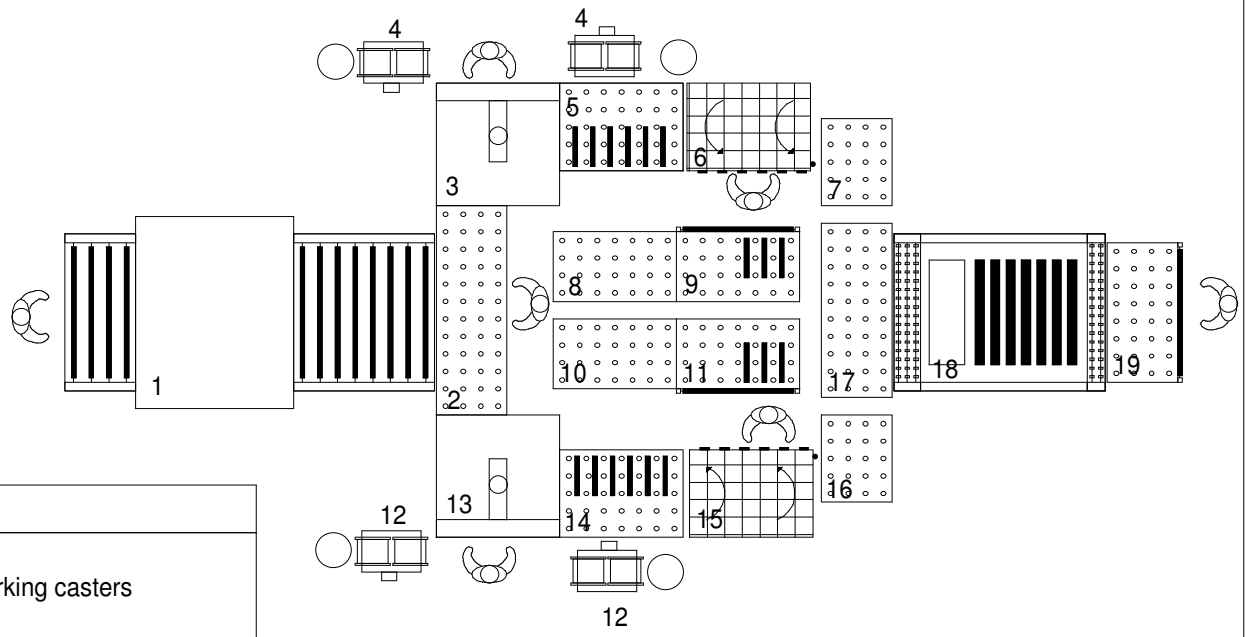
1. Second special LH tool required.
2. Two spool stands required.

Estimated UPMH:

60 second cycle time = 13.7 UPMH (2' x 3' units) = 380 units/table, 760 IG per line, per shift.

Glass Flow:

A. The first lite is sent to table 3 or 13 for spacer application.
B. The second lite (center lite) is sent to table 9 for table 3 or table 11 for table 13.
C. After spacer application to the first lite is completed, the operator at table 3 sends the applied lite to table 6 and the operator at table 13 sends the applied lite to table 15.
D. The operators at tables 6 and 15 place the first applied lite into squares and insert grids if required then flip and place the center lite. The top of the placed center lite can then be cleaned if necessary.
E. The third lite is sent to table 3 or 13 for the second spacer application.
F. After the second spacer application, the applied lite is sent to table 5 from table 3 and table 14 from table 13. The operators at tables 6 or 15 will flip and place the second applied lite to the partially assembled unit on their respective tables.
G. The dealer assists with large lites.



Equipment Legend

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2. 48" x 144" Caster Table - u channel - black paint & non marking casters
3. 84" x 84" Application Table
4. Dual Horizontal Spool Stand w/liner remover - 2 required
5. 84" x 60" Caster Table w/2 sets topping boards & non marking casters
6. 60" x 84" Tilting Air Float Table
7. 48" x 60 Caster Table
8. 84" x 48" Caster Table - non marking casters
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17. 48" x 120" Caster Table
18. 84" 7 Roll Press
19. 48" x 96" Caster Table w/ off load roller

Customer Name: Triples - Method D	
Location:	Drawing Name: TRIPD1
Drawn By: Joe Almasy	Date: 2/10/09

Method E - "TRIPE1"

Pros:

1. Good aesthetics, corners and tails align.
2. Gas filling simplest.
3. Easiest access to 4th corner for sealing.
4. Center lite can be flipped and cleaned, not intended to be part of the process.
5. Good for two different airspaces.

Cons:

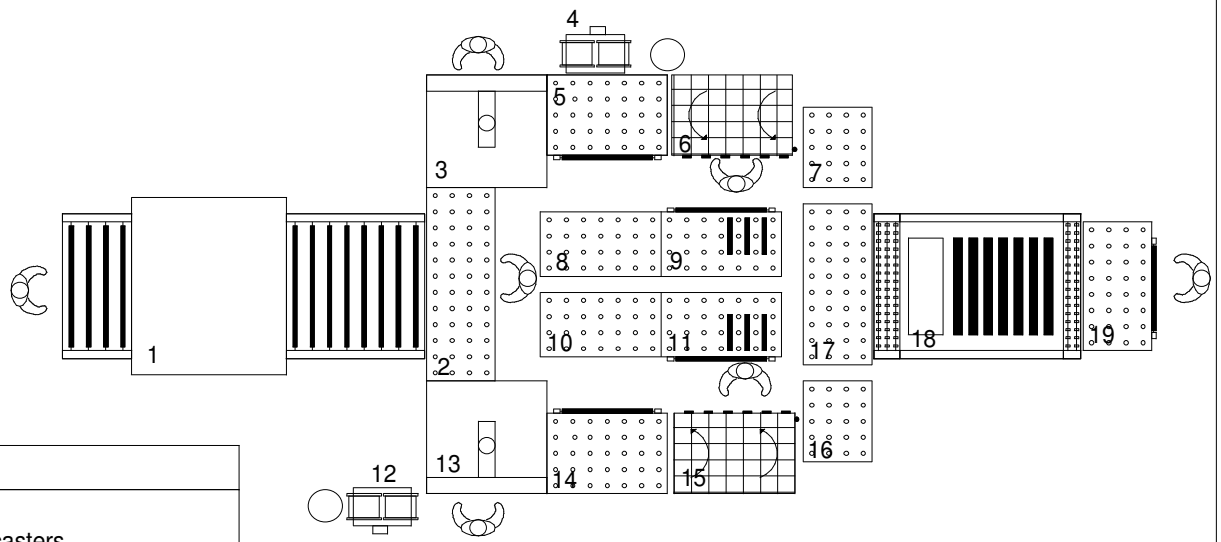
1. Keeping center lite clean is more difficult (cup needs to be "netted" to avoid cup mark/transfer).
2. More difficult to stack large units (ergonomics and keep clean).

Estimated UPMH:

60 second cycle = 13.7 UPMH (2' x 3' init) = 380 units/table, 760 IG per line, per shift.

Glass Flow:

A. The first lite is sent to table 3 or 13 for spacer application.
B. The second lite (top lite of the unit) is sent to table 9 for table 3 and table 11 for table 13.
C. After the first lite is applied it is sent to table 6 from table 3 and table 15 from table 13 and put into squares. The grid is inserted at this time.
D. The third lite fed is sent to tables 3 or 13 for the second application of spacer.
E. After spacer application the second applied lite is sent to table 5 for table 6 and table 14 for table 15.
F. The operators at tables 6 and 15 lift and place the second applied lite onto the first applied lite still in squares on their respective tables.
G. The operators at tables 6 and 15 will then take the last lite (2nd lite fed) and place it upon the two applied lites to complete the assembly.
H. The dealer assists the toppers with large lites.



Equipment Legend
1. 84" C-84MID Washer - 24FPM 2. 48" x 144" Caster Table - u channel - black paint & non marking casters 3. 84" x 84" Application Table 4. Dual Horizontal Spool Stand w/liner remover 5. 84" x 60" Caster Table w/non marking casters & non-marking off load roller 6. 60" x 84" Tilting Air Float Table 7. 48" x 60 Caster Table 8. 84" x 48" Caster Table - non marking casters 9. 84" x 48" Caster Table w/1 set topping boards, non marking casters & off load roller 10. 84" x 48" Caster Table - non marking casters 11. 84" x 48" Caster Table w/1 set topping boards, non marking rolls & off load roller 12. Dual Horizontal Spool Stand w/liner remover 13. 84" x 84" Application Table 14. 84" x 60" Caster Table w/non marking casters & non-marking off load roller 15. 60" x 84" Tilting Air Float Table 16. 48" x 60" Caster Table 17. 48" x 120" Caster Table 18. 84" 7 Roll Press 19. 48" x 96" Caster Table w/ off load roller

Customer Name: Triples - Method E	
Location:	Drawing Name: TRIPE1
Drawn By: Joe Almasy	Date: 2/10/09

Truseal IG Fabrication Process for Duralite Triple-Glazed w/Krypton Fill,

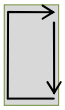
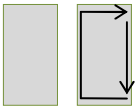
using a two-hole, two stream, sensor-fill, modified Method TRIPA1:

Background: This method is needed where muntins prohibit silicone time-fill lances to provide easy clearance to the bottom of the IG; bottom-fill supply is critical for krypton filling, given the extreme cost of krypton gas…….

1. First lites fed are sent to tables 3 and 15 for staging (as stated if the unit can be topped by one person; if the unit requires *two people to top*, then the first lite is sent to tables 10 and 12 for tables 4 and 14, respectively).
2. The next lite is sent to either table 4 or 14 for the first spacer application.
    a. Spacer application: Apply a first straight pass of spacer to a long leg, and finish with a three-sided, Cee-shaped trace pattern of Duralite to the two short and one remaining long connecting legs of the perimeter
        i. Start the first straight leg 7/16”/11mm from corner on a long leg and apply to the first side using the Pro Tool; cut the tail short of the corner by 7/16”/11mm as well.
        ii. Rotate the glass and start the three-sided “Cee-shaped” trace 1/8”/3mm short of the corner, and apply through two bent corners; lastly cut the last leg short of the glass edge by 1/8”/3mm.
    b. This detailing leaves the normal 1/8”/3mm gap for gas-filling through starting and ending with application of the tape to the remaining last leg, providing access for the fill lance at the bottom, as well as the sniffler at the top.
    c. Insert grids if this is the desired cavity for grids
3. After application, the operators at tables 4 or 14 will place the first applied lite into corner squares on their application table and flip and top the staged lite to the first applied lite with the lite from their adjacent table (if the unit requires two people to top, the first applied lite will be sent to table 7 for table 4 and table 16 for table 14).
4. The applicators then return the partially assembled unit back to the suction cup on their application table for the second application of spacer.
    a. With a second hand tool set for the first sandwich’s assembled height, apply the second spacer trace in the same exact fashion; all details should “line-up”.
    b. Insert grids if this is the desired cavity for grids
5. In all cases, the third and final lite is sent to table 10 for table 4 (or table 12 for table 14), and is to be flipped and topped after the second spacer application.
6. Press in the usual fashion

7. Krypton-Filling:
    a. Harp-rack the pressed IG with the "Cee" portion back-and-upright into the vertical rack, and the straight vertical trace portion facing out to the open aisle in gas-filling area.
    b. Set the flow rate to 2 lpm to drive fill-factors down.
    c. Insert the krypton 'fill lance' into the lower opening using a special block that facilitates penetration and also minimizes leakage during and after the filling cycle is completed.
    d. Insert the sniffler (with FDR-style spring clamps to prevent lance rotation) in the upper joint from the side, and initiate the fill cycle
    e. After sniffler triggers completion for sufficient fill level, remove and seal this top-opening in the usual fashion with removal, applied heat to 4th corner and Teflon stick; this completes the top joint.
    f. Flip the IG end-over-end 90°, such that the Kr-filling block and lance are now "up" and accessible to the gas-fill operator, and remove the Kr fill lance.
8. Repeat step #7e for the lower corner, and unit is complete.

Graphical Representation of Trace and Assembly Sequence

Method	Description of Method	View of bottom lite #1	View of center lite prior to assembly to first lite	View of Step Three	Requirements of Method	Positives of Method
Modified Method A **(using two strips of spacer, per cavity)**	"Two RH tools, but one at second application height"	 Std RH trace for lite #1	 Top w/clear as middle lite from staging table, then trace on stack w/second taller tool	 Top lite #3	-Second Cavity requires a second, special "taller" Pro Tool -Accuracy of topping clear lite dictates appearance of second trace -Dissimilar airspaces require two active spools	-Tails and corners align -Applied center lite can be flipped, ***pre-wiped*** & topped -Ease of gas filling, as all openings are aligned -Easiest access to seal 4th corner -Aesthetics are best