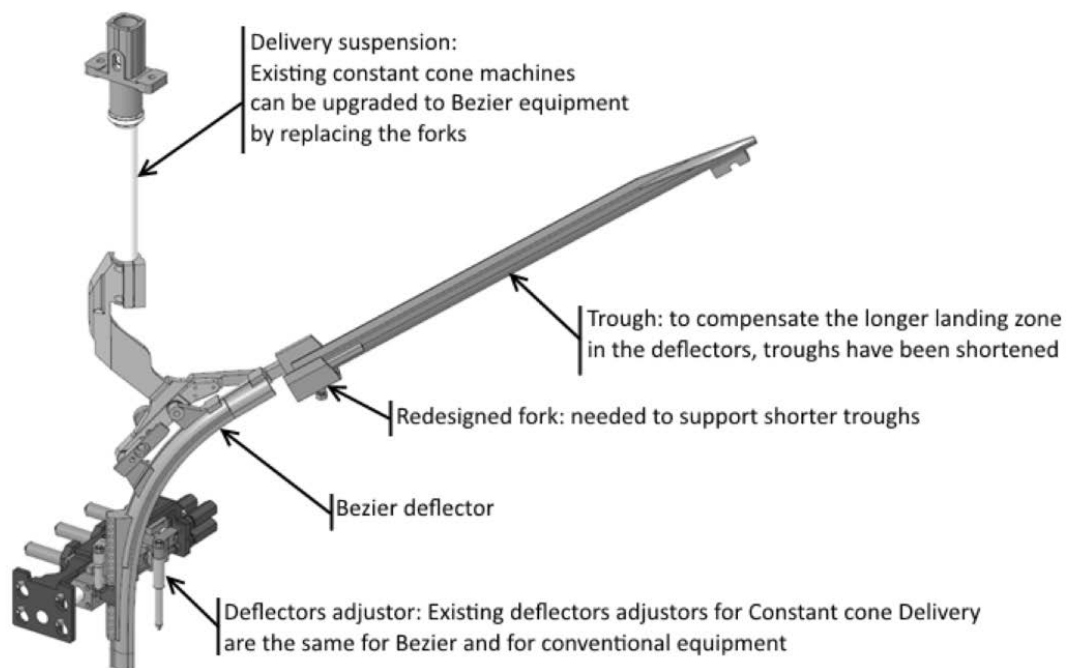


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Enhanced Gob Loading Constant Cone Bezier Delivery

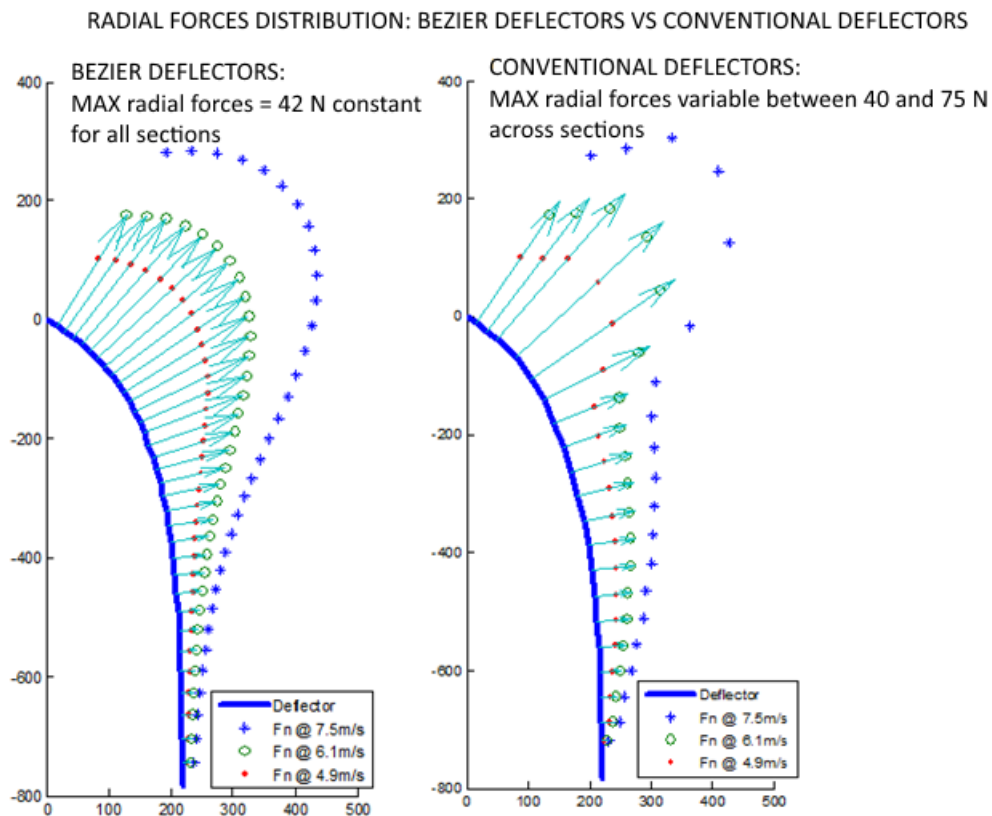
- Profile inspired by the Bezier curves
- Reduced gob entry angle variations
- Built in rack for easier setup, increased flexibility, spare parts optimization

Introduction

The Constant Cone Bezier Delivery is the latest development of the Constant Cone delivery launched by Bucher Emhart Glass in 2015 (TNB 235).

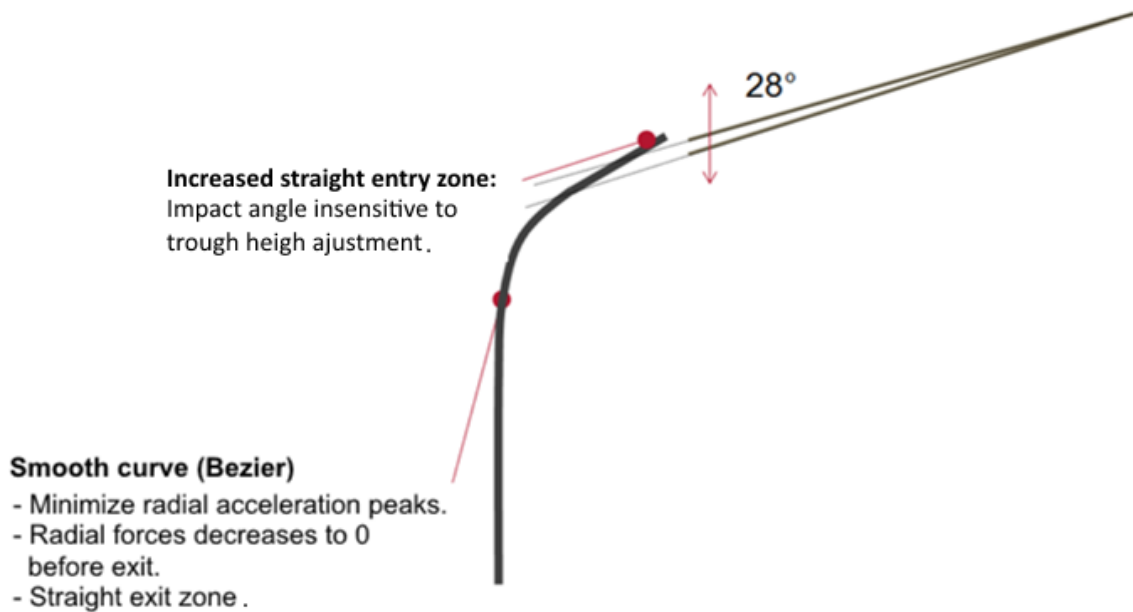
The Constant Cone Bezier Delivery system introduces a new family of Deflectors whose profile is inspired by the Bezier curves, a parametric function based on the Bernstein polynomial used since the 1960s to model smooth curves.

The application of a Bezier curve in the definition of the deflector profile results in a reduction and a homogeneity of the centripetal acceleration of the gobs during their transition through the deflector.



Picture 1: Plot of radial forces acting on deflectors, maximum radial force using Bezier curve is 42 N for all the sections, with 18000 series deflectors the maximum radial forces varies between sections from 40N to 75N.

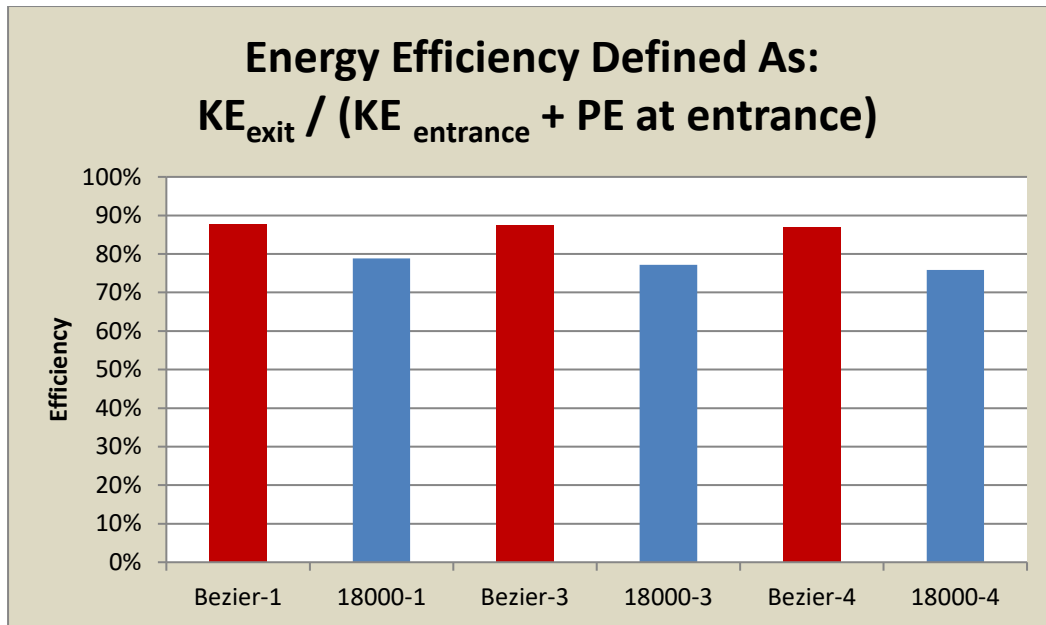
A straight extension has been added to the deflector's profile to maximize the advantages of the new curve, considering that in a Constant Cone Delivery all the troughs are having the same angle. The troughs for Constant Cone Bezier Delivery were shortened to compensate the additional straight extension at the deflector's entry.



Picture 2: Concept - Bezier curve with straight entrance

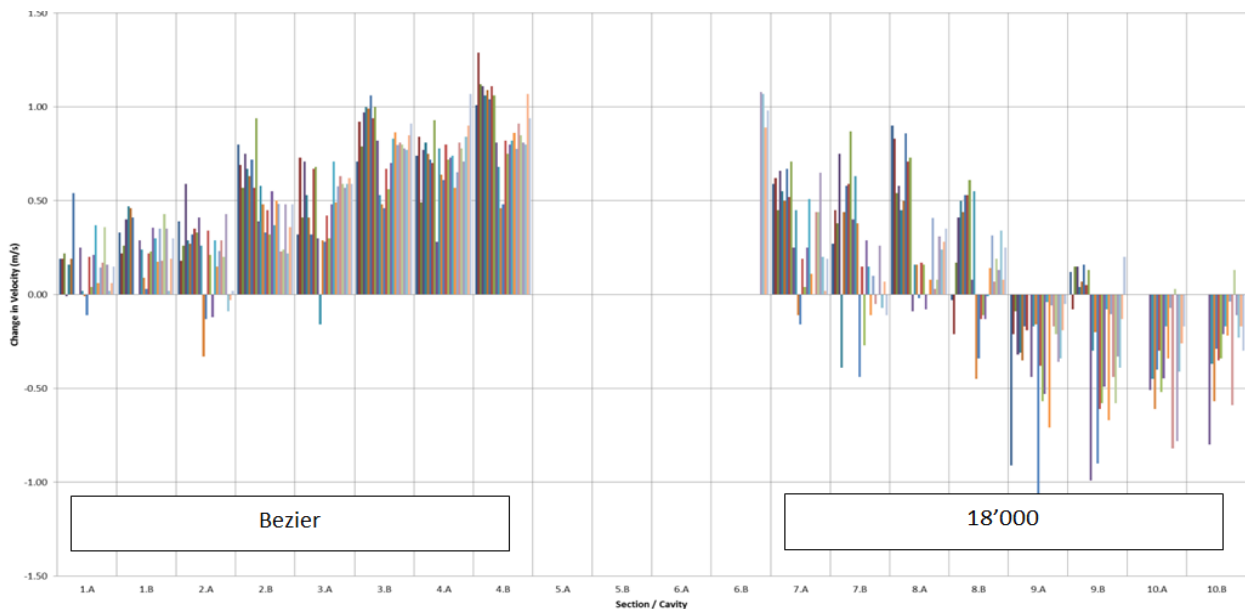
The advantages of the Constant Cone Bezier Delivery are:

- reduced gob entry angle variations
- reduced impact forces
- reduced and homogeneous normal forces along the sections and between cavities (see picture 1)
- less kinematical energy dissipation (See Picture 3)
- reduced gob shape variations
- increased loading stability (See Picture 4)
- higher loading speed (See Picture 4)
- longer coating lifetime (See Picture 5)



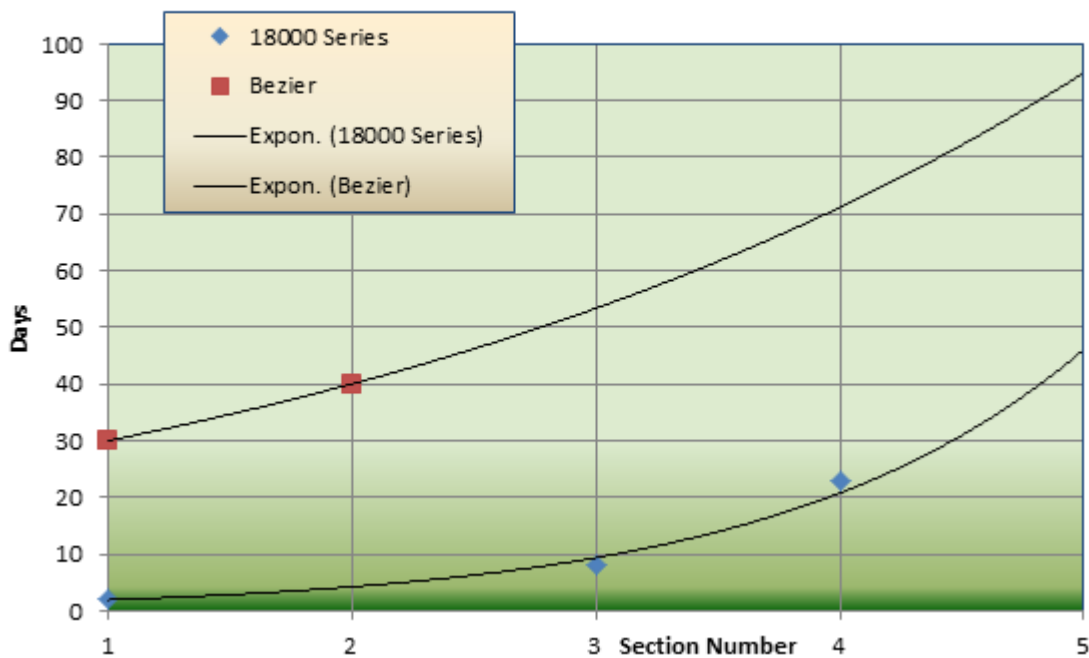
Picture 3: comparison of Energy efficiency between Bezier and conventional deflectors. The Bezier curve and the longer landing zone creates less Kinetic energy dissipation during the transition in the deflectors.

Legend: KE = Kinetic Energy, PE = Potential Energy

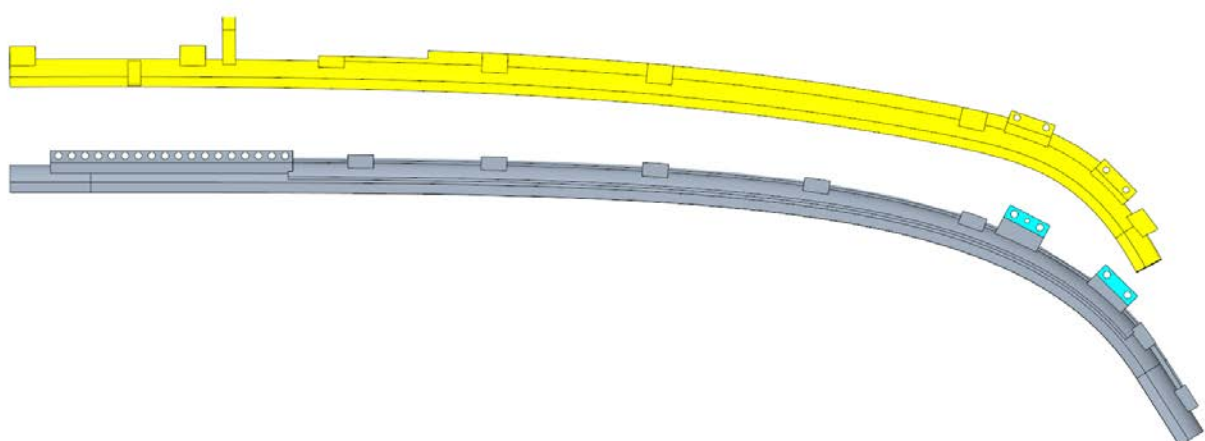


Picture 4: Changes in velocity Bezier Vs previous delivery from field trials on a 10 sections machine. Negative values means that gobs are decelerating during their transition through the delivery equipment.

Coating Life

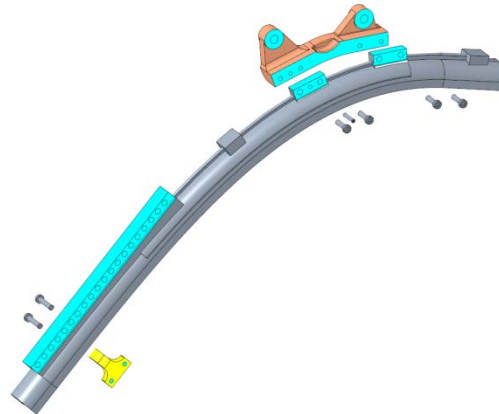


Picture 5: the graph shows the differences in terms of deflector coating duration between Bezier and conventional delivery. The reduction of the impact forces and the optimization of the radial forces have a huge impact on the coating life time.



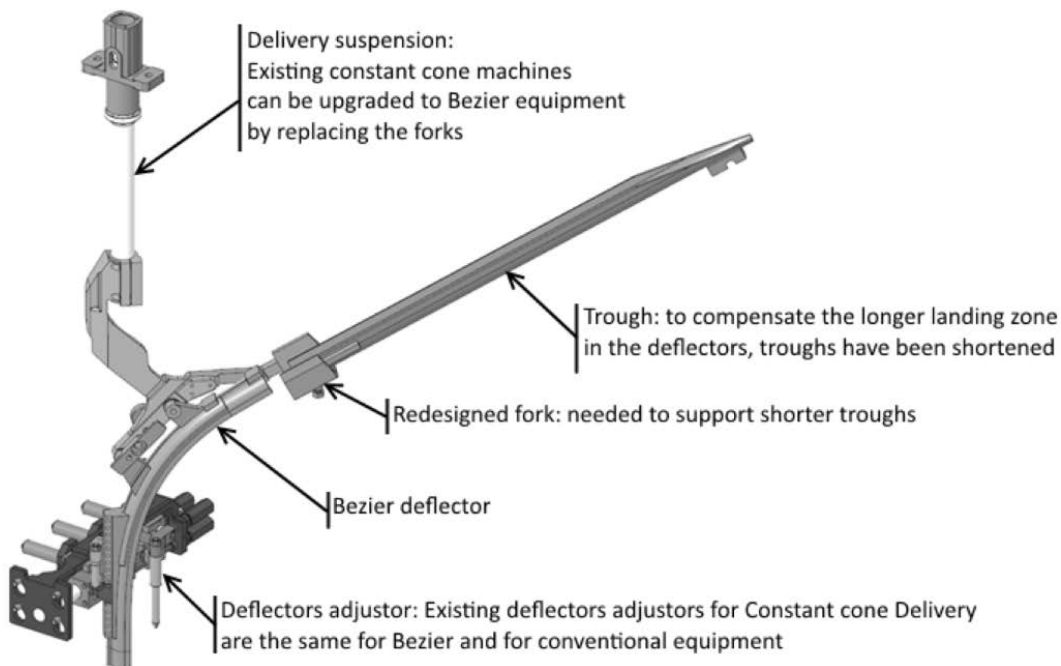
Picture 6: comparison of Bezier deflector (grey) and conventional deflector highlighting the larger curvature and the straight landing zone which are the key points in the Bezier design

The Bezier deflectors also present a redesigned lower lug, which is assembled on a rack. The rack is casted and machined as part of the deflector body and the lugs are separate parts which are assembled for specific cavities and sections. This configuration results in a higher flexibility for assembly and for spare parts orders.



Specification

The Constant Cone Bezier Delivery is available for IS, AIS, NIS and BIS machines. Existing machines with Constant cone delivery can be upgraded to Bezier equipment by replacing deflectors, troughs and forks.



Constant Cone Bezier Delivery master lists

| | | IS/AIS 6 sect | IS/AIS 8 sect | IS/AIS 10 sect | IS/AIS 12 sect | NIS 8 sect | NIS 10 sect | NIS 12 sect | BIS 8 sect | BIS 10 sect | BIS 12 sect |
|--------------------|----|---------------|---------------|----------------|----------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Delivery system | | 210-2150-00 | 210-2152-00 | 210-2154-00 | 210-2156-00 | 400-5403-00 | 400-5404-00 | 400-5405-00 | 401-1507-2 | 401-1509-2 | 401-1511-2 |
| Suspension | SG | 401-1364-12 | 401-1183-16 | 401-1227-12 | 401-1107-11 | N/A | N/A | N/A | N/A | N/A | N/A |
| Suspension | DG | 401-1364-9 | 401-1183-13 | 401-1227-9 | 401-1007-9 | 400-5222-2 | 400-5192-2 | 400-5147-2 | 401-1183-13 | 401-1227-9 | 401-1007-9 |
| Suspension | TG | 401-1364-10 | 401-1183-14 | 401-1227-10 | 401-1007-10 | 400-5223-2 | 400-5193-2 | 400-5148-2 | 401-1183-14 | 401-1227-10 | 401-1007-10 |
| Suspension | QG | N/A | N/A | N/A | N/A | 400-5224-2 | 400-5194-2 | 400-5149-2 | N/A | N/A | N/A |
| Deflector Adjustor | | 210-2051-00 | | | | 400-5087-00 | | | 401-1050-00 | | |
| Trough bracket | | 401-1182-00 | | | 401-1101-00 | 400-5138-00 | | | 401-1182-00 | 401-1101-00 | |
| Delivery equipment | | 401-1537-00 | 401-1515-00 | 401-1525-00 | 401-1532-00 | 400-5408-00 | 400-5410-00 | 400-5412-00 | 401-1515-00 | 401-1525-00 | 401-1532-00 |
| Set of Troughs | SG | | | | | N/A | N/A | N/A | N/A | N/A | N/A |
| Set of Troughs | DG | 401-1539-00 | 401-1517-00 | 401-1527-00 | 401-1534-00 | 400-5429-00 | 400-5417-00 | 400-5423-00 | 401-1517-00 | 401-1527-00 | 401-1534-00 |
| Set of Troughs | TG | | | | | 400-5430-00 | 400-5418-00 | 400-5424-00 | | | |
| Set of Troughs | QG | N/A | N/A | N/A | N/A | 400-5431-00 | 400-5419-00 | 400-5425-00 | N/A | N/A | N/A |
| Set of deflectors | SG | | | | | N/A | N/A | N/A | N/A | N/A | N/A |
| Set of deflectors | DG | 401-1538-00 | 401-1516-00 | 401-1526-00 | 401-1533-00 | 400-5426-00 | 400-5414-00 | 400-5420-00 | 401-1516-00 | 401-1526-00 | N/A |
| Set of deflectors | TG | | | | | 400-5427-00 | 400-5415-00 | 400-5421-00 | | | 401-1533-00 |
| Set of deflectors | QG | N/A | N/A | N/A | N/A | 400-5428-00 | 400-5416-00 | 400-5422-00 | N/A | N/A | N/A |

Application notes:

- (*) Delivery suspension for IS/AIS in Single gob uses double gob parts. Delivery equipment selection is limited to double gob sizes. (Deflectors from 3/8" to 1-3/4")
- (**) Single gob application on IS and AIS 6,8 and 10 sections is as subset of double gob for deflector sizes up to 1-3/4" and using troughs 0-2, 2-3 and #3-1/2
- (***) Single gob application with deflectors sizes from 1-3/4" to 2-3/4" needs a specific single gob suspension and is not planned to be Bezier type.
- (****) Standard troughs are in black steel fabricated. Trough sizes 0-2 and 2-3 for DG and TG machines are available in machined cast iron. Troughs double gob size #3-1/2 re available in machine cast iron only.

Installation Requirements

The Constant Cone Bezier Delivery can be specified as standard for all new machines.

Upgrade of existing machines already equipped with constant cone delivery is possible by replacing troughs and deflectors and by upgrading the suspension.

The suspension upgrade for Bezier equipment consists in the forks replacement.

| | | 12 SECTIONS | | | 10 SECTIONS | | | 8SECTIONS | | | 6 SECTIONS | | |
|---------|-----------|-------------|----|----|-------------|----|----|-----------|----|----|------------|----|----|
| | | DG | TG | SG | DG | TG | SG | DG | TG | SG | DG | TG | SG |
| FORK RH | 401-13097 | 12 | 18 | 6 | 10 | 15 | / | 8 | 12 | / | 6 | 9 | / |
| FORK LH | 401-13098 | 12 | 18 | 6 | 10 | 15 | / | 8 | 12 | / | 6 | 9 | / |

Features / Benefits

| Features | Benefits |
|-----------------------------|---|
| Smoother curve | Reduced radial forces → Reduced gob shape variation + increased loading stability + higher loading speed + longer coating life |
| Straight deflector entrance | Insensitive to trough eight adjusting, reduced impact forces → longer coating life + reduced gob shape variation + increased loading stability + higher loading speed |
| Built in rack | Easier setup, increased flexibility, spare parts optimization |