Important Points for Installation and Operation

1. Basic Guidelines Installation

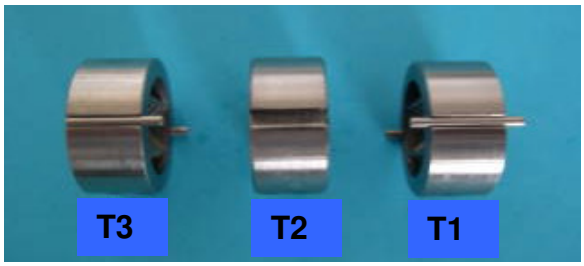
➔ Detail design and installation instructions of the complete mixing nozzle containing the SMN mixing elements are the responsibility of the nozzle manufacturer respectively the distributor (i.e. the supplier to the end user). ➔

Basic nozzle design and installation of the mixing elements:

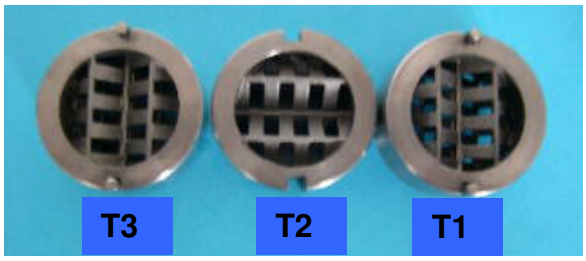
Putting together of the mixing elements:
There are three types of single mixing elements (see picture 1)

- Type 1 (T1): mixing element with pins extruding on both sides
- Type 2 (T2): mixing element with slots (no pins)
- Type 3 (T3): mixing elements with pins extruding on one side only

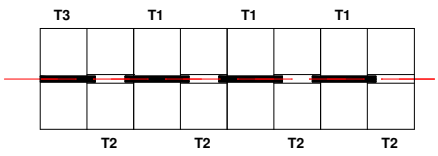
Mixing elements with pins and slots have to be put together alternatively in order to assure they are properly assembled and oriented 90º relative to each other (see picture 2).
Graphic 1 and picture 3 show the standard assembly of eight (8) SMN mixing elements consisting of three elements of type 1, four elements of type 2 and one element of type 3.



Picture 1: Three types of mixing elements: T1, T2 and T3



Picture 2: Orientation of slots and pins of the mixing elements T1, T2 and T3 relative to the mixer grid



Graphic 1: Assembly of eight (8) SMN mixing elements

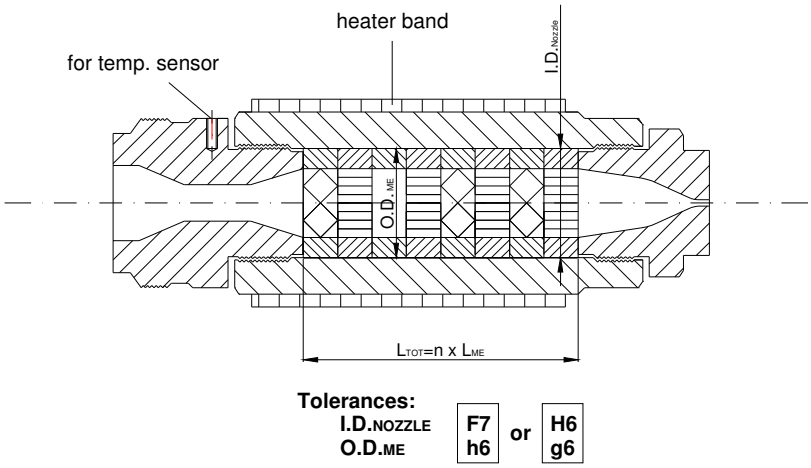
Picture 3: Assembly of eight (8) SMN mixing elements

Each single mixing element is flow symmetrical and can therefore be installed into the nozzle body in either direction.

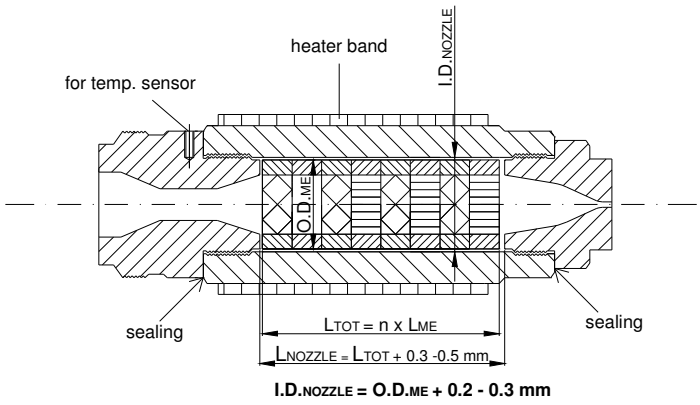
Installation of mixing elements into the nozzle body:
There are two principle installation methods of the mixing elements into the nozzle body:
For details see the following graphic 2 (showing recommended tolerances) and graphic 3.

- tight installation of the mixing elements with a narrow gap between the O.D. of the mixing elements and the I.D. of the nozzle body
- "floating" installation of the mixing elements into the nozzle body, i.e. there is a small gap between the mixing element O.D and the I.D. of the nozzle body which in operation is filled-up with polymer. The reason is to achieve about an identical pressure in the flow path of the mixing elements as well as in the outside gap to minimize mechanical stress on the mixing elements.

Graphic 2: Tight installation of mixing elements into nozzle bore



Graphic 3: "Floating" installation of mixing elements into nozzle bore



Temperature sensor:
Each nozzle should be equipped with a temperature sensor for temperature control in order to prevent a possible damage of the mixing elements during start-up and operation.

For installation follow the instructions of the supplier.

Heater bands:
The mixing nozzle has to be heated on the maximum possible outside surface.
The recommended heating capacity is 4 to 5 W/cm^2 of heated surface.

Installation of the heater bands to be made according to suppliers instructions. Previous to start-up shall be checked the fuse protection of the corresponding electrical circuit is adjusted to the capacity of the heater bands. Don't forget to tighten the heater band for good contact with the nozzle body after the first heating-up. Once in operation, the contact between heater band and the nozzle body has to be controlled periodically.

2. Basic Guidelines Operation

➔ Detailed operating instructions are the responsibility of the nozzle manufacturer respectively the distributor (i.e. the supplier to the end user). ➔

The following key points have to be considered for save start-up and save operation:

1. Installation of the nozzle according to the instructions of the nozzle supplier
   It is recommended to apply a grease containing copper for all threads to ensure sufficient heat conductivity between the individual nozzle parts.

2. Careful heating-up of the nozzle
   With the injection unit fully retracted, bring the barrel and the mixing head to operation temperature of the polymer to be processed.
   The nozzle has to be heated up until its temperature controller switches on and off the heating in regular intervals. Thereafter additional time is required (see below table point 3) to allow complete melting of the polymer in the nozzle.
   If heating-up is not done properly and operation is started before all polymer in the nozzle and transition pieces between the barrel and the SMN inlet is completely molten, there might be a risk to destroy the mixing element grid. Protection against a possible damage by unmolten material in the start-up phase would be achieved by the installation of a GPD (Grid Protection Disk – see next page point 3. Basic Guidelines Installation for SMF Filters and GPD Grid Protection Disk)

3. Recommended additional heating time:

SMN-12:	approx. 10 min.	SMN-27:	approx. 25 min.
SMN-18:	approx. 15 min.	SMN-33:	approx. 30 min.
SMN-22:	approx. 20 min	SMN-40:	approx. 35 - 40 min.

   The reason for the increasing heat-up time with increasing mixer diameter is the much thicker polymer "rod" which has to be heated up by thermal conductivity. Please note, polymer melts are insulators which have a very bad conductivity thus a longer time to complete melting also in the centre is needed. The polymer layer thickness to be heated in the screw section is much thinner than it is in the SMN mixer and thus takes less time to melt completely.

4. When the preset additional heat-up time has elapsed:
   - press the first polymer (about the volume of 3 to 5 shots) in extrusion mode out to the air. If any major resistance of the melt is felt (check sound), stop and soak for another 5 minutes and start again with extrusion. When the polymer is flowing regularly out of the nozzle switch to injection mode
   - inject the first 3 to 5 shots using a dosing time which is at least 3 times longer as the normal one under operating conditions
   - reduce injection/dosing time gradually - in 2 to 3 steps - to normal operating conditions
   - start with regular production .

5. If after fitting of the SMN mixing nozzle the oil pressure of the injection hydraulics has to be raised more than approx. 20 - 30 bar for achieving the required injection conditions, the mixing nozzle installed should be replaced by the next larger size.
   Maximum operating temperature: approx. 300 ºC.

6. If the operating conditions are changed (operating temperature, shot size, injection time, material) it has to be checked carefully whether the SMN mixing nozzle is suitable for the new conditions or not in order to avoid a possible damage of the mixer by a too high pressure drop across the mixer elements.
   Careful heat-up as for start-up is required again (repeat points 2 to 5).

7. For brief interruptions of operation the nozzle temperature settings may be lowered about 10 to 20 ºC. During longer interruptions the nozzle heating should be switched off completely. When starting production again the start-up procedure as per points 2 to 5 has to be observed.

8. Changing polymer or colorant
   Usually the static SMN mixing nozzle has not to be dismantled for cleaning. Due to the good self-cleaning behaviour the former polymer melt will be purged completely by the new one within a few shots.

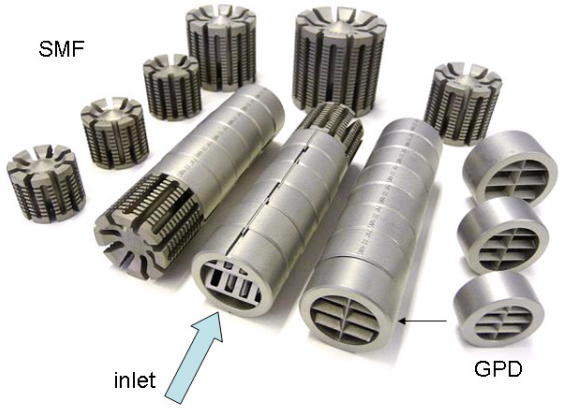
9. For cleaning of the mixing elements fluidized bed bath or vacuum pyrolysis can be applied. Heating above 400 ºC and open flame/blow torch cleaning is not allowed. Otherwise the strength of the heat treated mixing element material will be affected.

3. Basic Guidelines Installation for SMF Filters and GPD Grid Protection Disk

➔ Detail design and installation instructions of the complete mixing nozzle containing the SMN mixing elements, the SMF filters and the GPD Grid Protection Disk are the responsibility of the nozzle manufacturer respectively the distributor (i.e. the supplier to the end user). ➔

• **For both the SMF and GPD** retrofitting is possible without modification of the nozzle body

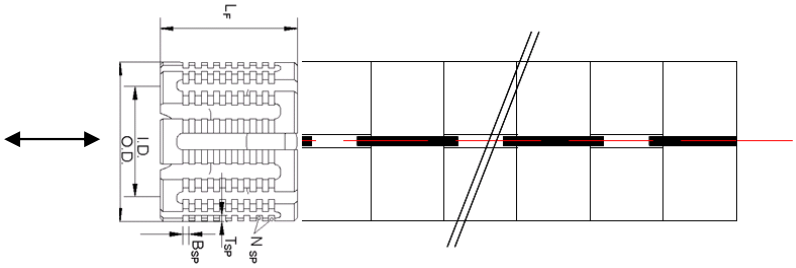
- O.D. of SMF filter and GPD Grid Protection Disk = O.D. of mixing elements
- Length of SMF filter = length of two mixing elements
- Length of GPD (grid protection disk) = length of one mixing element



Picture 4: Combination of SMN static mixing elements with SMF filter or GPD Grid Protection Disk.

Picture #4 shows the different installation combinations. On the left, the SMF filter is installed at the feed section (inlet) of the SMN static mixing elements; in the middle, the SMF filter is placed at the outlet; and on the right the first static mixing element has been replaced by the corresponding GPD Grid Protection Disk.

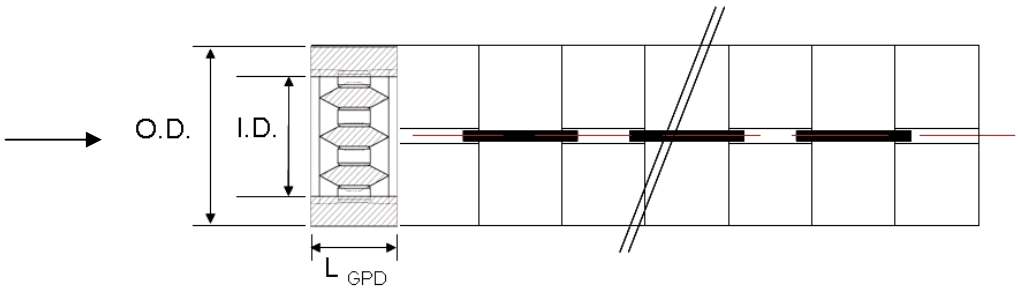
SMF FILTER DESIGN, INSTALLATION AND CHARACTERISTICS



L_F :	LENGTH OF FILTER
L_{ME}:	LENGTH OF MIXING ELEMENT
I.D.:	INSIDE DIAMETER
O.D.:	OUTSIDE DIAMETER
B_{SP}:	WIDTH OF SLOTS OF FILTER
T_{SP} :	DEPTH OF SLOTS OF FILTER
N_{SP} :	NUMBER OF SLOTS IN PARALLEL

View of SMF-Filter showing the installation – $L_F = 2 \times L_{ME}$

GPD – GRID PROTECTION DISK INSTALLATION AND CHARACTERISTICS



View of GPD showing the installation – $L_{GPD} = L_{ME}$