Important Points for Installation and Operation

1. Basic Guidelines Installation

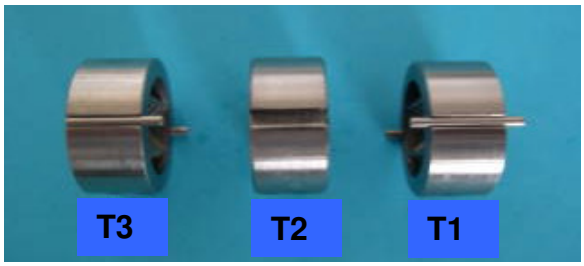
➔ Detail design and installation instructions of the complete melt blender containing the SMB-R or SMB-GXS mixing elements are the responsibility of the melt blender manufacturer respectively the distributor (i.e. the supplier to the end user). ➔

Basic melt blender design and installation of the mixing elements:

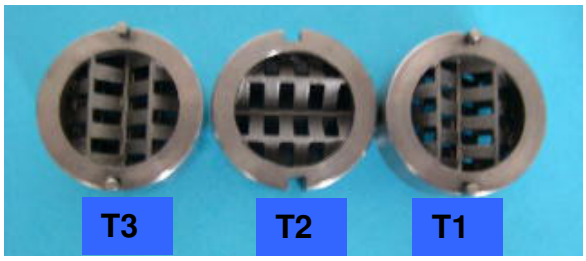
Putting together of the mixing elements:
There are three types of single mixing elements (see picture 1)

- 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

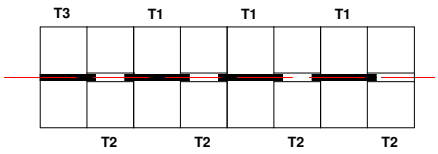
Mixing elements with pins and slots have to be put together alternatively in order to assure they are properly assembled and oriented 90º relative to each other (see picture 2).
Graphic 1 and picture 3 show the standard assembly of eight (8) SMB-R mixing elements consisting of three elements of type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

Picture 3: Assembly of eight (8) SMB-R mixing elements

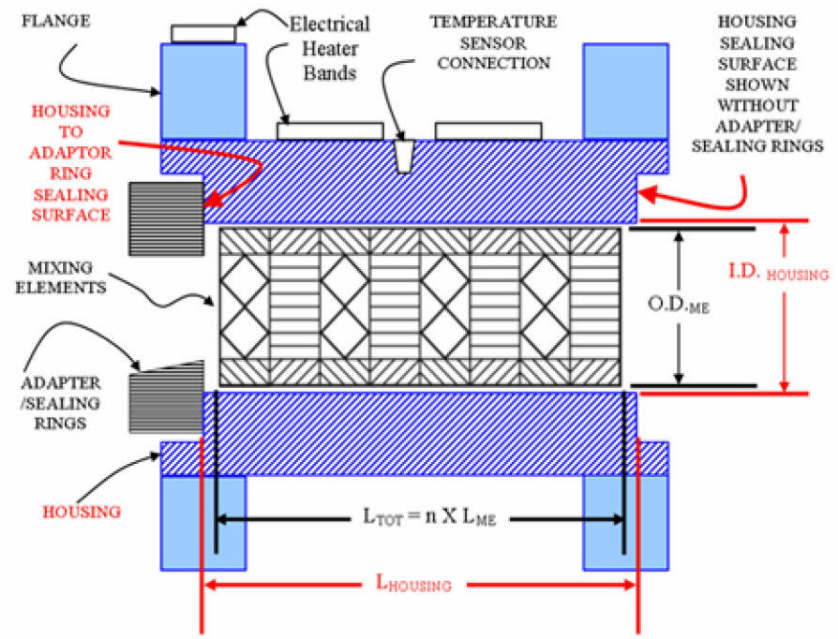
Each single mixing element is flow symmetrical and can therefore be installed into the melt blender in either direction. The mixing elements should always be installed in front of the die. This is especially important in applications such as blown film lines where a 90° change in polymer direction is necessary to feed the die.

Installation of mixing elements into the melt blender:
There are two principle installation methods of the SMB-R mixing elements into the melt blender housing:

- Tight installation of the SMB-R mixing elements with a narrow gap between the O.D. of the mixing elements and the I.D. of the housing body
- "Floating" installation of the SMB-R mixing elements into the housing body, i.e. there is a small gap between the mixing element O.D and the I.D. of the housing 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.

Figure #1 shows the basic design and principle methods of installing SMB-R mixing elements into a housing

Figure# 1: Schematic installation of SMB-R mixing elements into a housing body



Defintions:
N = Number of mixing elements
L_{ME} = Length of one (1) mixing element
L_{TOT} = Length of n mixing elements
$L_{Housing}$ = Length of Housing sealing surface to sealing surface
O.D. $_{ME}$ = Outside diameter of mixing elements
I.D. $_{Housing}$ = inside diameter of housing

Tight Installation of Mixing Elements in Housing Bore
Tolerances

I.D. $_{Housing}$	F7		H6
O.D. $_{ME}$	H6	or	G6

$L_{Housing}$ = L_{TOT} (Thermally sensitive polymers) = or =L_{TOT} + 0.3 to 0.5mm (not thermally sensitive polymers)

Floating Installation of Mixing Elements into Housing bore
I.D. $_{Housing}$ = O.D.$_{ME}$ + 0.2 to 0.3mm
$L_{Housing}$ = L_{TOT} + 0.3 to 0.5mm

Adaptor / Sealing Rings
The inside diameter of the Adaptor/Sealing Ring may be straight or tapered. However, the side facing the mixing element must have the dimension I.D.$_{ME}$

General Comments on Threads

a) Flanges: if the melt blender is to be permanently mounted on an extruder, it is recommended that a fine-thread be used to connect the flanges to the housing barrel. If frequent flange change-out is required to relocate Melt Blender to extruders with different connections, a coarse-thread is recommended to avoid thread stripping. Where flanges over 200mm are used, they should be heated.
b) Temperature Sensor Connection: A second temperature sensor connection is suggested to avoid thread stripping in the event the Melt Blender is required to be frequently relocated to other extruders that require different thermocouple types.

Temperature sensor:
Melt Blender housing should be equipped with a temperature sensor to control housing heater band operation on a dedicated circuit. This is required to assure heat is supplied to the housing to prevent possible damage of the mixing elements during start-up and operation. For thermocouple installation and operation, follow the instructions of the thermocouple supplier.

Heater bands:
The Melt Blender housing must be heated on the outside surface. Housing heater bands and thermocouple must be connected to a dedicated auto tuned control zone to assure than an accurate housing temperature is maintained. The recommended heating capacity is 4 to 5 W/cm^2 of heated surface. If the housing is flanged, it is advisable to provide heater bands for flanges with outside diameter greater than 200mm. Installation and operation of the heater bands should be made in accordance to the supplier's instructions.

Assurance of good tight contact between the heater bands and housing body should be verified before and after the first heat-up. Once in operation, continued good contact between heater band and housing body should be checked periodically.

2. Basic Guidelines Operation

➔ Detailed operating instructions are the responsibility of the Melt Blender 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. Maximum Operating Conditions
   A standard SMB-R Mixing Element Assembly with eight (8) static mixing element is designed for the following maximum operating conditions:
   a) 300°C maximum continuous operating temperature
   b) 80 bar maximum allowable pressure drop
   Where these limits are expected to be exceeded, special melt Blenders are available.

   The maximum admissible throughput for a melt blender depends on the viscosity of the polymer at the processing temperature and shear rate. Before changing over to another polymer therefore, always make sure that the maximum admissible pressure drop of the melt blender will not be exceeded under the specific operating conditions.

2. Installation of the Melt Blender according to the instructions of the supplier
   It is recommended to apply a grease containing copper for all threads to ensure sufficient heat conductivity between the individual melt blender parts.

3. Careful heating-up of the Melt Blender
   The SMB Melt Blender must be allowed to soak at the operating temperature so that all internal parts of the mixing element fingers and frozen polymer within the mixing elements is melted and is at operating temperature prior to processing polymer. Because melting is brought about solely by heat conduction, it is advisable to set the temperature around the melt blender some 10-20°C higher than the operating temperature provided the material in question can tolerates this.
   If heating-up is not done properly and operation is started before all polymer in the melt blender and transition pieces between the barrel and the SMB-R inlet is completely molten, there might be a risk to destroy the mixing element grid.

4. Recommended additional heating time:

SMB-R-32 or SMB-GXS-25/32:	~25 min.	SMB-R-75 or SMB-GXS-65/75:	~45 min.
SMB-R-48 or SMB-GXS-40/48:	~35 min.	SMB-R-90 or SMB-GXS-80/90:	~50 min.
SMB-R-60 or SMB-GXS-50/60:	~40 min	SMB-R-115 or SMB-GXS-100/115:	~55 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 SMB-R mixer and thus takes less time to melt completely.

5. "Cold Start" Protection
   To check if the polymer is in fact completely melted, it is advisable before starting production to measure the temperature of the polymer/compound upstream of the melt blender. If the extruder operator feels uncomfortable assuring that all polymer is completely molten upstream of the mixing elements and inside the mixing elements during start-up (to prevent a possible cold start induced mixing element failure), it is recommended that upstream and downstream breaker plates be installed where the holes are about 1/10th of the inside diameter of the mixing element

   a) Upstream Breaker Plate:
      An upstream breaker plate will prevent a "rod" of frozen polymer from upstream equipment striking the mixing elements. This "rod" of frozen upstream polymer originates from empty

transition pieces connecting the filter, gear pump and mixer. When a "Cold Start" mixing element failure occurs, most instance are the results of a "rod" of frozen polymer originating in improperly heated upstream transition pieces which an upstream breaker plate could have stopped.

b) Downstream Breaker Plate:
A downstream breaker plate will protect the downstream die from being possibly damaged during a cold start mixing element failure induced by start-up with frozen polymer within the mixing element assembly or upstream of the mixing element assembly.

6. Interruption of Extrusion Operations
   a) For brief interruptions of extrusion operations, temperature to the Melt Blender Housing may be lowered about 10-20℃.
   b) During longer interruptions, the heating should be switched off completely.
   c) For normal and emergency shutdowns when thermally sensitive polymers are being processed, normal purge procedures prior to shut-down should be followed. The static mixer should be purged with a purging compound so that upon next start-up, the long soak time required does not cause polymer degradation. Polymer degradation may cause carbonization within the mixing elements, housing and transition pieces requiring auxiliary equipment burn-out.
   d) In all above cases, the above procedures starting with point 3 must be followed for re-start of normal operations

7. Color changes
The SMB-R Mixing Elements have a very narrow residence time distribution. This means that when changing polymers or color, the contents of the mixing elements will be purged completely in a short period of time by the new material (approx. 5 mixing element residence times). In the event streaks of color are observed after a color change, it is probably material that is hung-up somewhere downstream of the mixing elements that is breaking-off slowly/intermittently. If a hue of color appears continuously or intermittently that is blended throughout the extruded polymer, it is probably material that is hung-up somewhere in the upstream equipment such as the extruder screw flights, filter, gear pump assembly or upstream transition pieces which is breaking-off/purging slowly/intermittently and is being mixed by the mixing elements. The SMB-R mixing elements will mix all upstream color hang-up breakthrough material so tha a well blended hue of color will appear. Continue color change-over operations until the equipment upstream and downstream of the static mixer have purged.
A useful technique for achieving rapid color changes/purging is to heat the Melt Blender above normal operating temperature which decreases the viscosity of the polymer inside the mixer, and at the same time decrease the temperature of the polymer in the screw that increases the viscosity of the polymer. Purging a low viscosity polymer with a high viscosity polymer push will enhance color purging.

8. Cleaning of Mixing Elements
   a) open flame cleaning of mixing elements is prohibited because it is detrimental to the 17-4 PH mixing element material heat treatment
   b) If the mixing elements require cleaning, a purge compound is recommended. If a complete removal of polymer is required, a fluidized bed bath or a vacuum pyrolysis oven is recommended. Maximum cleaning temperature should be 400℃ to retain the integrity of the 17-4 PH mixing element material heat treatment.
   c) If removing the mixing elements from the housing is necessary for inspection or cleaning, a number of options are available for removal:
      With Melt Blender installed on extruder, remove downstream equipment and while polymer is still warm, slowly extrude the mixing elements out of the housing.
      With the Melt Blender installed on extruder, if the polymer is frozen in the housing, remove downstream equipment, warm the housing slightly to melt polymer near the wall and then extrude the mixing elements out of the housing.
      If bench removal of the mixing elements is desired and must be done cold, the mixing elements may be rammed out of the housing with the stipulation that the rod used to ram the mixing elements out of the housing (normally aluminium or wood for light weight) is flat at the end and is near the full inside diameter of the housing so that the force of ramming is carried out by the outside ring of the mixing elements and that no force is imparted on the finger bars of the mixing elements.

9. Flat Sheet and Flat Film Applications
   a) For flat sheet and flat film extrusion applications, the last mixing element (just in front of the die) should be installed so that the eight (8) parallel bars of the mixing element run parallel (same direction) to the width of the die
   b) This is especially true for foamed films and sheet
   c) For sheets thicker than 4mm, a distance of 1-2 pipe diameters between mixer outlet and die inlet is recommended.