Claims

1. Calibration device (30) for an extruded plastic profile strand for calibrating the extruded plastic profile strand into a calibrated plastic profile (50) comprising
a calibrator body (31) with at least one channel (34, 35, 36; 37, 37a, 37b, 37c), which extends in a movement direction (F) and has at least one inlet and one outlet and has a cross-sectional shape perpendicular to the movement direction (F) at the outlet, which corresponds to the calibrated external cross-section of the plastic profile (50) to be calibrated,
characterized
in that the calibrated plastic profile (50) comprises at least two complementary elements (51c, 52h, 52c, 52d; 52c, 51h, 51d, 51e; 51h, 51f, 51g, 52g; 52h, 52f, 52g, 51g; 53c, 53h, 53d, 53e) in the calibrated state on the output side (33), which complementary elements form a form fit in the cross section perpendicular to the movement direction (F), and
in that the at least one channel (34, 35, 36; 37, 37a, 37b, 37c) has a cross-sectional shape perpendicular to the movement direction (F) at the inlet in which the at least two complementary elements (51c, 52h, 52c, 52d; 52c, 51h, 51d, 51e; 51h, 51f, 51g, 52g; 52h, 52f, 52g, 51g; 53c, 53h, 53d, 53e) of the plastic profile (50) to be calibrated are separated perpendicular to the movement direction (F) and do not form a positive fit, and
in that the at least one channel (34, 35, 36; 37, 37a, 37b, 37c) is designed from the inlet to the outlet such that the at least two complementary elements (51c, 52h, 52c, 52d; 52c, 51h, 51d, 51e; 51h, 51f, 51g, 52g; 52h, 52f, 52g, 51g; 53c, 53h, 53d, 53e) of the at least one channel are formed along the movement direction (F) in a manner (Q1, Q2, Q3) bringing them progressively closer to each other and then together into one calibrating channel region (36; 37c) in such a way that the sections of the extruded plastic profile strand forming the at least two complementary elements (51c, 52h, 52c, 52d; 52c, 51h, 51d, 51e; 51h, 51f, 51g, 52g; 52h, 52f, 52g, 51f; 53c, 53h, 53d, 53e) are brought into form fit at the outlet by plastic and/or elastic deformation.

2. Calibration device according to claim 1, wherein
the at least one channel (34, 35, 36) comprises the (first) cross-sectional shape perpendicular to the movement direction (F) on the side of the at least one inlet such that at least two separate inlets (34, 35) are formed such that one (51c; 51h, 51d, 51e; 51h, 51f, 51g; 51g) of the at least two complementary elements of the plastic profile to be calibrated can enter the

channel in one (34) of the separate inlets and another one (52h, 52c, 52d) of the at least two complementary elements of the plastic profile (50) to be calibrated can enter the channel in another one (35) of the separate inlets; 52c; 52g; 52h, 52f, 52g), and comprises the (second) cross-sectional shape (36) on the outlet side which corresponds to the calibrated external cross-section of the plastic profile to be calibrated.

3. Calibration device according to claim 1, wherein
the at least one channel (37, 37a, 37b, 37c) comprises the (first) cross-sectional shape perpendicular to the movement direction (F) on the side of the at least one inlet in such a way that one inlet (37, 37a, 37b, 37c) is formed in such a way that each one (53c; 53h, 53d, 53e) of the at least two complementary elements of the plastic profile (50) to be calibrated can enter the channel spatially separated each in another area (37a, 37b) of the same inlet, and comprises the (second) cross-sectional shape (37c) on the side of the outlet which corresponds to the calibrated outer cross-section of the plastic profile (50) to be calibrated.

4. Calibration device (30) according to one of the claims 1 to 3, wherein
the calibrator body (31) has an input side (32) and an output side (33), which is arranged on a side of the calibrator body (31) opposite the input side (32) in a movement direction (F), and the at least one channel (34, 35, 36; 37, 37a, 37b, 37c) extends from the input side (32) to the output side (33) and has a first cross-sectional shape perpendicular to the movement direction (F) on the input side (32), in which the at least two complementary elements (51c, 52h, 52c, 52d; 52c, 51h, 51d, 51e; 51h, 51f, 51g, 52g; 52h, 52f, 52g, 51g; 53c, 53h, 53d, 53e) of the plastic profile (50) to be calibrated are separated perpendicular to the movement direction (F) and do not form a positive fit, and on the output side (33) has a second cross-sectional shape perpendicular to the movement direction (F) on the output side (33), which corresponds to the calibrated outer cross-section of the plastic profile (50) to be calibrated,
the channel regions of the at least one channel which calibrate the at least two complementary elements (51c, 52h, 52c, 52d; 52c, 51h, 51d, 51e; 51h, 51f, 51g, 52g; 52h, 52f, 52g, 51g; 53c, 53h, 53d, 53e) of the plastic profile (50) to be calibrated comprise in a region along the movement direction (F) in which the sections of the extruded plastic profile strand forming the at least two complementary elements (51c, 52h, 52c, 52d; 52c, 51h, 51d, 51e; 51h, 51f, 51g, 52g; 52h, 52f, 52g, 51g; 53c, 53h, 53d, 53e) are brought into a form fit by plastic and/or

elastic deformation, an overmeasure relative to the added dimensions of the at least two complementary elements (51c, 52h, 52c, 52d; 52c, 51h, 51d, 51e; 51h, 51f, 51g, 52g; 52h, 52f, 52g, 51g; 53c, 53h, 53d, 53e) of the extruded plastic profile strand.

5. Calibration device (30) according to one of the claims 1 to 4, wherein
the calibrator body (31) has cooling channels (31k), preferably at least one of which extends between channel regions which come continuously closer to one another, and/or
the at least one channel (34, 35, 36; 37, 37a, 37b, 37c) is designed in such a way that the extruded plastic profile strand can be moved in the movement direction (F) through the calibrator body (31) by drawing the calibrated plastic profile (50) downstream of the outlet.

6. Calibration device (30) according to one of the claims 1 to 5, wherein
the plastic profile (50) to be calibrated comprises at least two complementary elements (51c, 52h, 52c, 52d; 52c, 51h, 51d, 51e; 51h, 51f, 51g, 52g; 52h, 52f, 52g, 51g; 53c, 53h, 53d, 53e) on the output side (33) in the calibrated state such that the one first complementary element is a protrusion (51c; 52c; 51g; 52g; 53c) with a stem (51s; 52s) and a head (51k; 52k) at the free end of the stem (51s; 52s), wherein the head (51k; 52k) has a larger diameter (51kd; 52kd) in cross section than the stem, and that the other second complementary element is a recess (51h; 52h; 53h) which, in the calibrated state, is adapted to receive the head (52k; 51k) and is delimited by two lateral wall elements (52c, 52d; 51d, 51e; 51f, 51g; 52f, 52g; 53d, 53e), which are preferably formed by protrusions, such that the opening (51o; 52o) of the recess has a diameter (51od; 52od) in cross section which is greater than the diameter (52sd; 51sd) of the stem (52s; 51s) but smaller than the diameter (52kd; 51kd) of the head (52k; 51k) of the first complementary element, such that there is a form fit of the recess (51h; 52h; 52h) with the head (52k; 51k) in cross section enclosing the head in two opposite directions, and
the at least one channel (34, 35, 36; 37, 37a, 37b, 37c) is formed from the inlet to the outlet such that the channel regions of the at least one channel which calibrate the protrusion (51c; 52c; 51g; 52g; 53c) and the lateral wall elements (52c, 52d; 51d, 51e; 51f, 51g; 52f, 52g; 53d, 53e) delimiting the recess (51h; 52h; 53h) of the plastic profile (50) to be calibrated, are designed to continuously approach each other (Q1, Q2, Q3) and then brought together in one calibrating channel region (36; 37c) for pressing the protrusion into the recess under plastic and/or elastic deformation.

7. Method for calibrating an extruded plastic profile strand into a calibrated plastic profile (50) which, in the calibrated state, comprises at least two complementary elements (51c, 52h, 52c, 52d; 52c, 51h, 51d, 51e; 51h, 51f, 51g, 52g; 52h, 52f, 52g, 51g; 53c, 53h, 53d, 53e) which, in cross section perpendicular to a longitudinal direction of the calibrated plastic profile (50), form a form fit, comprising the steps:
inserting at least one extruded plastic profile strand to be calibrated into at least one channel (34, 35, 36; 37, 37a, 37b, 37c) of a calibrator body (31) in such a way that the at least one plastic profile strand to be calibrated can move in a movement direction (F) from an input side (32) of the calibrator body (31) to an output side (33), which is arranged on a side of the calibrator body (31) opposite the input side (32) in the movement direction (F), through the calibrator body (31), and that the at least one plastic profile strand to be calibrated has, upon insertion, a cross-sectional shape perpendicular to the movement direction (F), in which the at least two complementary elements (51c, 52h, 52c, 52d; 52c, 51h, 51d, 51e; 51h, 51f, 51g, 52g; 52h, 52f, 52g, 51g; 53c, 53h, 53d, 53e) of the plastic profile (50) to be calibrated are separated perpendicular to the movement direction (F) and do not form a form fit;
moving the plastic profile strand to be calibrated in the movement direction (F) from the input side (32) of the calibrator body (31) to the output side (33) through the at least one channel and calibrating the plastic profile strand during this movement; and
outputting the calibrated plastic profile (50) at the output side (33),
wherein,
while moving through the at least one channel (34, 35, 36; 37, 37a, 37b, 37c),
the sections of the extruded plastic profile strand forming the at least two complementary elements (51c, 52h, 52c, 52d; 52c, 51h, 51d, 51e; 51h, 51f, 51g, 52g; 52h, 52f, 52g, 51g; 53c, 53h, 53d, 53e) are continuously brought closer to each other (Q1, Q2, Q3) along the movement direction (F) and then brought together (Q4) and thereby brought into a form fit by plastic and/or elastic deformation, so that the at least two complementary elements (51c, 52h, 52c, 52d; 52c, 51h, 51d, 51e; 51h, 51f, 51g, 52g; 52h, 52f, 52g, 51g; 53c, 53h, 53d, 53e) form a positive fit in the cross section perpendicular to the longitudinal direction of the calibrated plastic profile (50).

8. The method according to claim 7, wherein
in the inserting step, at least two extruded plastic profile strands are inserted into at least one channel (34, 35, 36; 37, 37a, 37b, 37c) of the calibrator body (31) in at least two separate inlets (34, 35) in such a way that one (51c; 51h, 51d, 51e; 51h, 51f, 51g; 51g) of the at least two complementary elements of the plastic profile to be calibrated enters into one (34) of the separate inlets as part of one of the at least two extruded plastic profile strands and another one (52h, 52c, 52d; 52c; 52g; 52h, 52f, 52g) of the at least two complementary elements of the plastic profile strand to be calibrated enters the channel in another one (35) of the separate inlets and these are thus separated perpendicular to the movement direction (F) and do not form a form fit.

9. The method according to claim 8, wherein
the at least two extruded plastic profile strands, when moving in the movement direction (F) from the input side (32) of the calibrator body (31) to the output side (33), are first moved through two channel regions (34, 35) which are separate from each other and are brought closer to each other (Q1, Q2, Q3) and calibrated and then brought together (Q4) in one channel region (36) and thereby brought into the form fit by elastic deformation without plastic deformation, in that the deformation is limited by the design of the channel regions in such a way that elastic deformation of the already firm but still soft complementary elements takes place without plastic deformation.

10. The method according to claim 8, wherein
the at least two extruded plastic profile strands, when moving in the movement direction (F) from the input side (32) of the calibrator body (31) to the output side (33), are first moved through two channel regions (34, 35) which are separate from each other andare thereby continuously brought closer together (Q1, Q2, Q3) under deformation and calibrated and then brought together (Q4) in one channel region (36) and thereby brought into the form fit by plastic deformation, in that the deformation is controlled by the design of the channel regions in such a way that plastic deformation of the already firm but still soft complementary elements takes place.

11. The method according to claim 7, wherein
in the inserting step, the at least one extruded plastic profile strand is inserted into the at least one channel (34, 35, 36; 37, 37a, 37b, 37c) of the calibrator body (31) in such a way that each one (53c; 53h, 53d, 53e) of the at least two complementary elements (53c, 53h, 53d, 53e) of the plastic profile (50) to be calibrated enters the channel in a different region (37a, 37b) of the same inlet in a spatially separated manner.

12. The method according to any one of claims 7 to 11, wherein
the plastic profile (50) to be calibrated comprises at least two complementary elements (51c, 52h, 52c, 52d; 52c, 51h, 51d, 51e; 51h, 51f, 51g, 52g; 52h, 52f, 52g, 51g; 53c, 53h, 53d, 53e) on the output side (33) in the calibrated state such that the one first complementary element is a protrusion (51c; 52c; 51g; 52g; 53c) with a stem and a head at the free end of the stem, wherein the head has a larger diameter in cross section than the stem, and that the other second complementary element is a recess (51h; 52h; 53h) which, in the calibrated state, is adapted to receive the head and is surrounded by two lateral wall elements (52c, 52d; 51d, 51e; 51f, 51g; 52f, 52g; 53d, 53e), which are preferably formed by protrusions, such that the opening of the recess has a diameter in cross section which is larger than the diameter of the stem but smaller than the diameter of the head of the first complementary element, so that in cross section there is a form fit of the recess with the head enclosing the head in two opposite directions, and
while moving through the at least one channel (34, 35, 36; 37, 37a, 37b, 37c),
the sections of the extruded plastic profile strand forming the protrusion (51c; 52c; 51g; 52g; 53c) and the recess (51h; 52h; 53h) are continuously brought closer to other (Q1, Q2, Q3) along the movement direction (F) and are subsequently brought together (Q4) and thereby the protrusion (51c; 52c; 51g; 52g; 53c) is pressed into the recess (51h; 52h; 53h) with plastic and/or elastic deformation of the head and/or the lateral wall elements (52c, 52d; 51d, 51e; 51f, 51g; 52f, 52g; 53d, 53e).

13. Calibrated plastic profile (50) extending in a longitudinal direction and having a cross-sectional shape perpendicular to the longitudinal direction and comprising two separate calibrated plastic profile strands (51, 52) and four complementary elements (51c, 52h, 52d,

52e; 52c, 51h, 51d, 51e; 51h, 51f, 51g, 52g; 52h, 52f, 52g, 51g), of which pairs of two each form a form fit in cross section, wherein

a first complementary element on a first plastic profile strand (51) of the two separate plastic profile strands is formed as a first protrusion (51c; 51g) with a stem (51s) and a head (51k) at the free end of the stem, in which the head (51k) has a larger diameter (51kd) in cross section than the stem (51sd),

a second complementary element on a second plastic profile strand (52) of the two separate plastic profile strands is formed as a first recess (52h) which, in the calibrated state, is adapted to receive the head (51k) of the first protrusion and is delimited by two lateral wall elements (52d, 52e; 52f, 52g) in such a way that the opening of the first recess (52h) has a diameter in cross section which is larger than the diameter (51sd) of the stem (51s) but smaller than the diameter of the head (51k) of the first protrusion (51c; 51g), so that there is a form fit of the first recess with the head of the first protrusion enclosing the head in two opposite directions in cross section and the two separate plastic profile strands (51, 52) are thus connected by form fit to form a plastic profile, and

a third complementary element on the second plastic profile strand (52) is formed as a second protrusion (52c; 52g) with a stem and a head at the free end of the stem, in which the head has a larger diameter in cross section than the stem,

a fourth complementary element on the first plastic profile strand (51) is formed as a second recess (51h) which, in the calibrated state, is adapted to receive the head of the second protrusion (52c; 52g) and is delimited by two lateral wall elements (51d, 51e; 51f, 51g) in such a way that the opening (51o) of the second recess (51h) has a diameter (51od) in cross section which is larger than the diameter of the stem but smaller than the diameter of the head of the second protrusion (52g), so that there is a form fit of the second recess with the head of the second protrusion enclosing the head in two opposite directions in cross section and the two separate plastic profile strands (51, 52) are thus connected by form fit to form a plastic profile,

in which the protrusions (51c; 52c; 51g; 52g) and the recesses (51h; 52h) are designed in such a way that the two separate calibrated plastic profile strands (51, 52) can be displaced relative to one another in the longitudinal direction at room temperature,

characterized

in that, in the first protrusion (51c; 51g), the head (51k) comprises a diameter (51kd) in cross section that is at least 2 times larger than a diameter (51sd) of the stem (51s),

in that, in the first recess (52h), the opening comprises a diameter in cross section that is 5 to 50 % larger that the diameter (51sd) of the stem (51s) of the first protrusion,
in that, in the second protrusion (52c; 52g), the head (52k) comprises a diameter (52kd) in cross section that is at least 2 times larger than a diameter (52sd) of the stem (52s),
in that, in the second recess (51h), the opening comprises a diameter in cross section that is 5 to 50 % larger that the diameter (52sd) of the stem (52s) of the second protrusion,
in that the form fit of the four complementary elements (51c, 52h, 52d, 52e; 52c, 51h, 51d, 51e; 51h, 51f, 51g, 52g; 52h, 52f, 52g, 51g) cannot be separated at room temperature by applying a force in any direction perpendicular to the longitudinal direction, the amount of which force is less than or equal to 300 N per 2 cm length of the plastic profile (50).

14. Calibrated plastic profile (50) according to claim 13, wherein
the first protrusion (51g) forms one of the two lateral wall elements (51f, 51g) which delimit the second recess (51h), and
the second protrusion (52g) forms one of the two lateral wall elements (52f, 52g) which delimit the first recess (52h).

15. Calibrated plastic profile (50) according to claim 13 or 14, wherein
the calibrated plastic profile is formed of polyamide with glass fibre reinforcement and the form fit of the four complementary elements (51g, 52h, 52f, 52g; 51h, 51f, 51g, 52g) cannot be separated at room temperature by applying a force in any direction perpendicular to the longitudinal direction, the amount of which force is less than or equal to 500 N per 2 cm length of the plastic profile (50).