CLAIMS

1. Method for installing an elongated element into a duct (6), comprising the steps of:

- inserting the elongated element into the duct (6) through a pressure chamber (12) located at an entry of the duct (6), by applying a driving force (F_a) to the elongated element, resulting in an effective pushing force (F_{2eff}) downstream the pressure chamber (12),

- introducing pressurized fluid into the duct (6) at a nominal pressure, through the pressure chamber (12),

wherein, after an instant when said elongated element has entered the duct (6) and before an instant when said elongated element reaches a final position into the duct (6), the method comprises the steps of:

- monitoring at least fluid pressure (p_d) into said duct (6) and said driving force (F_a)

- reducing said fluid pressure (p_d) to a predetermined value lower than the nominal pressure, in relation to said driving force (F_a),

wherein fluid pressure (pd) is reduced if:

$$\frac{F_{eff}}{F_{bc}} \leq 0.1;$$

where:

$F_{2eff} = F_a - F_1 - F_i$;

$F_i = \frac{\pi}{4} D_c^2 p_d$;

$F_{bc} = \frac{\pi}{4} D_c D_d p_d$;

F_a : applied and measured driving force ;

F_1 : applied and measured force to pull the elongated element from reel ;

D_c: elongated element diameter ;

D_d: Duct internal diameter ;

p_d: fluid pressure.

2. Method according to the preceding claim, wherein the driving force (F_a) is applied upstream an entry of the elongated element into the pressure chamber so as to push the elongated element into the pressure chamber with a external pushing force (F_2), and wherein the fluid pressure (p_d) is reduced if the fluid pressure (p_d) results in an axial outward pressure force applied to the elongated element susceptible to be equal or greater than the external pushing force (F_2).

3. Method according to the preceding claim, wherein the external pushing force (F_2) is equal to the driving force (F_a) subtracted with a force to pull the cable from the reel (F_1).

4. Method according to claim 1, wherein the driving force (F_a) is applied downstream an entry of the elongated element into the pressure chamber so as to pull the elongated element into the pressure chamber with an effective pulling force (F_{1eff}), and wherein the fluid pressure (p_d) is reduced if the fluid pressure (p_d) results in an axial outward pressure force (F_i) applied to the elongated element susceptible to be equal or greater than the driving force (F_a) subtracted with a force to pull the cable from the reel (F_1).

5. Method according to the preceding claim, wherein the effective pulling force (F_{1eff}) is equal to the sum of the pressure force (F_i) and a force to pull the cable from the reel (F_1).

6. Method according to any one of the preceding claims, comprising a step of:

- uncoiling the elongated element from a reel before pushing the elongated element into the duct (6) ;
- measuring a pulling force (F_1) applied to the elongated element to uncoil the elongated element ;
- correcting the driving force (F_a) by the measured pulling force (F_1), to obtain

the effective pushing force (F_{2eff}) and to decide if fluid pressure (p_d) shall be reduced.

7. Method according to the preceding claim, wherein the step of measuring the pulling force comprises a step of measuring a transverse force applied to the elongated element, between the reel and driving means arranged to apply the driving force (F_a).

8. Method according to any one of the preceding claims, wherein the fluid is gas.

9. Method according to the preceding claim, wherein elongated element velocity (v_c) is monitored, and wherein the gas pressure (p_d) is reduced if the elongated element velocity (v_c) is lower than a predetermined speed, and/or if an undulation/deviation from a taut position of the elongated element in the duct (6) is detected.

10. Method according to any one of claims 8 to 9, wherein the step of reducing the gas pressure (p_d) comprises a step of venting the gas pressure (p_d) by opening an orifice at the entry of the duct (6).

11. Method according to any one of claims 8 to 10, wherein the step of reducing the gas pressure (p_d) is followed by a step of increasing the gas pressure (p_d) in relation to said driving force (F_a).

12. Method according to the preceding claim, wherein if an abrupt increase of gas pressure (p_d) up to the nominal pressure is applied to the unpressurized duct (6), a constant decrease of pressure per meter along said duct (6) is reached at a given time t_c, and wherein the increase of gas pressure (p_d) of the preceding claim is done at a rate so that the nominal pressure is reached at a time t_M comprised in the range: $0.15t_c \leq t_M \leq 0.5t_c$.

13. Method according to any one of claims 11 or 12, wherein the steps of reducing the fluid pressure (p_d) and increasing the pressure are repeated several times before the instant when said elongated element reaches the final position into the duct (6).

14. Method according to any one of claims 11 to 13, wherein if several sequences of pressure decrease and pressure increase are performed, the last sequence is performed so that the pressure increase ends to supply gas at a nominal pressure greater than the nominal pressure achieved by the previous sequences and lower than a nominal pressure creating a pressure force equal or greater than:

- the external pushing force (F_2) if the driving force (F_a) is applied upstream the entry of the elongated element into the pressure chamber (12),

- the driving force (F_a) subtracted with the force to pull the cable from the reel (F_1), if the driving force (F_a) is applied downstream the entry of the elongated element into the pressure chamber (12).

15. Apparatus for installing an elongated element into a duct (6), comprising:

- a pressure chamber (12) connected to an entry of the duct (6), and arranged to be pressurized at a nominal pressure,

- a driving unit arranged to apply a driving force (F_a) to the elongated element to insert the elongated element into the duct (6), through the pressure chamber (12),

- a monitoring unit, arranged for monitoring at least the duct (6) pressure and the driving force (F_a),

- a control unit arranged to automatically reduce the duct (6) pressure in relation to said driving force (F_a) according to the method of any one of claims 1-14.

16. Apparatus according to the preceding claim, further comprising:

- an unreeling unit, arranged to unreel the elongated element from a reel, and to supply the elongated element to the pushing unit at a predetermined angle,

- a transverse force measuring unit, arranged between the unreeling unit and the pushing unit, to measure a transverse force and/or an axial force being a pulling force applied to the elongated element to unreel the elongated element.

17. Apparatus according to the any one of claims 15 or 16, wherein the monitoring unit is arranged for monitoring the elongated element velocity (v_c),

- and wherein the control unit is arranged to automatically reduce the duct (6) pressure in relation to said elongated element velocity (v_c).

18. Apparatus according to the any one of claims 15 to 17, comprising an entry into the pressure chamber for the elongated element, and wherein the driving unit is arranged upstream the entry.

19. Apparatus according to the any one of claims 15 to 18, comprising an entry into the pressure chamber for the elongated element, and wherein the driving unit is arranged downstream the entry.