GEFRAN

VDA-M

Two or three channels amplifier

INSTRUCTION MANUAL

code: 80043

80043_VDA-M_06-2025_ENG

INDEX

INTRODUCTION

Device Data

In the space below, write the order code and other plate data shown on the label attached to the outside of the amplifier.
If you need technical assistance, this information must be given to Gefran Customer Service.

VDA-M	
Serial No.	
Description	

Warnings and Safety

Make sure that you always have the latest version of this manual, downloadable at no cost from Gefran's website (www.gefran.com).

The devices described in this manual must be installed by trained personnel in conformity to current laws and regulations, following all of the instructions in this manual.

Installers and/or maintenance personnel MUST read this manual and scrupulously follow all of the instructions contained herein and in the attachments.
Gefran will not be liable for any damage/harm caused to persons and/or property, or to the device itself, if all of such instructions are not followed.

Disposal

The amplifier VDA-M must be disposed of in conformity to current laws and regulations.

If not correctly disposed of, some of the components used in the devices may harm the environment.

Disclaimer

Although all of the information in this manual has been carefully checked, Gefran S.p.A. assumes no liability regarding the presence of any errors or regarding damage to property and/or harm to individuals due to any improper use of this manual.

Gefran S.p.A. also reserves the right to change the contents and form of this manual, as well as the characteristics of the devices described herein, at any time and without notice.
The technical data and performance levels specified in this manual are to be considered a guide for the user in order to determine the device's suitability for a defined use, and do not constitute a guarantee.
They may be the result of test conditions at Gefran S.p.A., and the user must compare them to his/her real application requirements.
Under no circumstances will Gefran S.p.A. be liable for any damage to property and/or harm to individuals due to tampering, incorrect or improper use, or use not conforming to the characteristics of the amplifier to the instructions contained in this manual.

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1. GENERAL DESCRIPTION

1.1. Profile

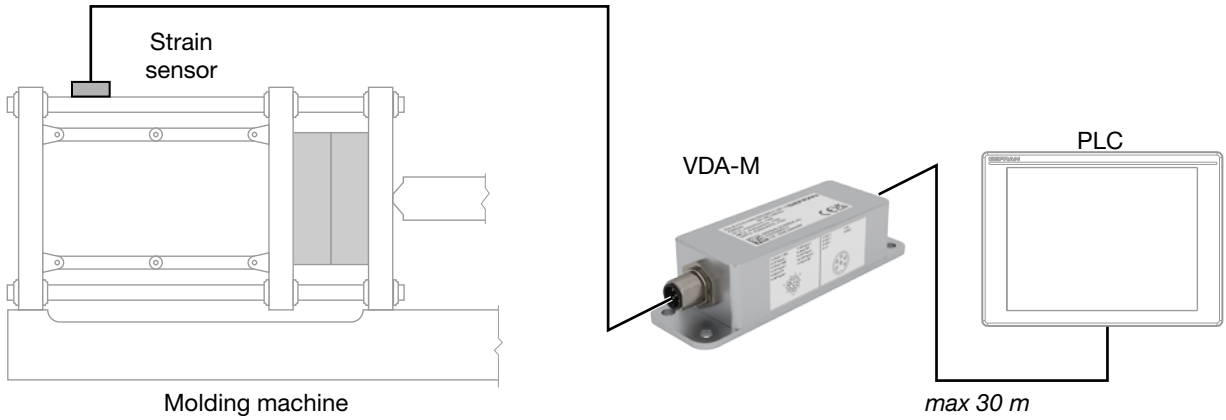
The variable digital amplifier, with PLC and strain sensor, checks the correct functioning of molding machines with toggle clamping to protect the machine and the mold.
The model VDA-M monitors the cavity pressure profile, optimizing the injection cycle and therefore the molded product.
By means of a single strain sensor, the amplifier generates three independent signals for three molding process parameters.
The sensor generates the signals based on the different strains on the machine during the molding cycle.
The signals are amplified with different factors to give the PLC the maximum signal level to be processed at all times.
The amplifier manages the following molding cycle parameters:

- Clamping force, i.e., the force exerted by the machine to close the two mold halves. If a deviation from the reference clamping force is detected, there is a problem with clamping the mold.
- Mold protection. Measuring strain while the mold is being closed and comparing it to the reference strain level can signal possible foreign bodies between the mold halves, with risk of damage to the mold.
- Cavity pressure profile. By comparing the cavity pressure profile generated during injection and molding with the reference profile, the PLC, in case of strain, can warn the operator that the molded product does not satisfy expected quality criteria. The cavity pressure profile can be measured only if the sensor is attached to one of the molding machine tie bars.

The amplifier is powered directly by the PLC, which can be positioned up to 30 meters from the amplifier.

The amplifier is intended mainly for molding machine manufacturers because the correct settings must be guaranteed in the PLC.

System architecture

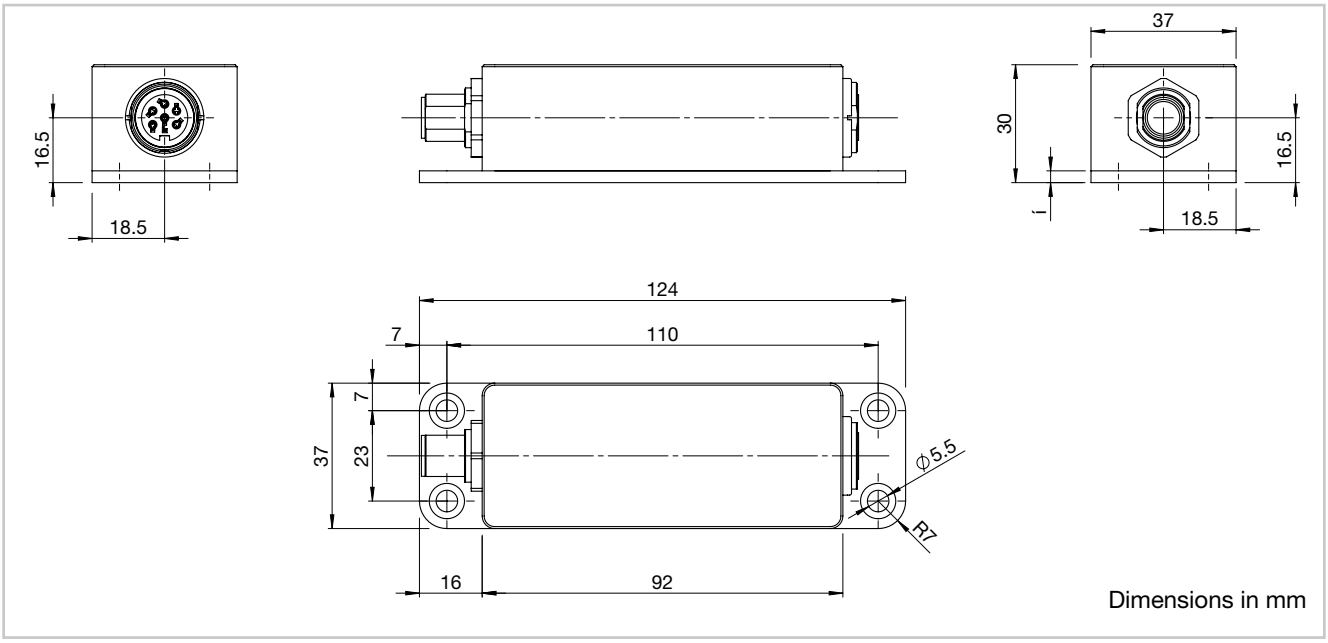


1.2. VDA-M

Main features

- Solution for:
  - Clamping Force measurement
  - Mold Protection
  - Cavity Pressure Profile monitoring
- Only one sensor mounted either on the tie-bar or on the toggle
- Usable on injection molding machines with toggle lever

1.2.1. Dimensions



Dimensions in mm

2. INSTALLATION

Attention! The devices described in this manual must be installed by trained personnel in conformity to current laws and regulations, following all of the instructions in this manual.

Before installing, check that the amplifier is in perfect condition and was not damaged in shipment. Make sure that the package contains all of the accessories listed on the accompanying document.
Check that the order code matches the configuration required for the intended application (supply voltage, number and type of inputs and outputs). See Chapter ”5. Order Methods” on page 10 to check the configuration corresponding to each order code.

Attention! If even one of the requirements mentioned above (trained technician in, device in perfect condition, correct configuration) is not satisfied, interrupt the installation and contact your Gefran dealer or Gefran Customer Service.

2.1. Mounting the Amplifier

2.1.1. General installation rules

The amplifier is designed for permanent indoor installation.

2.1.1.1. Protection against infiltration of dust and water

The amplifier has an IP65 protection index, so the device can be installed without problems in rooms that are very dusty or subject to splashing water.

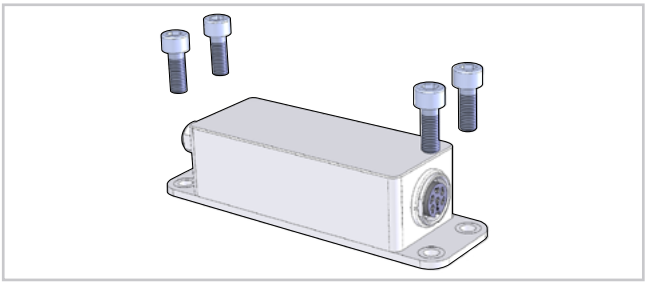
2.1.1.2. Minimum space for ventilation

The temperature in the housing containing the amplifier must NEVER exceed 85 °C.

Advice. The lower the temperature in which the device works, the longer the life of its electronic components.

2.1.2. Positioning

Fasten the amplifier to a sufficiently rigid and robust support. Use the four through holes on the amplifier and M5 screws or bolts.



2.2. Connections

Attention! Failure to follow the instructions in this section may cause problems in electrical safety and electromagnetic compatibility, in addition to voiding the warranty.

2.2.1. General rules for connections

1. Connected external circuits must have double isolation.
2. Use twisted and shielded cables for connections.
3. The shield of the shielded cables must be grounded at a single point (amplifier connector side).
4. Do not connect unused terminals.
5. Secure the cables so that mechanical forces are not exerted only on the connectors.
6. 24 VDC models must be powered by a class II or low-voltage limited-energy source. The power supply must use a line separated from the one used for electromechanical power devices, and low-voltage power cables must run along a path separated from the system or machine power cables.
7. Make sure the ground connection is efficient. Absent or inefficient grounding can make the device unstable due to excessive noise.
8. To prevent noise, the sensors cables must be kept away from the power cables (high voltages or high currents).
9. The amplifier cables and the power cables must not be placed parallel to one another.

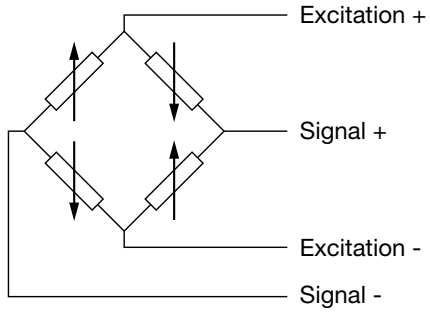
2.2.2. Connectors

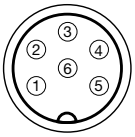
The Gefran catalog offers cables pre-fit with the M12 connector. See table ”5.3. Accessories” on page 10 for order codes.

2.3. Connection Diagrams

2.3.1. Electrical Connection Sensor Side

Sensor 4/4 bridge M16 6-pin

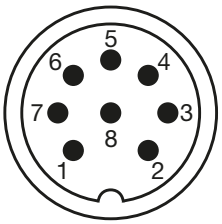




Connector PIN	Function
1	Excitation +
2	Excitation +
3	Excitation -
4	Signal +
5	Signal -
6	Excitation -

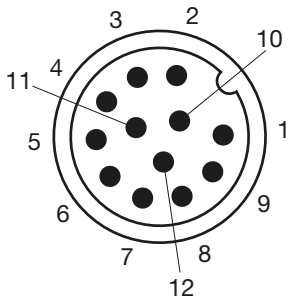
2.3.2. Electrical Connection PLC Side

PLC M12 8-pin



Connector PIN	Function
1	Power 12...36 VDC
2	CF Signal -
3	Power GND
4	CF Signal +
5	Reset CF signal
6	MP or CPP signal -
7	MP or CPP signal +
8	Reset MP or CPP Signal

PLC M12 12-pin



Connector PIN	Function
1	Power 12...36 VDC
2	CF Signal -
3	Power GND
4	CF Signal +
5	Reset CF signal
6	MP signal -
7	MP signal +
8	Reset MP signal
9	CPP signal -
10	CPP signal +
11	Reset CPP signal
12	

MP : Mold Protection
CF : Clamping Force
CPP : Cavity Pressure Profile

The cable (between amplifier and control system) must be shielded, the maximum length must be 30 meters and the shield must be connected on connector side only (floating on control side)

3. OPERATION

3.1. Power-on

Power is supplied by the PLC to which the amplifier is connected; therefore, the amplifier is powered on and off simultaneously with the PLC.

The amplifier is completely operative 0.5 seconds after power-on.

3.2. Calibration

Before working, you have to calibrate the following signals:
- clamping force;
- mold protection;
- cavity pressure profile.

Run about a dozen of dry molding cycles (without injection), measure the data, and calculate the average to obtain reference values for calibration.

3.2.1. Calibration of clamping force

Clamp the mold by applying the clamping force and measure the strain either on the tie bars (with the GE1029 sensor) or on the platen on toggle (with the SB46 sensor).
The measured value, which typically differs from the sensor's full-scale value, will be set on the PLC as a value equal to 100% of the mold clamping force.
You can convert from με to tons / kN with the Gefran QE1008 measurement system.

3.2.2. Calibration of mold protection

Run a dry molding cycle (without injection) and store the values during mold closing.
Using this strain curve as average value, set a tolerance band on the PLC (depending on the mechanical noise of the molding machine), which will be the allowed tolerance during molding operations.

3.2.3. Calibration of cavity pressure profile

We measure actually the mold-breathing or mold opening caused by the cavity pressure (F = area multiplied by the pressure in the cavity). This leads to a – very small – stretching of the tie bars. This stretching is proportional to the cavity pressure, thus we can gain the cavity pressure profile.
But this signal is superimposed to the relaxation signal of the machine after the machines is locked.
Clamp the mold and store the decreasing signal deriving from the reduction of clamping force.
The relaxation takes always place and is 0.5 to 1.5% of full locking force and is different with softer or stiffer molds.

In order to separate these 2 signals:
1) Lock the machine and reset the CPP signal.
2) Wait 10 seconds (this is NOT used during manufacturing, just set-up).
3) Reset again (signal is now zero and stable).
4) Now start Injecting: the cavity pressure profile is displayed.

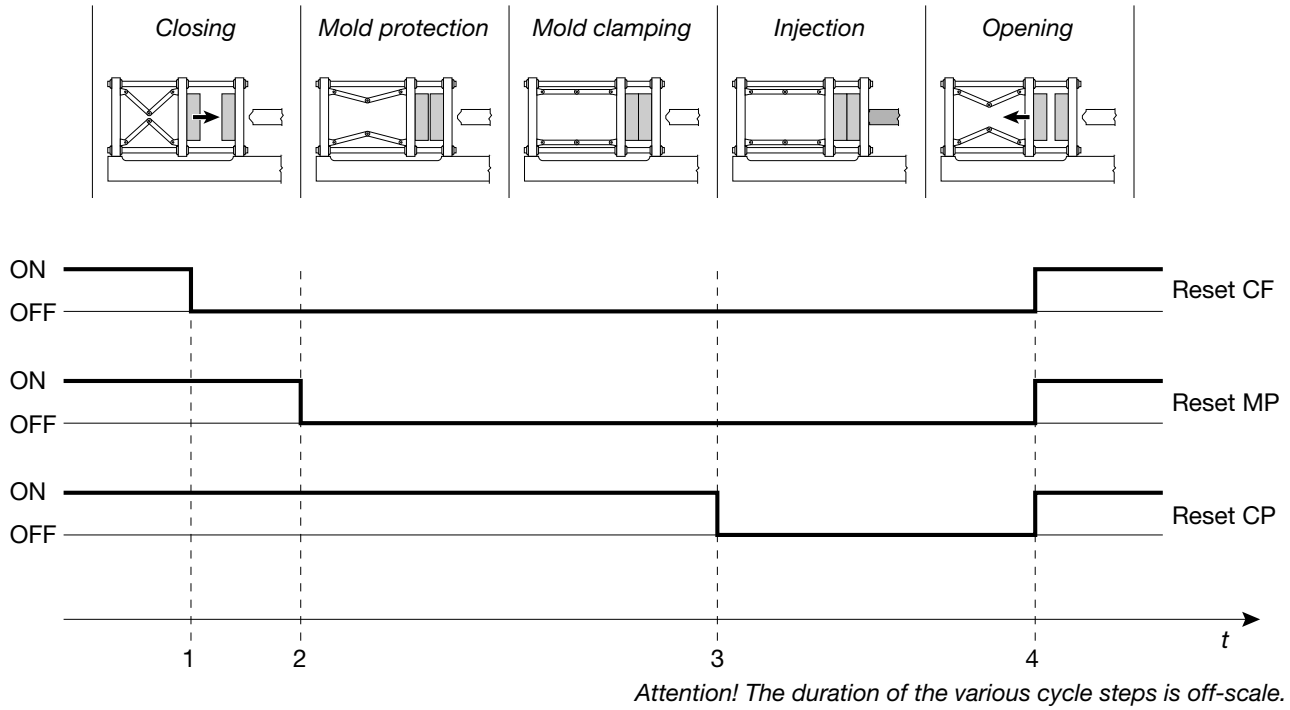
3.3. Control During Molding Operations

The data stored during calibration are used as a reference to detect any problems during molding operations.

With regard to the amplifier, a molding cycle starts at mold opening and ends at re-opening of the mold after another molding.

The PLC has to perform the following operations:
- Activation of the reset signal for clamping force (Reset CF) from mold opening to the start mold clamping (closing of the two mold halves).
- Comparison of the strain curve generated during closing with the reference curve stored during calibration. If measured values exceed the set tolerance band, you must stop the machine immediately to protect the mold. During the transition from "closed mold" to "clamped mold" the reset signal is activated to protect the mold (Reset MP).
- Measurement of injection cycle signal, from which the "mechanical relaxation" signal stored during calibration is subtracted. The resulting signal is the cavity pressure signal generated by the mold opening force caused by injection. This lets you check correct mold filling (attention: this does not measure absolute cavity pressure value, but compares the measured profile to the ideal injection profile).

3.4. Molding Cycle



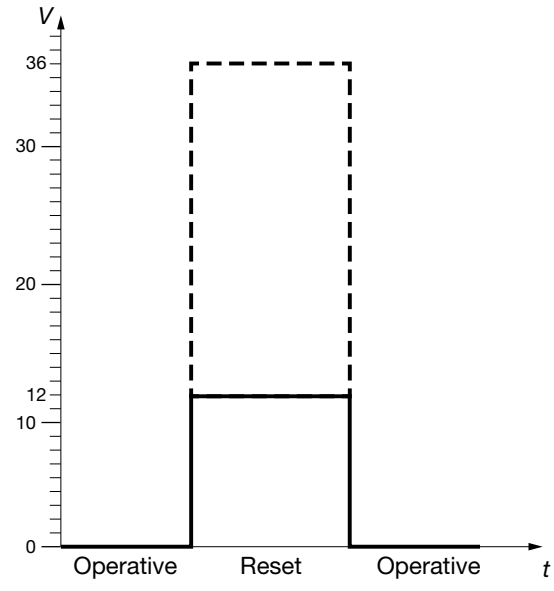
Attention! The duration of the various cycle steps is off-scale.

1) Deactivate Reset CF before mold closing.
2) Deactivate Reset MP just before the mold is clamped.
3) Deactivate Reset CP after the mold is completely clamped and before starting injection.
4) Activate Reset CF, Reset MP and Reset CP during mold opening.

3.5. Reset

To run a Reset, supply voltage from 12 and 36 V for at least the reset time selected in the order code (see datasheet, there are no limits to longer durations) to the Reset input of the function in question.

For normal function operation, there have to be 0 V (open contact) at the input.



4. TECHNICAL DATA

4.1. VDA-M

	Clamping force output (CF)	Mold protection output (MP)	Cavity pressure profile output (CPP)
Linearity	< ± 0.02% FS	< ± 0.02% FS	< ± 0.02% FS
Output signal	Voltage		
Accuracy at room temperature [1]	< ± 0.2% FS	< ± 1% typ. (< ± 2% max.)	< ± 1% typ. (< ± 2% max.)
Signal input range (FS)	0.1…3.00 mV/V (100…3000με)	0.02…0.10 mV/V (20...100με)	0.02…0.10 mV/V (20...100με)
Output resolution	16 bit	16 bit	16 bit
Sampling rate	1kHz	1kHz	1kHz
Low-pass filter	100 Hz	100 Hz	100 Hz
Case material	Aluminum anodized		
Reset time	see Order code		
Reset voltage	12…36 VDC		
Supply voltage	12…36 VDC		
Power consumption	0.6 W		
Allowed load	≥5 kΩ		
Operating temperature range	-40…+85 °C		
Storage temperature range	-40…+100 °C		
Temperature effects	± 0.01% FS/°C	± 0.02% FS/°C	± 0.02% FS/°C
Weight	~ 165 g		
Protection class	IP65		
Output short circuit protection	Yes		
Reverse polarity protection	Yes		
Dielectric strenght [2]	250 V		
EC Conformity A	According to Directive 2014/30/EU		

1) incl. Non-linearity, Hysteresis, Repeatability, Zero-offset and Span-offset
2) Uses 50 V 2J Voltage suppressor

The three output ranges are from 0 up to ±12 V.
The amplifier has an integrated sensor cable breakage detection. In the event of an interruption in one or more sensor lines, the output voltage increases or decreases to a value ±11.5 V ... ±12 V.
In order to properly use the cable breakage detection it is suggested to use the amplifier only in the range ±10.0 V and to make sure that the amplifier is reset after every machine cycle.

5. ORDER METHODS

5.1. Digital Strain-gauge Amplifier

Code F	Model	Clamping force	Mold Protection	Cavity profile
F085238	VDA-M-H-L-D-4-0500-0020-0000-H1-HR14-O	■	■	
F085239	VDA-M-H-L-N-4-0500-0030-0000-H2-HR11-O	■	■	
F085240	VDA-M-H-L-N-4-0500-0050-0000-H2-HR11-O	■	■	
F085241	VDA-M-H-L-N-4-0500-0000-0050-H2-HR11-O	■		■
F085243	VDA-M-H-S-N-4-0500-0020-0050-H2-HR11-O	■	■	■

5.2. Sensors

GE1029

Code F	Model	Full Bridge	Cable length (m)	Cable and connector
F075851	GE1029-4-005-C	■	0,5	■
F066943	GE1029-4-030-C	■	3	■
F071301	GE1029-4-050-C	■	5	■
F066913	GE1029-4-100-C	■	10	■

SB46

Codice F	Model	Connettor	Full Bridge	Lunghezza cavo (m)	Cavo e connettore
F069688	SB46-A1-4-030-X	90°	■	3	■
F071298	SB46-A1-4-050-C	straight	■	5	■

The sensors are special versions of the GE1029 (bar strain sensor) and SB46 (press-on strain sensor).
The SB46 sensor is applicable only on the toggle, and therefore does not measure the cavity pressure profile.
Please contact Gefran for information on compatibility with other sensors.

5.3. Accessories

Code	Description
TE-E-0591_00	Female connector M12 8-pin
F085191	2 meter cable with female connector M12 8-pin
F085192	5 meter cable with female connector M12 8-pin
F085193	10 meter cable with female connector M12 8-pin
F085232	15 meter cable with female connector M12 8-pin
TE-E-0590_00	Female connector M12 12-pin
F085233	2 meter cable with female connector M12 12-pin
F085234	5 meter cable with female connector M12 12-pin
F085236	10 meter cable with female connector M12 12-pin
F085237	15 meter cable with female connector M12 12-pin

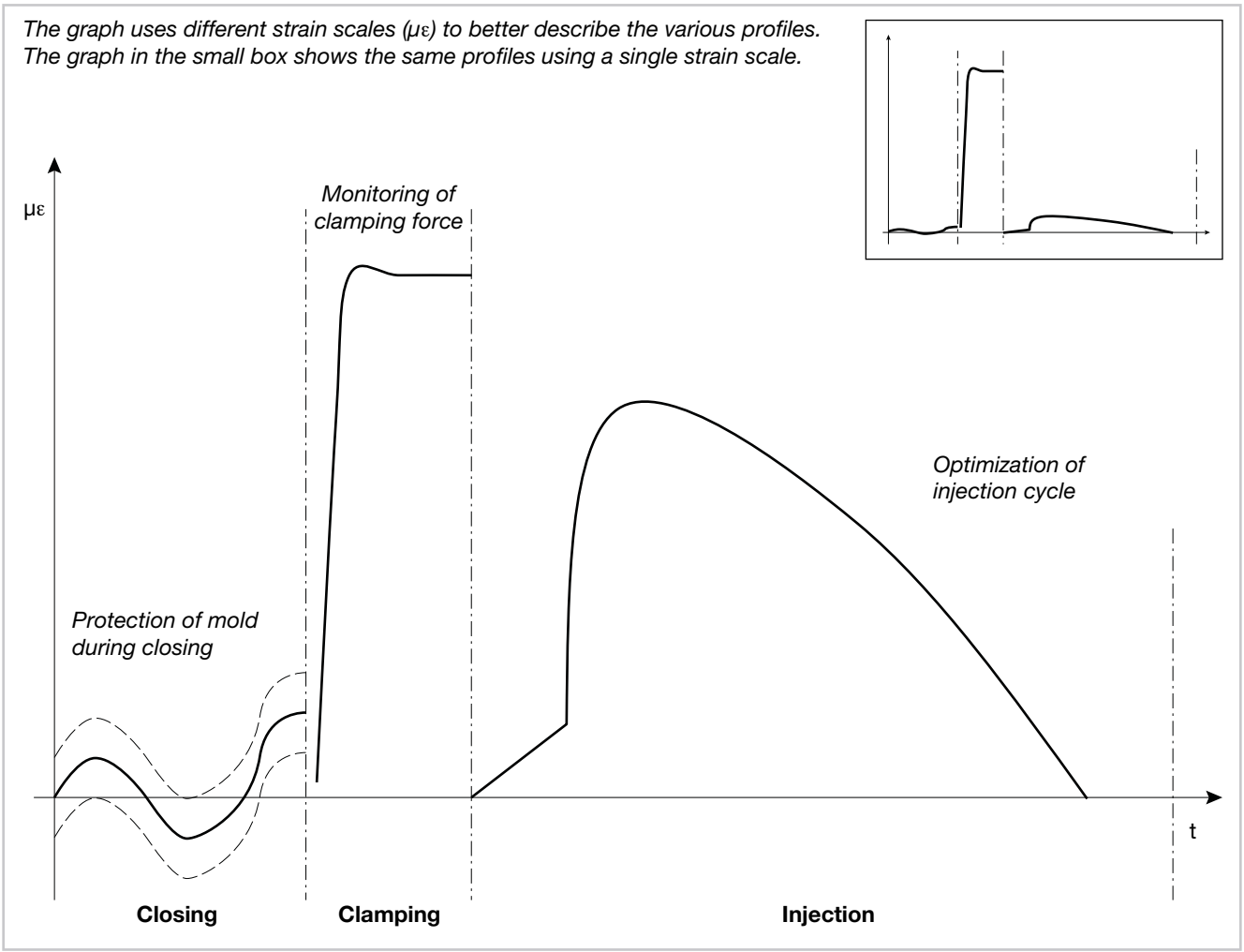
6. OPERATING PRINCIPLES

6.1. Strain Forces

During the cycle, the molding machine clamping system exerts a variable force to clamp the mold halves and keep them clamped during injection.
This force, applied by reaction to the machine structure, causes strain on some of its parts.
The strains are instantaneously proportional to the force exerted.
Therefore, by measuring the strains, you can calculate the force exerted by the clamping system.
This force measurement criterion can be applied only to machines with toggle clamping system.
On machines with hydraulic piston clamping, the elasticity of the hydraulic fluid prevents the force/strain correlation.

6.2. Different Amplifications

The molding machine is subject to limited absolute strains even if very high forces are exerted.
By measuring strain in με (microstrain), which is a dimensionless unit of measure corresponding to a change in length of 1 μm per meter, it is clear that this value changes considerably during the various steps of the molding cycle.
Approximately, by setting the strain (and thus the force needed to clamp the mold) to 1, the mold clamping force is over 50 and the injection force is about 5.
This means that the very small signal generated by the strain sensor has to be amplified with different factors to have significant full-scales for correct measurement of strains.
Therefore, the technical solution adopted so far involves differentiated sensors and amplifiers for the various steps of the molding cycle.
Instead, the Gefran solution employs a single sensor whose signal is amplified by a variable amplifier to satisfy the various steps of the molding cycle.



Time/strain diagram of a complete molding cycle

6.3. Ideal Molding Cycle

For every molding machine and every type of production, the molding cycle can be represented as a continuous variation of the force applied to the mold as a function of time.

By running a dry molding cycle with precise control of all operating conditions, you can create a time/force profile representing the ideal molding cycle, i.e., one that guarantees best product quality and longest machine life.

This profile is the sum of the profiles of all the steps needed to complete the molding cycle.

This sample cycle is used to calibrate the strain sensor reads during the various molding steps, setting the full-scale for each and recording the related time/force profile

6.4. How to Control Colding

Ideally, during production, each molding cycle must be identical to the previous one to ensure constant results.

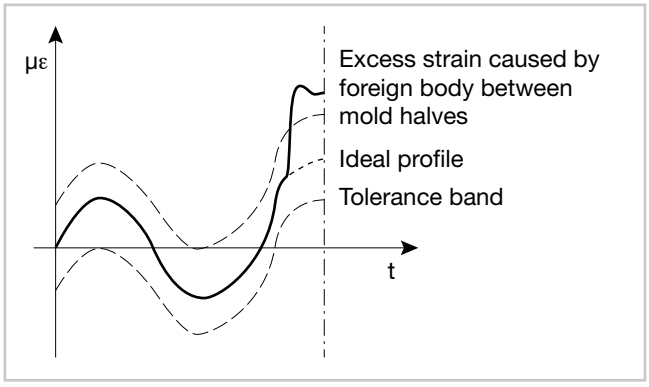
In reality, each cycle is slightly different from the others in terms of applied force and time taken.

These slight differences between one cycle and another do not affect the final product or machine life provided they remain within allowed limits of tolerance.

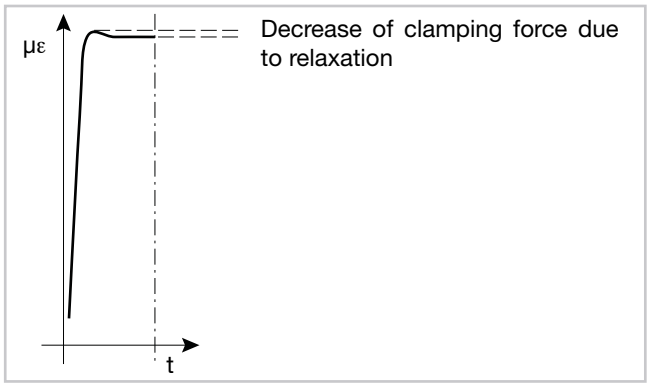
During the molding cycle, by comparing strain sensor data with the stored sample cycle data you can immediately note any problems, indicated as the exceeding of tolerance limits.

The PLC performs this check in real time, and therefore can also stop the machine immediately (before any damage is done) or promptly warn the operator that the produced piece does not meet the required quality standards.
In both cases, the company saves money.

During mold closing, a force exceeding allowed limits may mean either that there is a foreign body between the mold halves (excess force) or that the two mold halves are not perfectly closed (insufficient force).
The following graph shows the typical trend of strains recorded with allowed tolerances during closing of the mold halves.

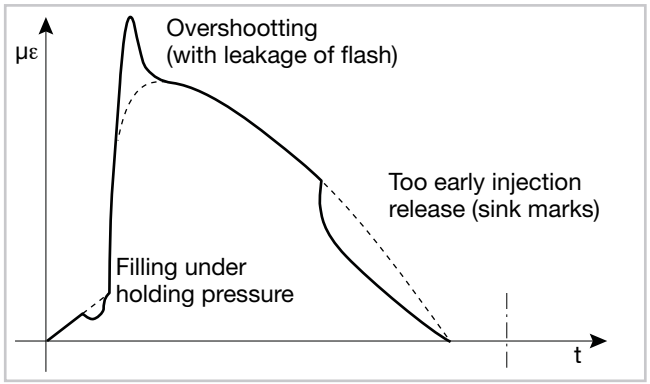


During clamping, you can check that the force exerted on the mold halves does not exceed the level needed for correct molding.
Avoiding excess force extends mold and machine life.
The following graph shows the typical trend of strains recorded during clamping.



During injection, a deviation from the ideal profile may indicate problems with filling the mold (or other problems) that will produce a defective molded piece, even if not immediately apparent.

The following graph shows the typical trend of strains recorded during injection, with indication of possible deviations and their effect on the quality of the molded piece.



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