



Istituto di Tecnologie Industriali e Automazione  
Consiglio Nazionale delle Ricerche



*MM&A*

*Micro Manipulation and Assembly*

## **D2.3 PROGETTO DI MASSIMA DEI MICROGRIPPER**

Documento interno	MM&A-PRIN2009-0003		
Progetto	PRIN2009	Coordinatore scientifico	Prof. Giovanni Legnani
Data	04/07/2012	N° pagine	31

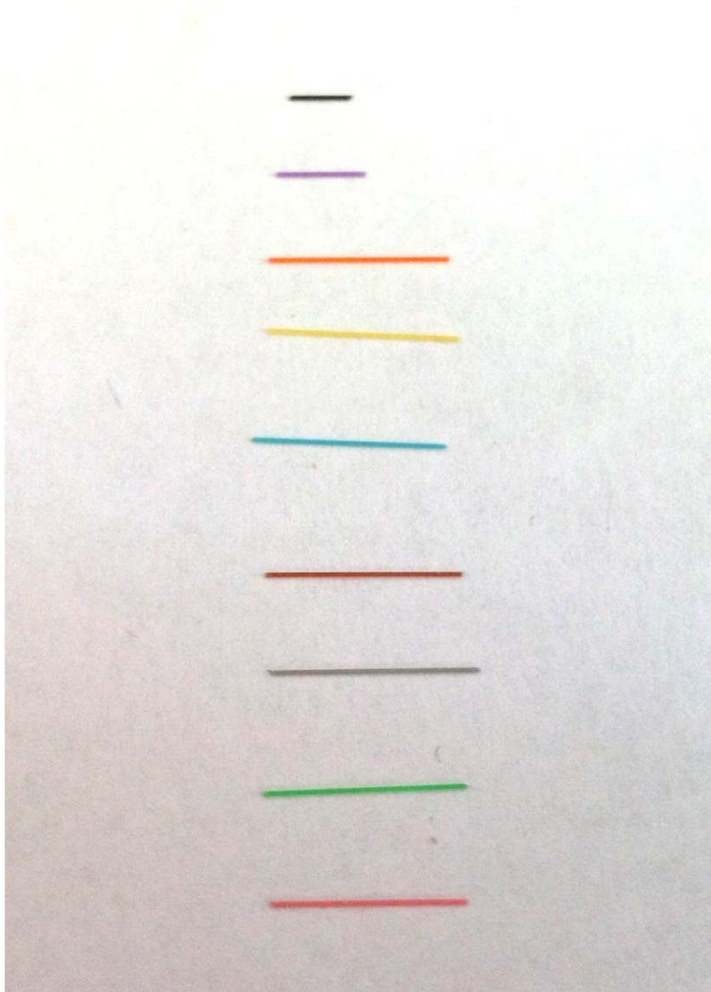
Autore: ITIA-CNR

## MICROCOMPONENTI: Overview

- Attualmente ITIA dispone dei seguenti componenti:
  - Fibre ottiche con coating
  - Parallelepipedi a base quadrata/rettangolare
  - Microsfere
  - Ugelli
  - Campioni per prove di trazione
  
- Non si esclude l'acquisizione di ulteriori tipologie di microcomponenti durante il corso del progetto
  
- La produzione interna ad ITIA di microcomponenti verrà valutata in base a vincoli temporali ed economici

## MICROCOMPONENTI (1/5)

### *FIBRE OTTICHE CON COATING*



***Dimensioni [mm]:  $\phi$  0.2 x 1 ÷ 5***

***Massa [mg]: < 2***

***Materiale: vetro e UV-cured urethane  
acrylate composite materials***

## MICROCOMPONENTI (2/5)

### ***PARALLELEPIPEDI A BASE QUADRATA/ RETTANGOLARE***



***Dimensioni [mm]:***

***(0.90 x 0.90 x 1.82) - (0.99 x 0.99 x 1.82) -***

***(1.26 x 1.01 x 2.3)***

***Massa [mg]: (2) - (2) - (3)***

***Materiale: polimero***

## MICROCOMPONENTI (3/5)

### *MICROSFERE*



***Dimensioni [mm]: ( $\phi$  0.8) - ( $\phi$  1 ÷ 1.2)***

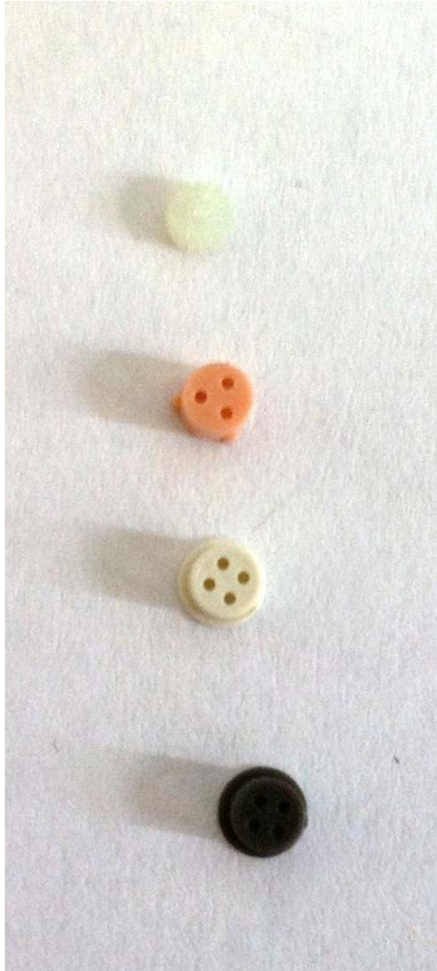
***Massa [mg]: (1) - (2)***

***Materiale: vetro***



## MICROCOMPONENTI (4/5)

### **UGELLI**



***Dimensioni [mm]:***

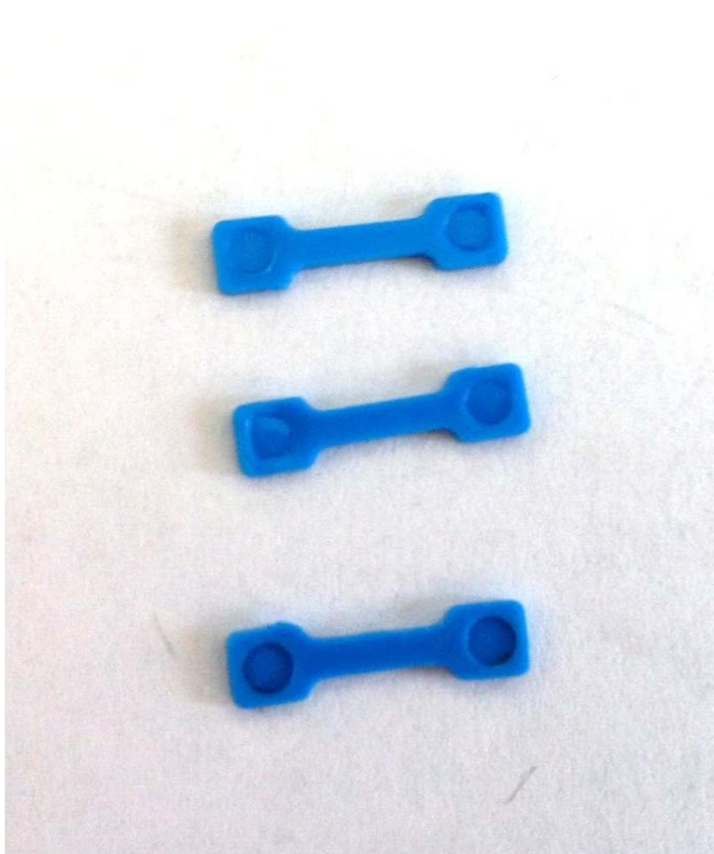
***( $\phi$  2.41 x 1.54) - ( $\phi$  2.54 x 2.17)***

***Massa [mg]: (7) – (10)***

***Materiale: polimero***

## MICROCOMPONENTI (5/5)

### *CAMPIONI PER PROVE DI TRAZIONE*



***Dimensioni [mm]:***

***2.90 x 0.95 x 11.6***

***(punto di possibile presa 1.42)***

***Massa [mg]: 32***

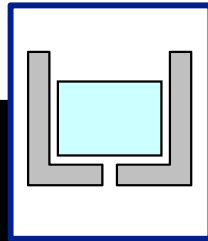
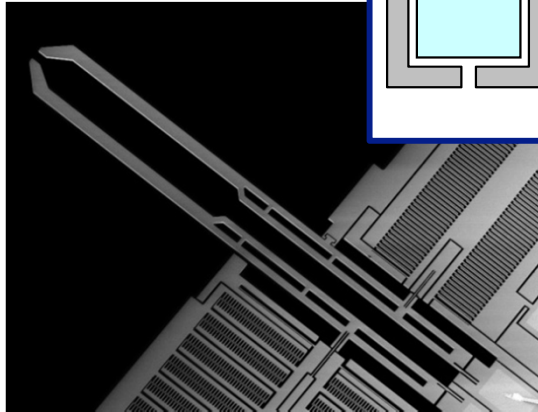
***Materiale: poliossimetilene (POM), PC,***

***PP, LCP***

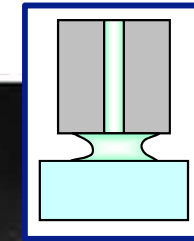


# TIPI DI MICROGRIPPERS CONSIDERATI

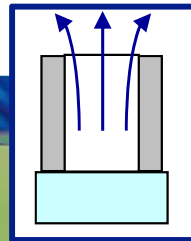
Meccanici



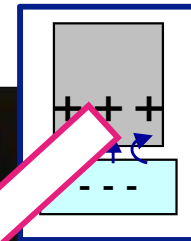
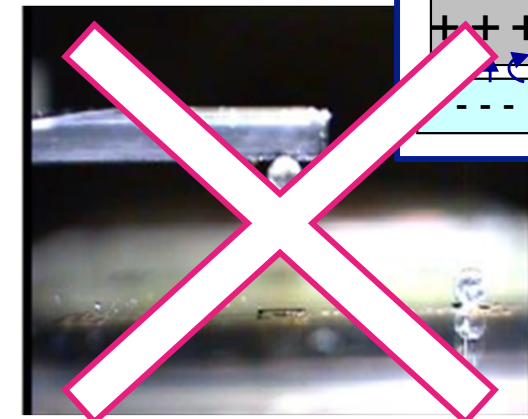
Adesivi



Capillarità e basati su Van der Waals



A vuoto



Elettrostatici

Abbandonati per problemi di isolamento dovuti alle elevate tensioni in gioco



# CONFRONTO TRA LE DIVERSE TIPOLOGIE

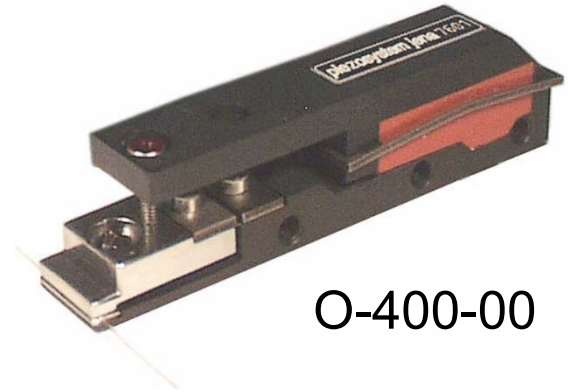
PRINCIPIO	COMPONENTI		PRESA	RILASCIO	AMBIENTE	FORZA di mantenimento	POSIZIONE DEL COMPONENTE
	Materiale	Taglia, forma					
<b>Meccanico</b>	Nessuna limitazione	Vincolato alla taglia del componente	ok	Adesione alle dita	No vincoli, ma RH basso è meglio	No vincoli	Riferimento tramite le dita
<b>Vuoto</b>	Non poroso	Adeguamento del foro alla superficie di presa	ok	Adesione alle dita	Controllo RH per limitare l'adesione	Secondo il foro e la depressione	Non c'è controllo, ma dipende dalla forma del gripper
<b>Capillarità</b>	A tendenza idrofila	Forza massima per superfici piane ma può andare anche per altre	ok	Serve una strategia supplementare	Non in mezzo liquido	In base al liquido, al materiale e alla geometria	Possibile effetto di centraggio in base alla forma del gripper
<b>Van der Waals</b>	Nessuna limitazione (per contro scelta critica per substrato e gripper)	Ottimo con diminuzione delle dimensioni	Strategia di trasferimento, dipende dall'adesione a ciascuna faccia		Molto sensibile	In base a RH, materiale e geometria	Non c'è controllo

# MICROGRIPPERS MECCANICI A CONFRONTO

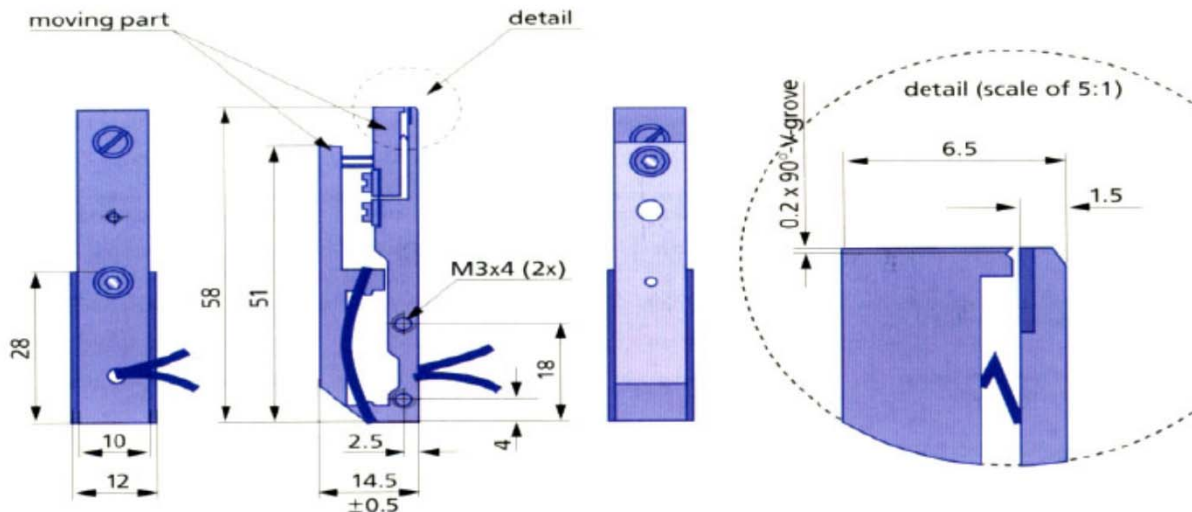
Company Name	Gripper name	Max Opening	Mass	Actuation	Application example	Force sensor
Piezo system jena	fiber gripper O-400-00	385 $\mu\text{m}$	?	Piezo	micro optics, fiber optics, precision mounting and adjusting	NO
Zyvex	BB-500	500 $\mu\text{m}$	?	Thermal	Microassembly, Pick and place, sample sorting	MAYBE
FemtoTools	FT-G102	100 $\mu\text{m}$ (custom up to 400 $\mu\text{m}$ )	?	Electrostatic	Microassembly, Nanoassembly Force-controlled handling of sensitive objects	YES
Schunk	MWPG20	2 mm (adjustable)	26 g	Pneumatic	Assembly, pick and place	Safety device
	MPG 10	2 mm	6 g	Pneumatic	assembly, testing, laboratory and pharmaceutical applications	Safety device
	SWG 10	17°	2.5 g	Pneumatic	Assembly, pick and place	Safety device
AVM Automation	240	6 mm	60 g	Pneumatic	Assembly, pick and place	NO
Gimatic	GW-10	2 x 20°	39	Pneumatic	Assembly, pick and place	NO
	PN 010-3(2)	3(2) x 19°	36-32 g	Pneumatic	Assembly, pick and place	NO
	SGP-20S	4 mm	33 g	Pneumatic	Assembly, pick and place	NO
	TFA10-25	2 x 12.5°	12 g	Pneumatic	Assembly, pick and place	NO

# Piezo system jena O-400-00

- The series of piezogripper was designed for micro systems handling applications.
- The accurate and high speed motion of a piezoactuator is transformed by the levered transmission of a solid state hinge joint to a 300 μm opening of the gripper gap.
- Because of its compact dimensions, it is well suited for OEM applications.
- All kinds of handling and manipulating small parts in research labs or industry are potential application fields for the piezogripper. The grip force depends on the used spring.



O-400-00



**technical data:**

part no.	unit	S-805-00	O-400-00
free gap	mm	0.3	depending on fiber
free gripper motion	μm	275	300
operating voltage	V	-10 to +150	-10 to +150
capacitance (± 20%)	μF	0.8	1.7
temperature range	°C	-20 to 80	-20 to 80
dimensions length	mm	54.5	58
width	mm	38	12
height	mm	7	15

# Zyvex Microgripper BB-500


- Zyvex's patented microgripper systems are active, micromachined silicon structures for micro- and nanoscale research, development, and production applications. With up to 50  $\mu\text{m}$  of tip actuation available, these grippers are capable of manipulating microcomponents with features from 1  $\mu\text{m}$  to 500  $\mu\text{m}$  in size. Low voltage analog control permits the most delicate of micro-assembly operations to be performed.
- Zyvex Microgrippers are available in a range of in-stock tip openings and thicknesses. Actuation of the gripper arms is available with power-on opening motion and power-on closing motion. These grippers are ideal for handling delicate microscale components and operate in both vacuum and ambient conditions.

## Technical Specifications

BB Microgrippers	
Thickness	$50 \pm 0.5 \mu\text{m}$
Max gripping force	0.55 mN
Max mechanical potential	$6.9 \times 10^{-9}$ Joules
Allowable in-plane deflection	55 $\mu\text{m}$
Out-of-plane stiffness	122 $\mu\text{N}/\mu\text{m}$
Allowable out-of-plane deflection	15 $\mu\text{m}$
In-plane gripper arm stiffness	22 $\mu\text{N}/\mu\text{m}$



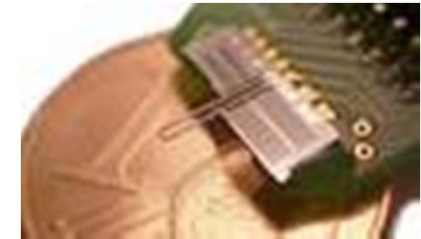
Model Number	Inside Opening ( $\pm 2$ microns)	Powered	Outside Opening ( $\pm 2$ microns)
SM-BB-0	0	open	12
SM-BB-5	5	close	17
BB-10	10	open	60
BB-50	50	open	110
BB-100	100	open	150
BB-150	150	open	200
BB-500	500	open	550



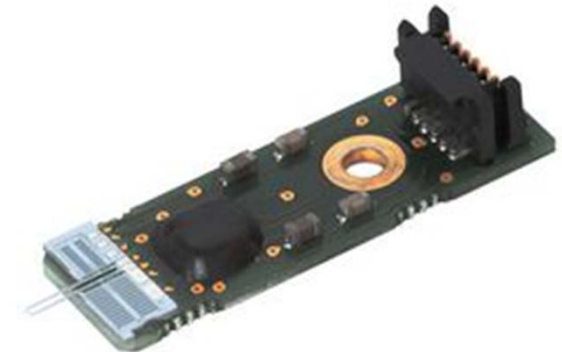
## FemtoTools FT-G102

The FT-G Microgripper series is designed to handle micro- to nanometer-sized objects.

The initial openings of the gripper arms are 30  $\mu\text{m}$ , 60  $\mu\text{m}$  and 100  $\mu\text{m}$  (respectively customizable up to 400  $\mu\text{m}$ ). The opening can be controlled with nanometer precision, such that the gripper arms are fully closed upon applying the maximum actuation voltage.



- Handle sub-millimeter objects ranging from 0.001 mm to 0.4 mm with nanometer precision
- High-resolution electrostatic actuation
- Highly precise fabricated gripper dimensions for the handling of micro- and nanoscale samples
- High gripping speed
- Low power requirements
- No heating of gripper arms
- No performance degradation over more than 100 million load cycles
- Gripping force feedback sensors are individually calibrated
- High-resolution gripping force measurement (unique on the market)
- Detection of successful gripping, object size and mechanical properties
- Customizable gripper arm geometry
- The gripper arms are insulated from the actuator and can be set to any electrical potential
- Air, liquid and vacuum compatible (application inside a SEM)
- Plug-and-measure: User-friendly interface with your PC via USB connection and the FT-GC01 Gripper Controller





## Micro gripper Schunk: MWPG 20

The MWPG 20 miniature-changing parallel gripper weighs just 26 g and is packed with amazing features. It is equipped with a connecting flange for the MWS 20 miniature changing system, and it has two integrated air feed-throughs in the changing system head for the supply with compressed air despite its outer diameter of only 20 mm.



### Product features

- Miniature-changing parallel gripper
- Connecting flange for MWS 20
- Integrated power feed-throughs
- Adjustable stroke
- Gripping force safety device
- Optical finger monitoring

### Basic technical data

- Gripping force 5 N
- Finger stroke 1 mm
- Repeat accuracy  $\pm 5 \mu\text{m}$
- Central through-bore with 7 mm  $\varnothing$

**Fingers are not included and are in charge to the customer**



# Micro gripper Schunk: MPG 10

2-Finger parallel gripper with smooth actuating base jaws guided on roller bearings

## Technical data

Description		MPG 10
	ID	0340006
Stroke per finger	[mm]	1.0
Closing force	[N]	9.0
Opening force	[N]	7.0
Weight	[kg]	0.006
Recommended workpiece weight	[kg]	0.045
Air consumption per double stroke	[cm <sup>3</sup> ]	0.15
Nominal pressure	[bar]	6.0
Minimum pressure	[bar]	3.0
Maximum pressure	[bar]	6.0
Closing time	[s]	0.01
Opening time	[s]	0.01
Max. permitted finger length	[mm]	10.0
Max. permitted weight per finger	[kg]	0.005
IP class		30
Min. ambient temperature	[°C]	-10.0
Max. ambient temperature	[°C]	90.0
Repeat accuracy	[mm]	0.02



# Micro gripper Schunk: SWG 10

Narrow 2-finger angular gripper with double actuation

## Technical data

Description		SWG 10
	ID	0305116
Opening angle per jaw	[°]	15.0
Opening angle per jaw up to	[°]	2.0
Closing moment	[Nm]	0.01
Closing moment ensured by spring	[Nm]	0.0027
Weight	[kg]	0.0025
Recommended workpiece weight	[kg]	0.007
Air consumption per double stroke	[cm <sup>3</sup> ]	0.055
Nominal pressure	[bar]	6.0
Minimum pressure	[bar]	4.0
Maximum pressure	[bar]	6.5
Closing time	[s]	0.015
Opening time	[s]	0.02
Max. permitted finger length	[mm]	10.0
Max. permitted weight per finger	[kg]	0.003
IP rating		30
Min. ambient temperature	[°C]	-10.0
Température ambiante max.	[°C]	90.0
Repeat accuracy	[mm]	0.05



## AVM Automation 240

- Parallel gripper with 2 concentric fingers.
- Pneumatic control double action.
- Constant clamping effort on all the stroke.
- Mechanism completely protected.
- External or internal clamping.
- Magnetic piston for detection without contact.
- The gripper combines reliability, repeatability and sturdiness.
- Material: housing: hardened anodised Al. finger, guide: treated steel.
- Working pressure: 2,5 to 8 bars.
- Working temperature: 5 to 50°C.
- Fluid: lubricated or no lubricated filtered air.
- To lubricate after 4 millions of operation



Model		240
Order Number		2402000
Effective clamping force at 6 bars	(N)	11
Stroke (2x stroke for each finger)	(mm)	2 x 3
Weight	(kg)	0,060
Repeatability	(mm)	0,02
Opening or closing time	(s)	0,03
Air consumption per cycle at 6 bars	(NI)	0,02
Recommended max. part weight	(kg)	0,020

# Micro gripper GIMATIC: GW-10

## Pinza pneumatica ad azione basculante autocentrante a 2 griffe (serie GW)

- Azionamento a doppio effetto
- Grande durata e affidabilità senza manutenzione
- Diverse possibilità di fissaggio
- Sensori magnetici opzionali



	GW-10	GW-16	GW-20	GW-25
Fluido <i>Medium</i>	Aria compressa filtrata, lubrificata / non lubrificata <i>Filtered, lubricated / non lubricated compressed air</i>			
Pressione di esercizio <i>Operating pressure range</i>	2 ÷ 8 bar			
Temperatura di esercizio <i>Operating temperature range</i>	5° ÷ 60°C.			
Coppia di serraggio per griffa in apertura a 6 bar <i>Opening torque at 6 bar on each jaw</i>	11 Ncm	45 Ncm	89 Ncm	178 Ncm
Coppia di serraggio totale in apertura a 6 bar <i>Opening total torque at 6 bar</i>	22 Ncm	90 Ncm	178 Ncm	356 Ncm
Coppia di serraggio per griffa in chiusura a 6 bar <i>Closing torque at 6 bar on each jaw</i>	8 Ncm	36 Ncm	78 Ncm	160 Ncm
Coppia di serraggio totale in chiusura a 6 bar <i>Closing total torque at 6 bar</i>	16 Ncm	72 Ncm	156 Ncm	320 Ncm
Corsa (±1°) <i>Stroke</i>	2x20°	2x20°	2x20°	2x20°
Frequenza max funzionamento continuativo <i>Maximum working frequency</i>	3 Hz	3 Hz	2 Hz	2 Hz
Consumo d'aria per ciclo <i>Cycle air consumption</i>	0.7 cm <sup>3</sup>	3 cm <sup>3</sup>	6 cm <sup>3</sup>	11 cm <sup>3</sup>
Tempo di chiusura senza carico <i>Closing time without load</i>	0.005 s	0.005 s	0.02 s	0.02 s
Ripetibilità <i>Repetition accuracy</i>	0.04°	0.04°	0.04°	0.04°
Peso <i>Weight</i>	39 g	88 g	171 g	300 g

# Micro gripper GIMATIC: PN 010-3 e PN 010-2

## Pinze pneumatiche ad azione basculante autocentrante

- Azionamento a doppio effetto.
- Rendimento ed affidabilità elevati, dovuti all'assenza di organi di trasmissione.
- Possibilità di scelta: 2 o 3 griffe.
- Sensori magnetici opzionali.



	PN 010-3	PN 010-2	PN 016-3	PN 016-2	PN 025-3	PN 025-2	PN 040-3	PN 040-2
Azionamento <i>Design</i>	Pinza pneumatica ad azionamento basculante autocentrante <i>Self - centering angular motion gripper</i>							
Fluido <i>Medium</i>	Aria compressa filtrata, lubrificata/non lubrificata <i>Filtered lubricated - non lubricated compressed air</i>							
Pressione di esercizio <i>Compressed air control range</i>	2 ÷ 8 bar							
Corsa <i>Stroke</i>	(± 1°) 3 x 19°	2 x 19°	3 x 19°	2 x 19°	3 x 19°	2 x 19°	3 x 19°	2 x 19°
Temperatura di esercizio <i>Permitted temperature range</i>	5 ÷ 60°C.							
Coppia di serraggio per ogni griffa a 6 bar <i>Maximum gripper torque at 6 bar on each jaw</i>	10 Ncm	15 Ncm	38 Ncm	57 Ncm	166 Ncm	249 Ncm	434 Ncm	651 Ncm
Coppia di serraggio totale a 6 bar <i>Total gripper torque at 6 bar</i>	30 Ncm		114 Ncm		498 Ncm		1302 Ncm	
Tempo di chiusura a 6 bar senza carico <i>Closing time at 6 bar without load</i>	0.02 s		0.03 s		0.06 s		0.1 s	
Frequenza max funzionamento continuativo a 6 bar <i>Maximum working frequency at 6 bar</i>	3 Hz				2 Hz		1 Hz	
Consumo d'aria per ciclo a 6 bar <i>Air consumption for cycle at 6 bar</i>	0.49 cm <sup>3</sup>		2.61 cm <sup>3</sup>		10.8 cm <sup>3</sup>		41.1 cm <sup>3</sup>	
Ripetibilità <i>Repetition accuracy</i>	0.1°				0.1°			
Peso <i>Weight</i>	36 g	32 g	115 g	105 g	400 g	340 g	1040 g	910 g



# Micro gripper GIMATIC: SGP-20S

## Pinza pneumatica a 2 griffe ad azione parallela autocentrante (serie SGP-S)

- Azionamento a doppio effetto.
- Meccanismo di regolazione del gioco brevettato.
- Prestazioni elevate in dimensioni ridotte.
- Costruzione robusta: grande durata e affidabilità senza manutenzione.
- Diverse possibilità di fissaggio e alimentazione.
- Predisposta per sensori induttivi regolabili



**SGP-20S**

	SGP-20S	SGP-25S	SGP-32S	SGP-40S
Fluido <i>Medium</i>	Aria compressa filtrata, lubrificata / non lubrificata <i>Filtered, lubricated / non lubricated compressed air</i>			
Pressione di esercizio <i>Operating pressure range</i>	2 ÷ 8 bar			
Temperatura di esercizio <i>Operating temperature range</i>	5° ÷ 60°C.			
Forza di serraggio per griffa in apertura a 6 bar <i>Opening gripping force at 6 bar on each jaw</i>	23 N	52 N	67 N	80 N
Forza di serraggio totale in apertura a 6 bar <i>Opening total gripping force at 6 bar</i>	46 N	104 N	134 N	160 N
Forza di serraggio per griffa in chiusura a 6 bar <i>Closing gripping force at 6 bar on each jaw</i>	20 N	47 N	60 N	73 N
Forza di serraggio totale in chiusura a 6 bar <i>Closing total gripping force at 6 bar</i>	40 N	94 N	120 N	146 N
Corsa totale (±0.3 mm) <i>Total stroke</i>	4 mm	6 mm	8 mm	12 mm
Frequenza max funzionamento continuativo <i>Maximum working frequency</i>	3 Hz	3 Hz	3 Hz	3 Hz
Consumo d'aria per ciclo <i>Cycle air consumption</i>	0.5 cm <sup>3</sup>	1.4 cm <sup>3</sup>	2.4 cm <sup>3</sup>	4.5 cm <sup>3</sup>
Tempo di chiusura senza carico <i>Closing time without load</i>	0.01 s	0.01 s	0.02 s	0.05 s
Ripetibilità <i>Repetition accuracy</i>	0.02 mm	0.02 mm	0.02 mm	0.02 mm
Peso <i>Weight</i>	33 g	43 g	86 g	170 g



# Micro gripper GIMATIC: TFA10-25

## Mini pinza angolare a due griffe autocentrante, serie TFA

- Azionamento a semplice effetto con apertura a molla.
- Vari accessori disponibili per il fissaggio.
- Kit opzionale per la sospensione



	TFA10-25	TFA14-25	TFA20-25 TFA20-25S
Fluido <i>Medium</i>	Aria compressa filtrata, lubrificata / non lubrificata <i>Filtered, lubricated / non lubricated compressed air</i>		
Pressione di esercizio <i>Pressure range</i>	2.5 ÷ 8 bar		
Temperatura di esercizio <i>Temperature range</i>	5 ÷ 60 °C.		
Corsa <i>Stroke</i>	2 x 12.5°		
Coppia di chiusura per griffa a 6 bar <i>Closing torque at 6 bar each jaw</i>	17 Ncm	48 Ncm	215 Ncm
Coppia di chiusura totale a 6 bar <i>Total closing torque at 6 bar</i>	34 Ncm	96 Ncm	430 Ncm
Coppia di apertura per griffa a 0 bar <i>Opening torque at 0 bar each jaw</i>	0.5 Ncm	0.8 Ncm	1.3 Ncm
Coppia di apertura totale a 0 bar <i>Total opening torque at 0 bar</i>	1 Ncm	1.6 Ncm	2.6 Ncm
Frequenza max funzionamento continuativo <i>Maximum working frequency</i>	2 Hz	2 Hz	2 Hz
Consumo d'aria per ciclo <i>Cycle air consumption</i>	0.2 cm <sup>3</sup>	0.5 cm <sup>3</sup>	2 cm <sup>3</sup>
Peso <i>Weight</i>	12 g	30 g	95 g (TFA20-25) 120 g (TFA20-25S)

## Interfaccia per microgripper meccanici (1/2)

- Piezo system jena O-400-00: contattare azienda
- Zyvex BB-500: contattare azienda
- FemtoTools FT-G102: contattare azienda
- Schunk MPG 10 e SWG 10: si utilizzano due viti M1.2.
- Schunk MWPG20: si utilizza l'interfaccia MWS 20 (MINIATURE CHANGE SYSTEM)

Fasten the MWK to the robot.  
 Use the 3 cylindrical screws M2x8 from the enclosed pack. If exact alignment is required, then use the centering sleeves from the enclosed pack as well.  
 The mass is about 7-9 g.

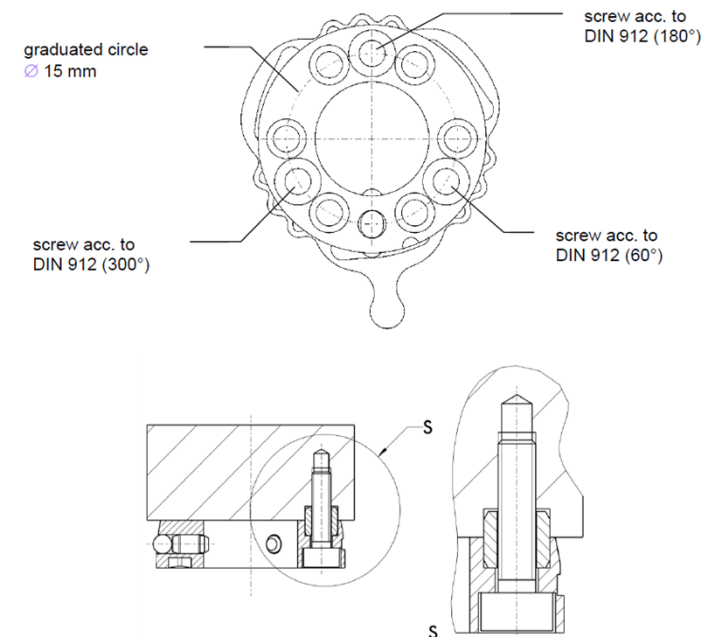


Figure 9: Screw position for MWK

## Interfaccia per microgripper meccanici (2/2)

- GIMATIC GW-10: si interfaccia tramite 2 viti M3x6 mm
- GIMATIC PN 010-3 e PN 010-2: si fissano per mezzo di un codolo filettato
- GIMATIC SGP-20S: collegamento tramite 2 viti M2.5x6mm
- GIMATIC TFA10-25: è presente un codolo filettato G1/8"x8 mm

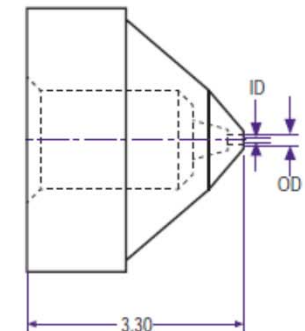
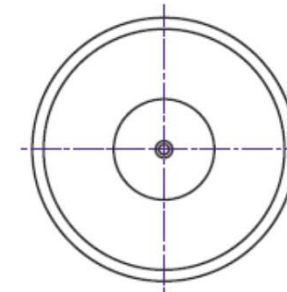


# MICROGRIPPERS A VUOTO A CONFRONTO

Company Name	Gripper name	Internal diameter range	Mass
Micro Mechanics	R7	0.13 - 0.30 mm	?
E.O.I.Tecne	TE	0.076 - 1.60 mm	26 mg
ITIA	Nozzle	0.110 - 0.280 mm	40 mg

## Micro-Mechanics MicroRubber Tip R7

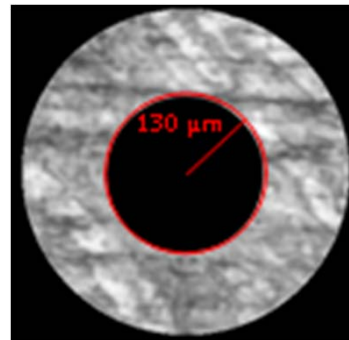
- MicroRubber Tips™ are used for die-attach or pick-and-place of LED's, discrete devices or other small die applications. The MicroRubber™ Tip features a tip diameter of 0.21mm with a vacuum hole of 0.13mm.
- Unlike plastic or metal tools, the compliant rubber material helps eliminate scratches, smears or other damage to the chip surface.
- The tip is replaceable and fits any of the 12U3 or 12U1 style holders made by Micro-Mechanics. Together with an ultra-clean, static dissipative material, the MicroRubber™ Tip is the perfect solution for improved assembly yield.



No.	Part No.	OD	OD	ID	ID	Holder
		inch	mm	inch	mm	
1	R7M-0021-0	0.008	0.21	0.005	0.13	12U3
2	R7M-0025-0	0.010	0.25	0.006	0.15	12U3
3	R7M-0030-0	0.012	0.30	0.008	0.20	12U3
4	R7M-0038-0	0.015	0.38	0.006	0.15	12U3
5	R7M-0040-0	0.016	0.40	0.012	0.30	12U3

## E.O.I. Tecne Aghi Serie TE

- Aghi di dosatura: attacco in polipropilene, tubetto in acciaio inox.
- Questa linea di aghi di dosatura è priva di bave, inoltre la cannula è lucidata elettroliticamente per consentire un flusso di materiale uniforme e senza deformazioni.
- Questi aghi di dosatura sono privi di silicone e cloruri e sono disponibili in conf. da 50 pz (conf. 1000 pz a richiesta).
- Massa = 26 mg



Vista da sotto

### Codice colore e diametro

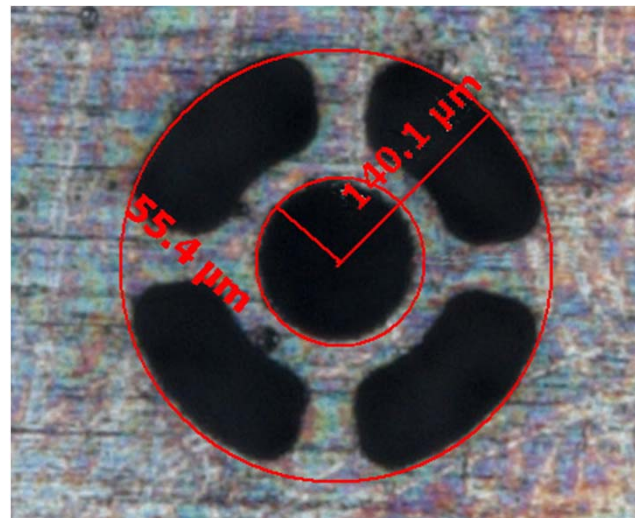
	Misura	Colore	D.I. (mm)
	14	Oliva	1.60
	15	Ambra	1.37
	16	Grigio	1.00
	18	Verde	0.84
	20	Rosa	0.60
	21	Porpora	0.51
	22	Blu	0.41
	23	Arancio	0.34
	25	Rosso	0.26
	27	Trasparente	0.20
	30	Lavanda	0.16
	32	Giallo	0.10

Anche verde lime con  
 $\varnothing$  int. 0.076 mm – 0.114 mm



## Ugello ITIA

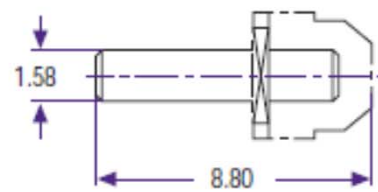
- Innovative multi-lumen nozzle: two main radii can be identified. It has a central circular hole with radius equal to 55.4 microns and an external circle, that circumscribes the internal hole and the other four holes, with radius equal to 140.1 microns.
- This geometry was conceived with the purpose of manipulating a wider range of components, avoiding the need of changing the gripper during the manipulation of components with different sizes and geometries.
- The nozzle should be able to perform like a needle with dimension equal to its internal radius and a needle with dimension equal to its external one at the same time.
- Mass = 40 mg



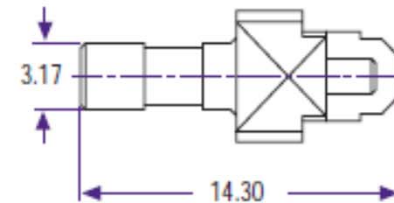
Vista da sotto

## Interfaccia meccanica per microgripper a vuoto

- Il gripper MicroMechanics può essere interfacciato con componenti commerciali (ampia scelta). Si riporta di sotto un esempio, ma un set più completo è disponibile sul catalogo 2012.



ESEC 2006

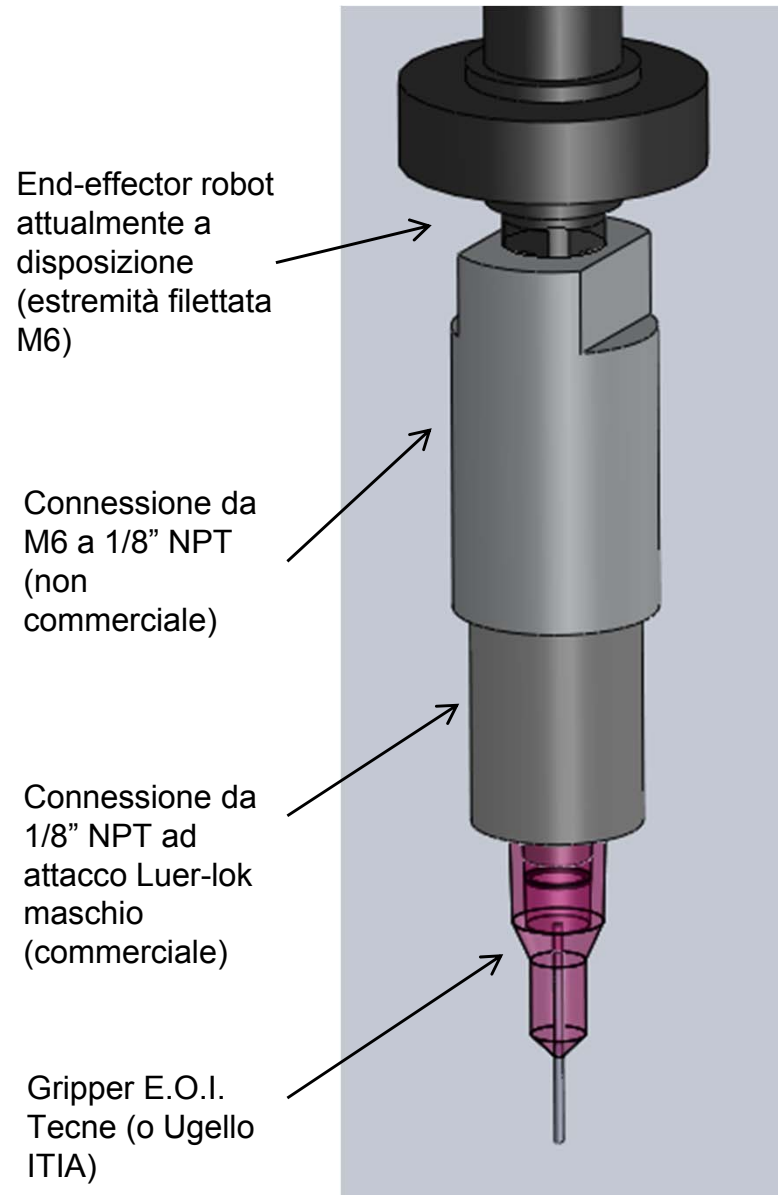
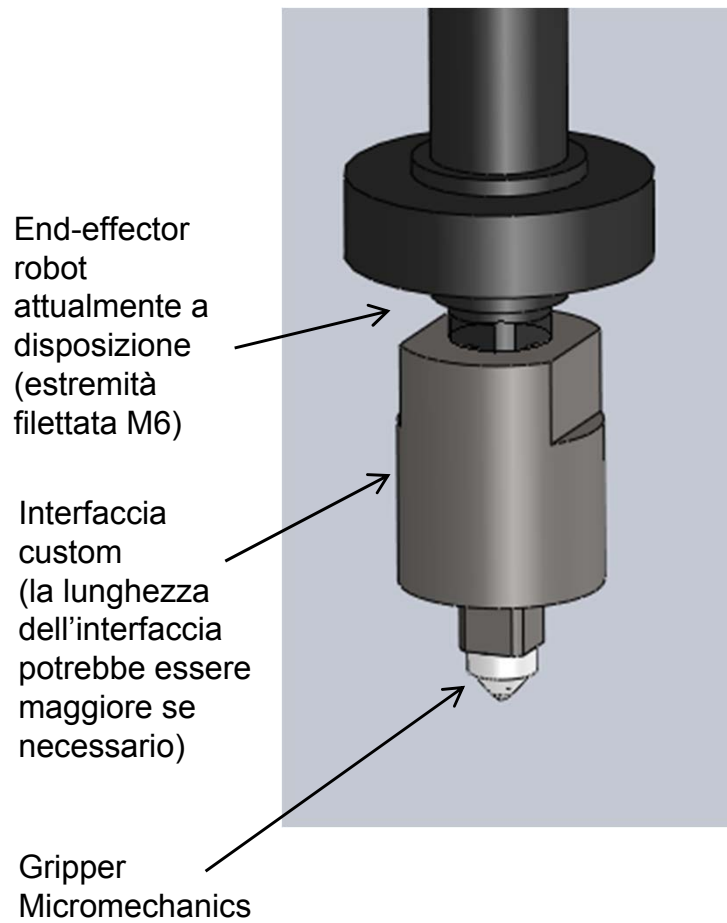


ESEC 2007



- I gripper a vuoto E.O.I Tecne e l'ugello ITIA possono essere interfacciati all'end-effector del manipolatore tramite un innesto Luer-lock standard.

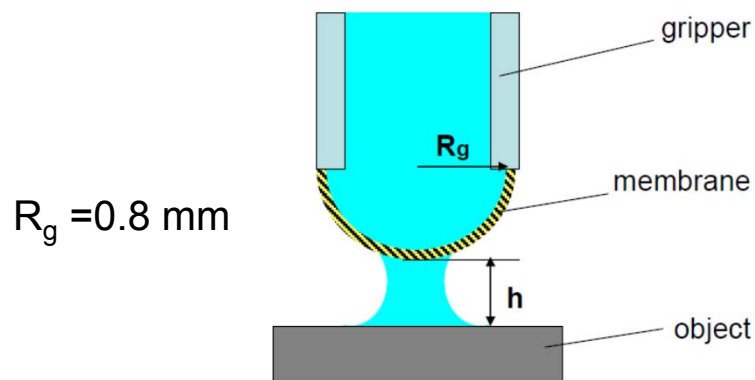
# Progetto interfaccia meccanica per microgripper a vuoto



# MICROGRIPPERS ADESIVI

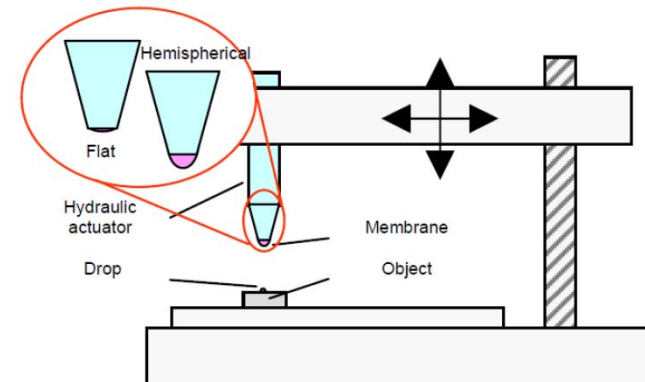
## Gripper a capillarità

### MINI-prototipo ITIA



Schematic representation of a deformable membrane acting as the gripper with variable curvature

The experimental handleable weight range is between 48 and 198 mg.



# MICROGRIPPERS ADESIVI

## Gripper basato sulle forze di Van der Waals

Van der Waals are short-range forces, acting when surfaces are sufficiently close together, and are due to spontaneous electrical and magnetic polarizations that cause a fluctuating electromagnetic field within the medium and the gap between the surfaces involved

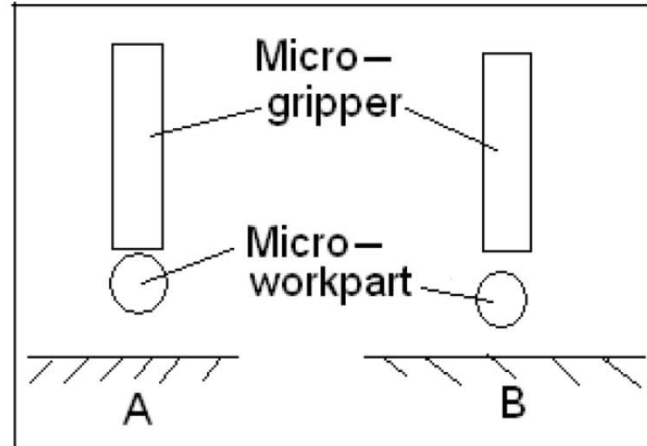


Figure 6 - The picking of a micro-workpart from material A (of low  $A_H$ ) to B (of high  $A_H$ )