

LSR 2K-Injection molding

(액상실리콘 이중 사출성형 기술)



Presenter

공학박사
LSR Specialist

추 성 민
Seong-Min, Choo Ph.D.

LSR 기술세미나 신청과 원본자료 요청은 (주)실리코너스로 연락주시기 바랍니다

Presenter

History of LSR
Since 1999



Technical Advice

- S 전자 MC사업부 기술자문
- L 전자 MC사업부 기술자문
- H 모터스 신기술 부문 기술자문
- 생산기술연구원 감성소재개발 자문위원

Development

- 액상실리콘 장비개발/수입판매
- 액상실리콘 자동화 금형 개발
- 액상실리콘 제품생산
- 액상실리콘 사출기 국산화 개발

現 (주)실리코너스 대표이사

現 중국 CSR그룹 기술자문

前 (주)KCC 실리콘사업부 기술자문

CEO 추성민

- 경영학 학사
- 전자공학 석사
- 전자공학 박사

SILICONERS

Be the World class LSR Specialist

Presenter

개발이력



삼성전자 Galaxy S6(2015), S7(2016), S8(2017) ~
Galaxy watch(2021) ~



스마트폰/스마트와치 내부 방수(IP68 sealing) 구조개발

Presenter

개발이력



코모토모 실리콘 젓병
다이슨 에어랩 멀티 스타일러 스무딩 브러쉬

생활소품 이종사출 부품 개발공급

como[®]
tomo 可么多么



Presenter

개발이력



F-35 Fighter combat plane 2016



K-9 self propelled artillery 1999



Multi function switch



T-50 Advanced trainer 2001 KAI

조종그립 멀티스위치 부품 개발납품(USA, MILL규격)

록히드마틴 F-35 전투기(2016, USA)

한국항공우주(KAI) T-50 고등훈련기(2001)

삼성테크윈 K-9 자주포(1999)

주 제: 액상실리콘(LSR) 이중 사출성형 기술 (LSR 2K-Injection molding)

CONTENTS



- **Silicone & Silicone history**
- **LSR** (Liquid Silicone Rubber)
- **LIM** (Liquid Injection Molding)
 - What is LSR LIM system
 - Why to use LSR LIM system
 - **LSR** molding
- **2K Injection molding & ETC**
- **LSR 2K Injection Molding**
 - What is **LSR 2K** Injection Molding
 - Why to use **LSR 2K** Injection Molding
 - How to make **LSR 2K** Injection Molding
- **Self bonding LSR** (자가접합형 액상실리콘)
- Introduction **SILICONERS**

Silicone & Silicone history

실리콘은 규소(Si)와 산소(O)의 결합(..Si-O-Si-O..)을 포함한 중합체 중,
폴리실록산(Polysiloxane)계열 화합물의 총칭, 어원은 silicon

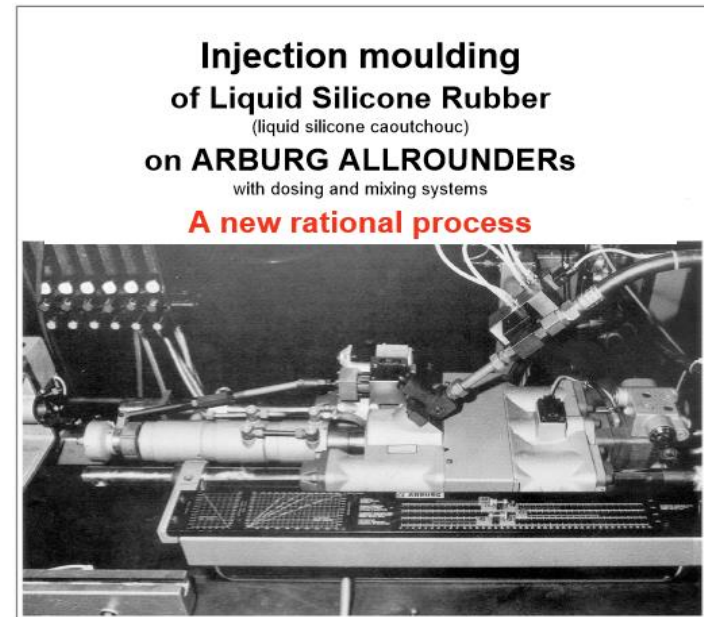
- **SILICON** : 규소이며(원소기호 SI), 암회색의 금속, 반도체용 실리콘 웨이퍼, 합금등
- **SILICONE**: 유기기를 함유한 규소(organo silicone)와 산소등이 결합된 폴리머, 형태에 따라 oil(실리콘오일), rubber(실리콘고무), resin(실리콘레진)으로 구분된다.
 - **실리콘 Oil**
디메틸실리콘오일, 메틸페닐실리콘오일, 변성실리콘 오일,...
 - **실리콘 Rubber**
HCR, LSR, MMR, RTV,
 - **실리콘 Resin**
intermediate resin(중간체), 내열 도료의 베이스, 이형코팅제의 베이스,...

Silicone & Silicone history

액상실리콘은 1950년 초반에 개발되었고,
1960년대 중반에 액상실리콘 고무의 기본적인 것이 갖추어졌다

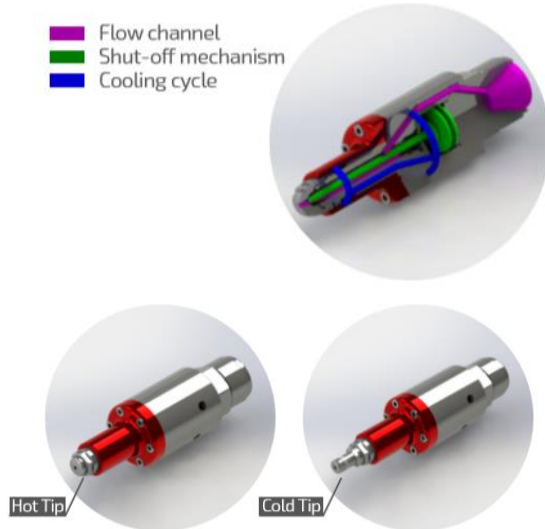
- **고상실리콘(Solid Silicone):** 실리콘오일을 제조한 이후 충전제와 가류제를 넣고 믹싱(롤러사용)하여 미리블형 실리콘 고무 컴파운드 제조
- **액상실리콘(Liquid Silicone):** 실리콘오일을 제조한 이후 충전제, 가교제, 촉매를 넣고 배합(교반)하여 액상실리콘 고무 컴파운드 제조

- 초기 LSR(액상실리콘) LIM System 구축 1960년대 후반
- Development in cold runner technology & mold design
- Photo: ARBURG Automation serial production 1980년



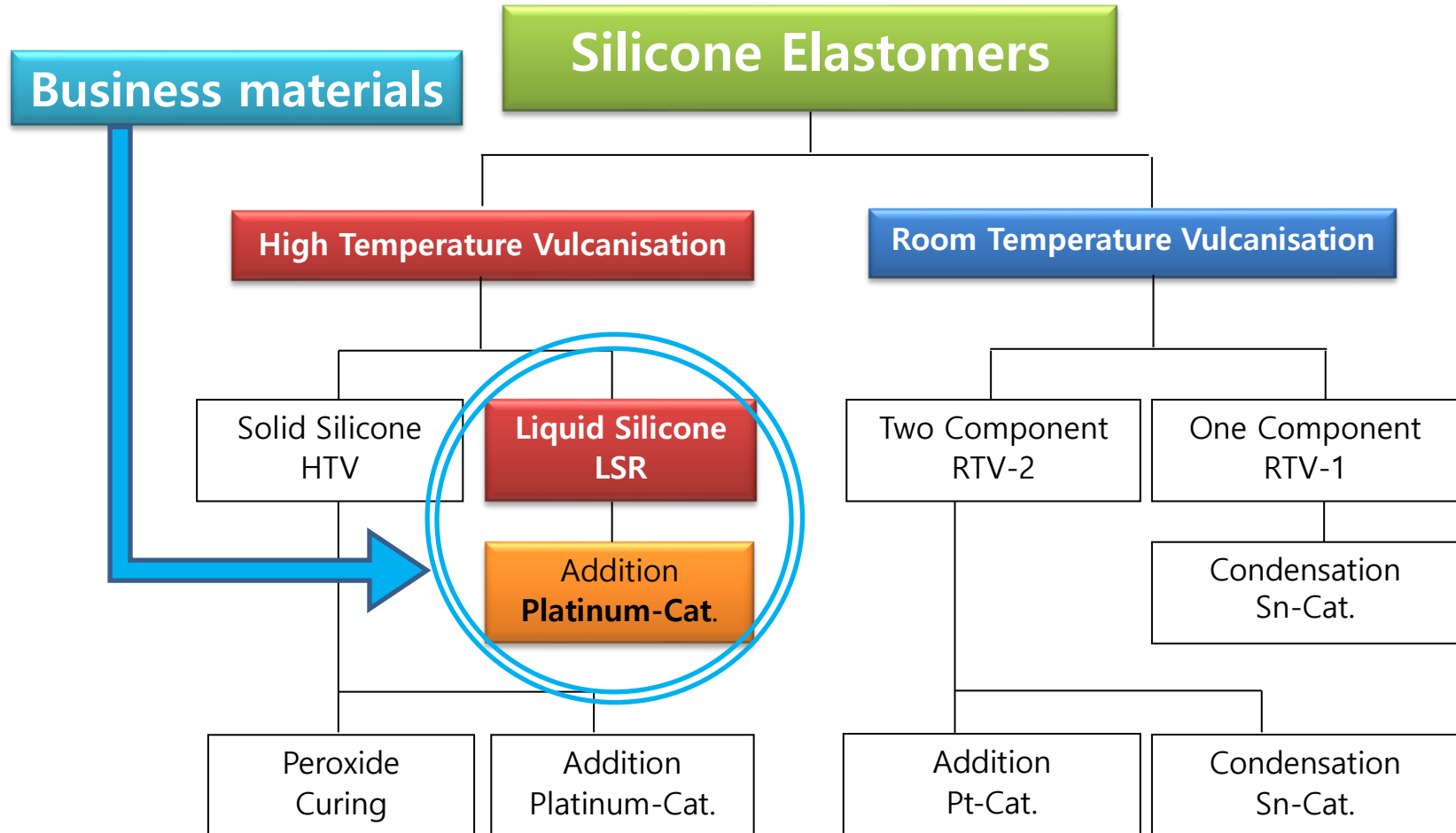
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LSR(Liquid Silicone Rubber)



LSR(Liquid Silicone Rubber)

Packing

- **Two parts** at 1:1 ratio
Base polymer in both parts: vinyl terminated silicone oil,
 $\text{ViMe}_2\text{SiO}(\text{Me}_2\text{SiO})_n\text{SiMe}_2\text{Vi}$
- **Filler** in both parts:
- Catalyst in **Part A: Pt compound**(백금촉매)
- **Crosslinker** in **Part B**: * hydride containing silicone oil,
 $(-\text{Me}_2\text{SiO})_n(\text{MeHSiO}-)_m$
* **Inhibitor**(경화 지연제) in Part B
- Additives(기타첨가제)

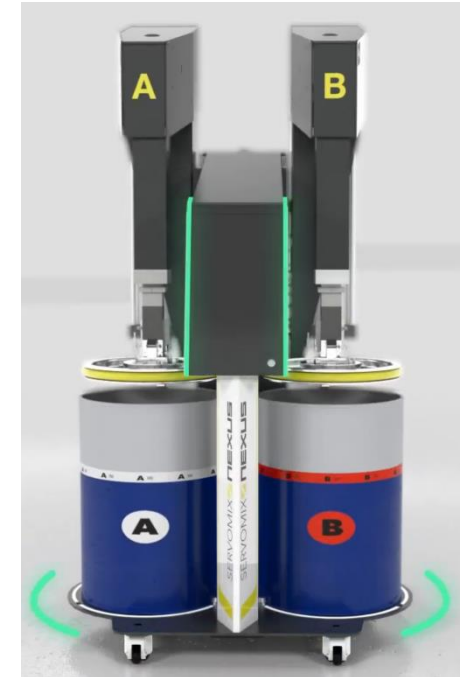
Part A
Vinyl polymer
Filler

Pt-cat.

Part B
Vinyl polymer
Filler

Inhibitor
(경화지연제)

Cross-linker



LSR(Liquid Silicone Rubber)

Mixing rate

- **A : B = 1 : 1** 구조적으로 가장 안정적 (최상의 기계적 물성, 화학적 상태)
- **A > B = A** 제가 많이 들어갈 경우(축매반응 빨라짐=> 사출조건 틀어짐)
(경화를 지연시켜 줄 수 있는 경화지연제 부족으로 경화시간이 빨라진다)
- **A < B = B** 제가 많이 들어갈 경우(축매반응 늦어짐=> 사출조건 틀어짐)
(경화를 지연시키는 경화지연제 과다투입으로 경화시간이 느려지고,
비닐폴리머(경화용 폴리머) 결합이 줄어들어, 경도가 낮아지는 현상이 나타나며,
B제가 일정비율 이상 들어갈 경우 경화 자체가 안되는 경우가 발생한다)
- **(A : B) + C(color ink)** A, B 배합시 칼라잉크를 투입할 경우 비반응성 오일베이스의 칼라잉크이거나, 반응성 오일베이스의 칼라잉크라 하더라도 **투입비율이 4%**를 넘게 되면 경화 속도가 늦어지거나, 경화가 일어나지 않을 수 있다 c

Part A
Vinyl polymer
Filler

Pt-cat.

Part B
Vinyl polymer
Filler

Inhibitor
(경화지연제)

Cross-linker

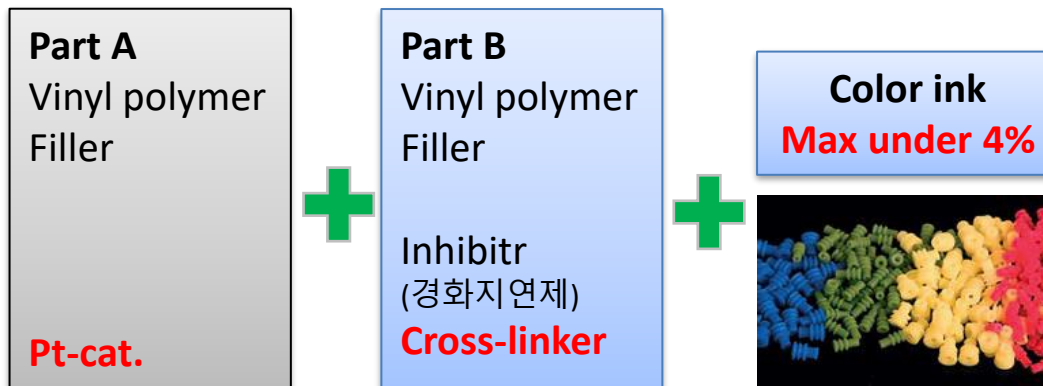
LSR(Liquid Silicone Rubber)

Color Mixing rate

- (A : B) + C(color ink)

칼라잉크를 투입(A+B+C)할 경우 비반응성 오일베이스(페닐계 오일)의 칼라잉크, 또는 반응성 오일베이스(디메틸계 오일)의 칼라잉크라 하더라도 **투입비율이 4%**를 넘게 되면 경화 속도가 늦어지거나, 경화가 일어나지 않을 수 있다

- 실리콘 잉크 제조사별 추천 칼라혼합비율(최대 4% 미만 혼입, 2% 미만 혼입 추천)
 - wacker : 0.5 ~ 4 %
 - momentive : 0.5 ~ 2 %
 - nusil : 0.5 ~ 2 %



COLOR		TRANSLUCENT COLOR	
LSR	HCR	UNRESTRICTED	RESTRICTED
WED-4001	WED-4001	WED-4001	WED-4001
WED-4002	WED-4002	WED-4002	WED-4002
WED-4003	WED-4003	WED-4003	WED-4003
WED-4004	WED-4004	WED-4004	WED-4004
WED-4005	WED-4005	WED-4005	WED-4005
WED-4006	WED-4006	WED-4006	WED-4006
WED-4007	WED-4007	WED-4007	WED-4007
WED-4008	WED-4008	WED-4008	WED-4008
WED-4009	WED-4009	WED-4009	WED-4009
WED-4010	WED-4010	WED-4010	WED-4010
WED-4011	WED-4011	WED-4011	WED-4011
WED-4012	WED-4012	WED-4012	WED-4012
WED-4013	WED-4013	WED-4013	WED-4013
WED-4014	WED-4014	WED-4014	WED-4014
WED-4015	WED-4015	WED-4015	WED-4015
WED-4016	WED-4016	WED-4016	WED-4016
WED-4017	WED-4017	WED-4017	WED-4017
WED-4018	WED-4018	WED-4018	WED-4018
WED-4019	WED-4019	WED-4019	WED-4019
WED-4020	WED-4020	WED-4020	WED-4020
WED-4021	WED-4021	WED-4021	WED-4021
WED-4022	WED-4022	WED-4022	WED-4022
WED-4023	WED-4023	WED-4023	WED-4023
WED-4024	WED-4024	WED-4024	WED-4024
WED-4025	WED-4025	WED-4025	WED-4025
WED-4026	WED-4026	WED-4026	WED-4026
WED-4027	WED-4027	WED-4027	WED-4027
WED-4028	WED-4028	WED-4028	WED-4028
WED-4029	WED-4029	WED-4029	WED-4029
WED-4030	WED-4030	WED-4030	WED-4030
WED-4031	WED-4031	WED-4031	WED-4031
WED-4032	WED-4032	WED-4032	WED-4032
WED-4033	WED-4033	WED-4033	WED-4033
WED-4034	WED-4034	WED-4034	WED-4034
WED-4035	WED-4035	WED-4035	WED-4035
WED-4036	WED-4036	WED-4036	WED-4036
WED-4037	WED-4037	WED-4037	WED-4037
WED-4038	WED-4038	WED-4038	WED-4038
WED-4039	WED-4039	WED-4039	WED-4039
WED-4040	WED-4040	WED-4040	WED-4040
WED-4041	WED-4041	WED-4041	WED-4041
WED-4042	WED-4042	WED-4042	WED-4042
WED-4043	WED-4043	WED-4043	WED-4043
WED-4044	WED-4044	WED-4044	WED-4044
WED-4045	WED-4045	WED-4045	WED-4045
WED-4046	WED-4046	WED-4046	WED-4046
WED-4047	WED-4047	WED-4047	WED-4047
WED-4048	WED-4048	WED-4048	WED-4048
WED-4049	WED-4049	WED-4049	WED-4049
WED-4050	WED-4050	WED-4050	WED-4050
WED-4051	WED-4051	WED-4051	WED-4051
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WED-4055	WED-4055	WED-4055	WED-4055
WED-4056	WED-4056	WED-4056	WED-4056
WED-4057	WED-4057	WED-4057	WED-4057
WED-4058	WED-4058	WED-4058	WED-4058
WED-4059	WED-4059	WED-4059	WED-4059
WED-4060	WED-4060	WED-4060	WED-4060
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WED-4062	WED-4062	WED-4062	WED-4062
WED-4063	WED-4063	WED-4063	WED-4063
WED-4064	WED-4064	WED-4064	WED-4064
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WED-4068	WED-4068	WED-4068	WED-4068
WED-4069	WED-4069	WED-4069	WED-4069
WED-4070	WED-4070	WED-4070	WED-4070
WED-4071	WED-4071	WED-4071	WED-4071
WED-4072	WED-4072	WED-4072	WED-4072
WED-4073	WED-4073	WED-4073	WED-4073
WED-4074	WED-4074	WED-4074	WED-4074
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WED-4076	WED-4076	WED-4076	WED-4076
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WED-4078	WED-4078	WED-4078	WED-4078
WED-4079	WED-4079	WED-4079	WED-4079
WED-4080	WED-4080	WED-4080	WED-4080
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WED-4082	WED-4082	WED-4082	WED-4082
WED-4083	WED-4083	WED-4083	WED-4083
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WED-4088	WED-4088	WED-4088	WED-4088
WED-4089	WED-4089	WED-4089	WED-4089
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WED-4094	WED-4094	WED-4094	WED-4094
WED-4095	WED-4095	WED-4095	WED-4095
WED-4096	WED-4096	WED-4096	WED-4096
WED-4097	WED-4097	WED-4097	WED-4097
WED-4098	WED-4098	WED-4098	WED-4098
WED-4099	WED-4099	WED-4099	WED-4099
WED-4100	WED-4100	WED-4100	WED-4100

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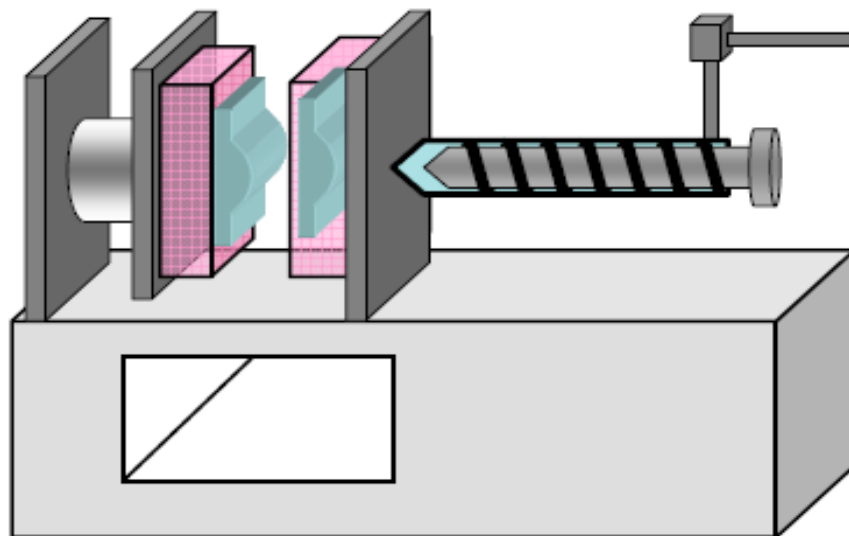
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- Introduction **SILICONERS**

What is LIM system(LSR Package)

LSR injection molding machine

Mold

- heated electrical or with fluid; $\vartheta = 150 - 220\text{ }^{\circ}\text{C}$
- Cold Runner, $\vartheta = 23\text{ }^{\circ}\text{C}$
- hardened steel for cavities
- Vacuum

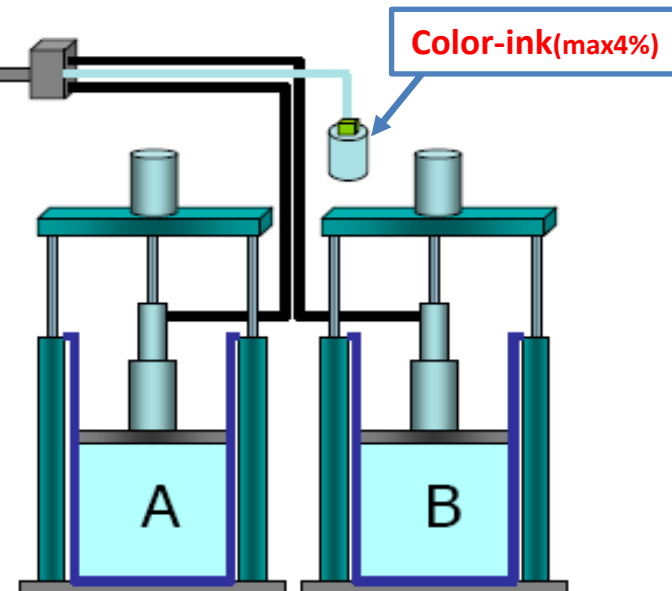


Injection Molding Machine

- standard Injection Molding Machine
- special injection unit, $\vartheta = 23\text{ }^{\circ}\text{C}$
- optimized Non-Return Valve
- Control Pump and Handling

Liquid Silicone Rubber

- viscose fluid
- 20 Liter Hobcock or 200 Liter drum
- Mixing ratio 1:1, kit matching

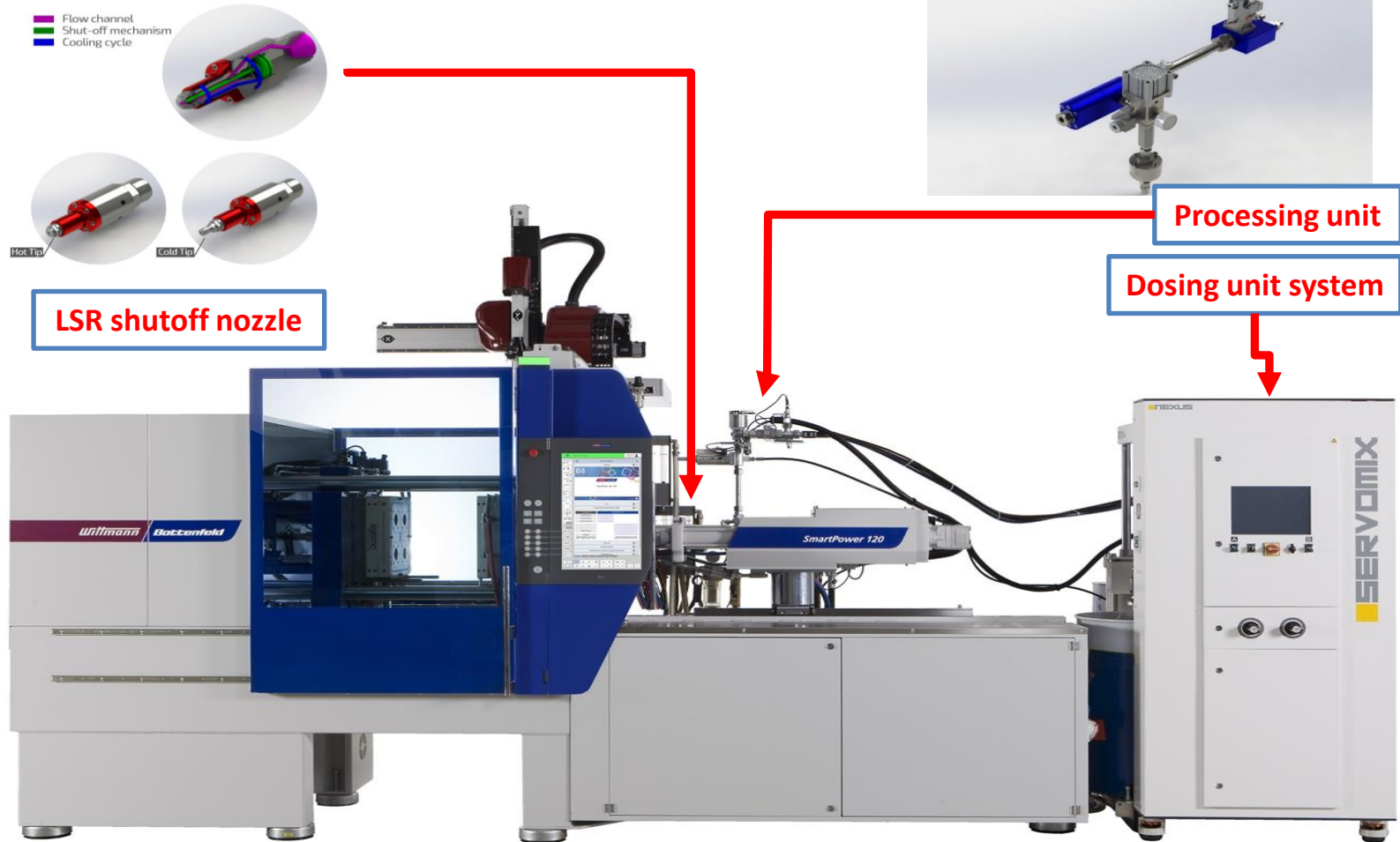


LSR Mixing Unit

- pneumatic or hydraulic
- material pressure $\sim 200\text{ bar}$
- Mixing ratio 1:1 additional color/additive line
- static mixer and pressure reduction

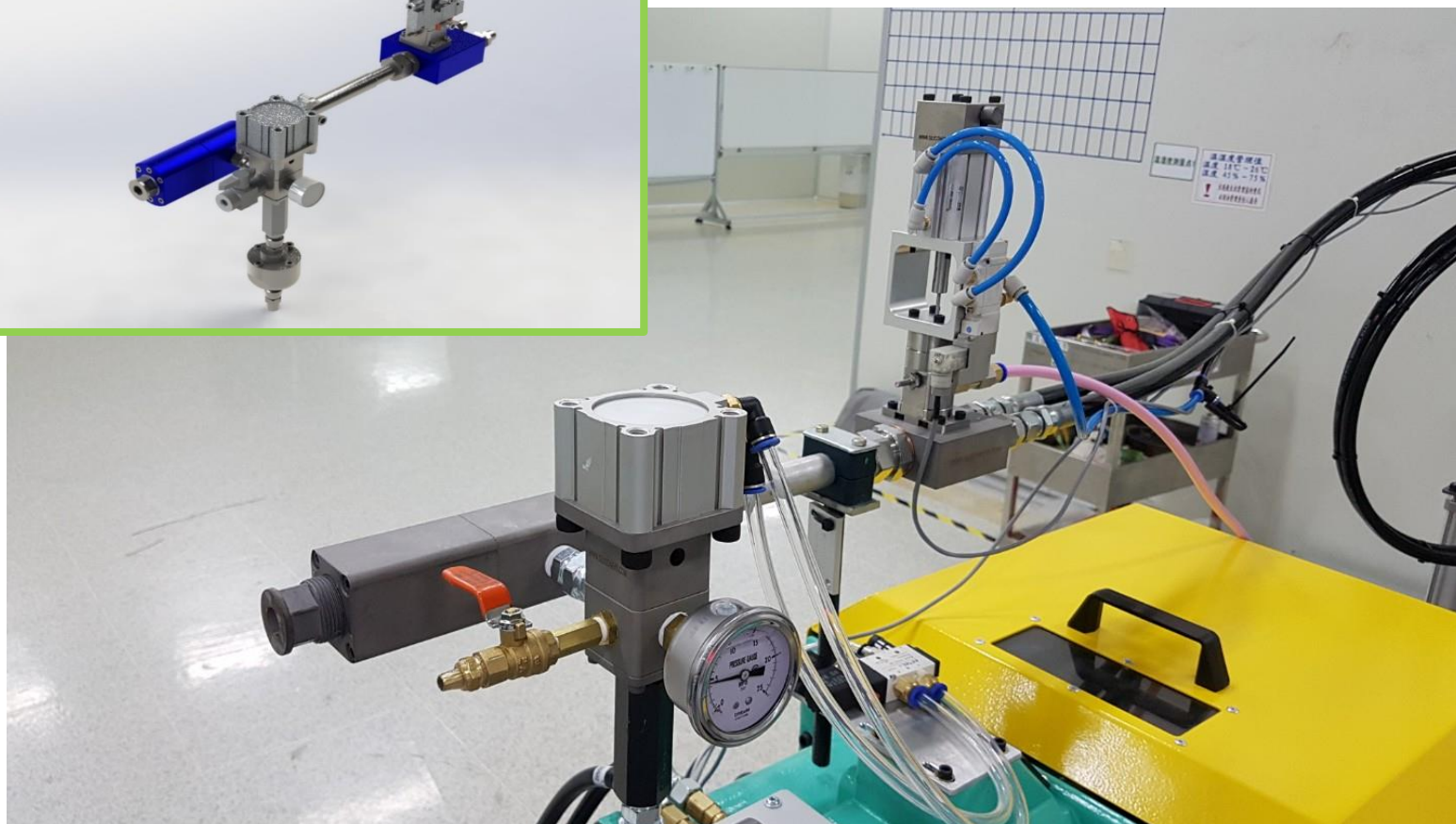
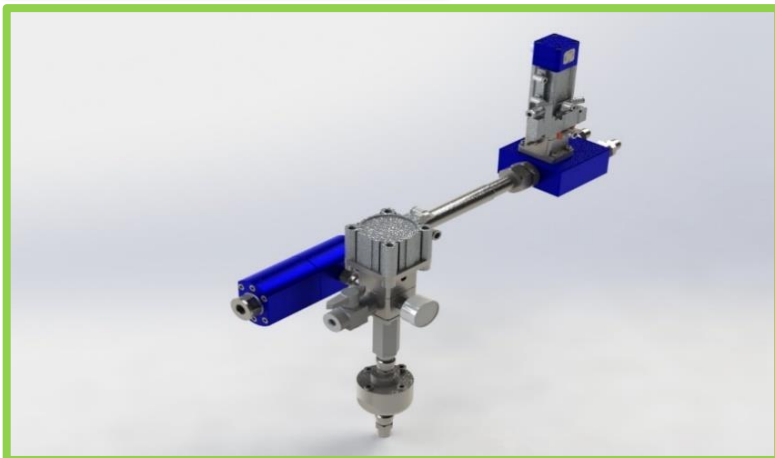
What is LIM system(LSR Package)

LSR injection molding machine



What is LIM system(LSR Package)

Processing unit



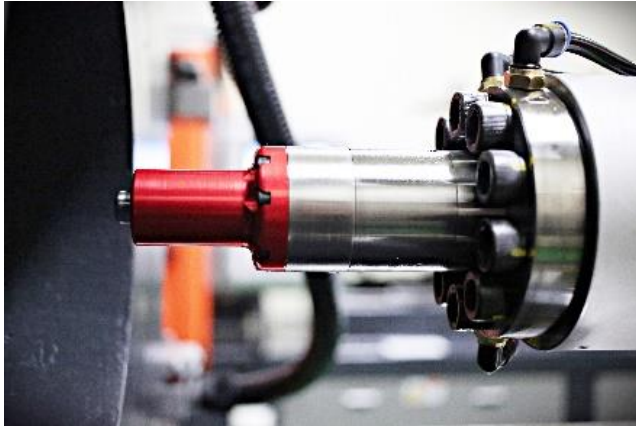
What is LIM system(LSR Package)

Processing unit



LIM system(LSR Package)

LSR injection molding machine(구성요소)



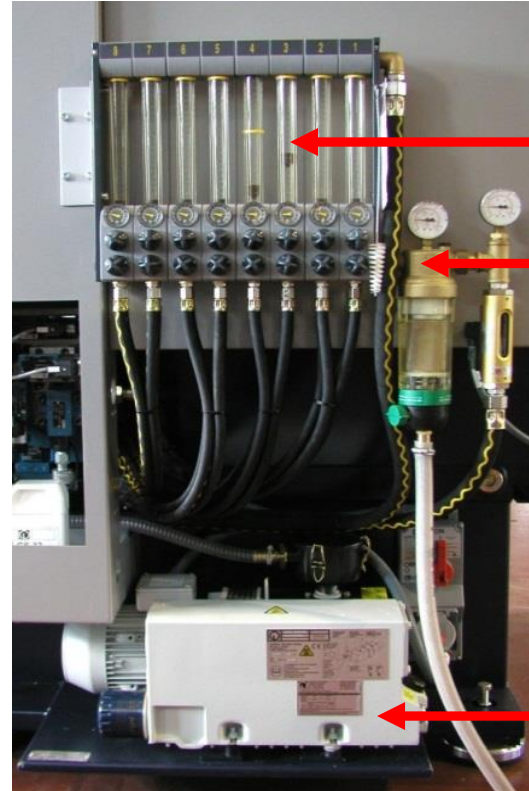
Cooling & Shut-off replacement nozzle



Plate type NRV with spring screw tip



Screw without compression



Water filtering unit

Water pressure supervision

Vacuum pump

What is LIM system(LSR Package)

Dosing system => for 2K injection



2KM, Elmet, EMT, Reinhardt 등,
펌프 상하수직 운동
펌프 펌핑 이송

Standard Dosing system

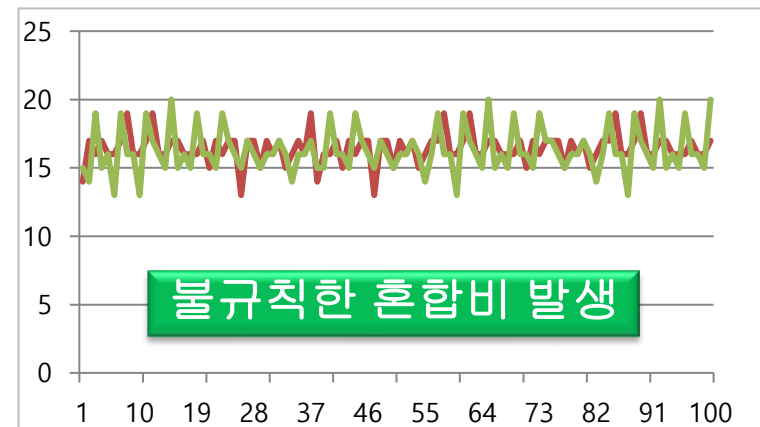
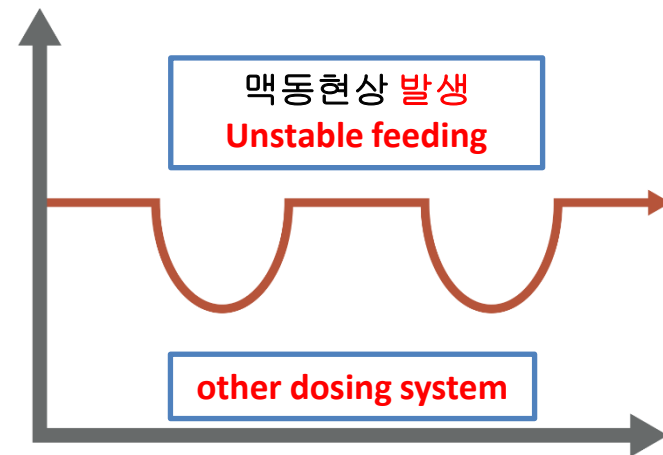
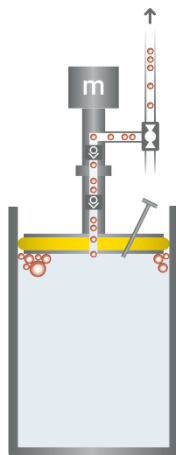
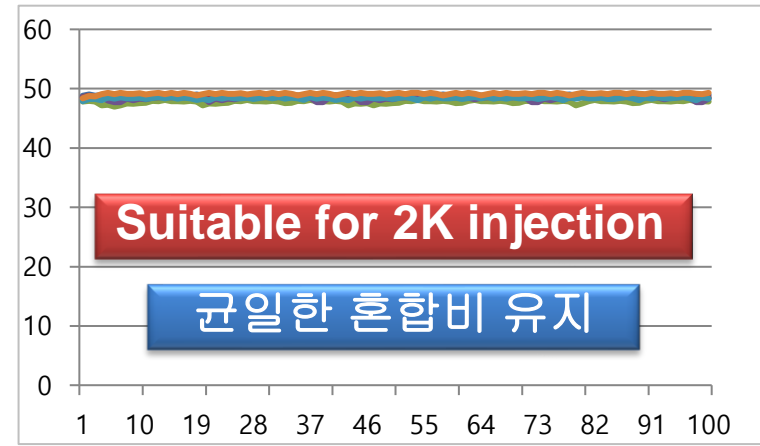
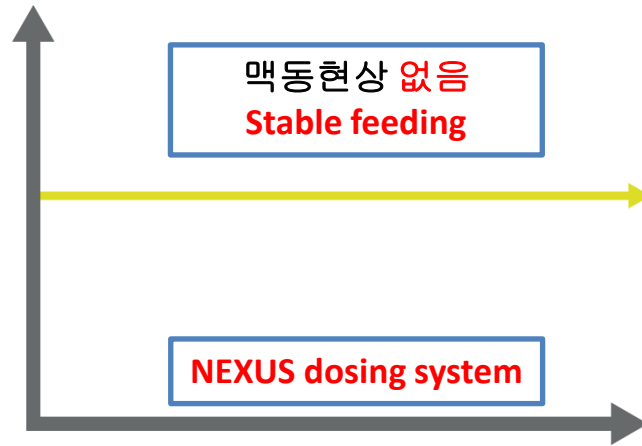
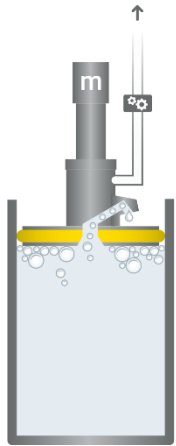


NEXUS servomix
이송 스크류 회전운동
스크류 회전 이송

Suitable for 2K injection

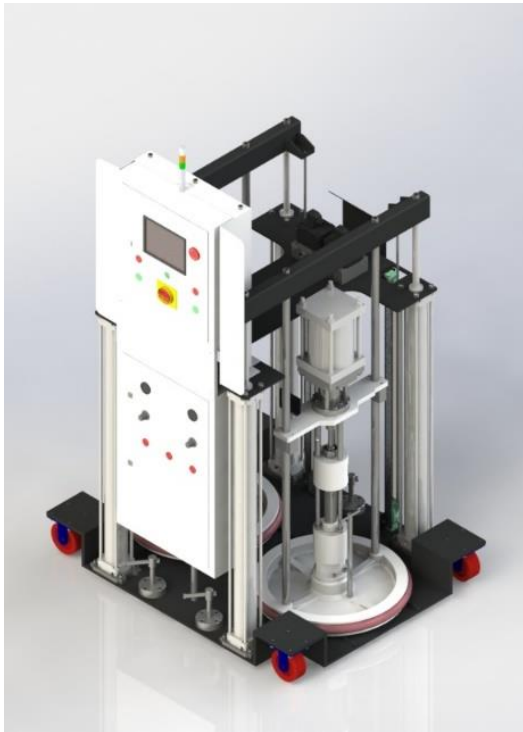
What is LIM system(LSR Package)

Dosing system => for 2K injection



주 제: 액상실리콘(LSR) 이중 사출성형 기술 (LSR 2K-Injection molding)

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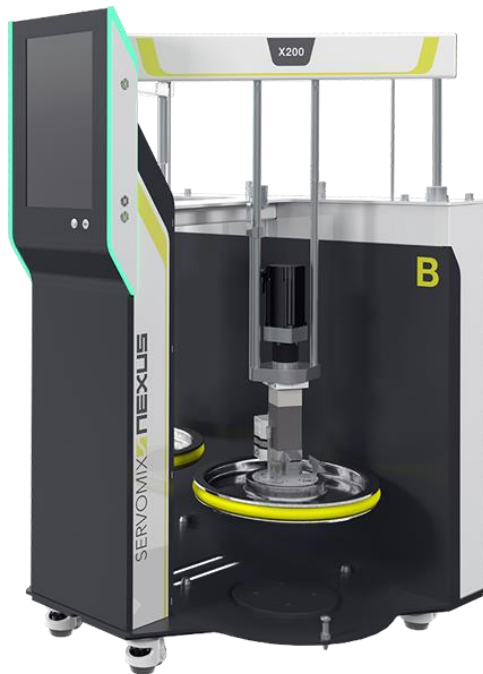
Why to use LSR LIM system

Benefits of LSR LIM system(LSR 제조공정의 장점)

- **Trusted processes(믿을 수 있는 제조공정)**
고상실리콘 생산방식 대비,
신뢰할 수 있는 원재료 사용, 제조공정에 대한 작업자의 개입이 불가한 시스템
(4M관리가 용이하다, **4M: man / machine / materials / method**)
- **Improved quality (안정적인 품질 제조공정)**
안정적인 품질(재현성) 구현 가능
- **Cost saving / Economic process (운용비용 절감 가능 제조공정)**
고상실리콘 생산방식 대비,
전문 생산인력의 필요성 감소, 고급인력난 해소 가능
자동생산 프로세스 구현을 통한 비용절감 실현 가능

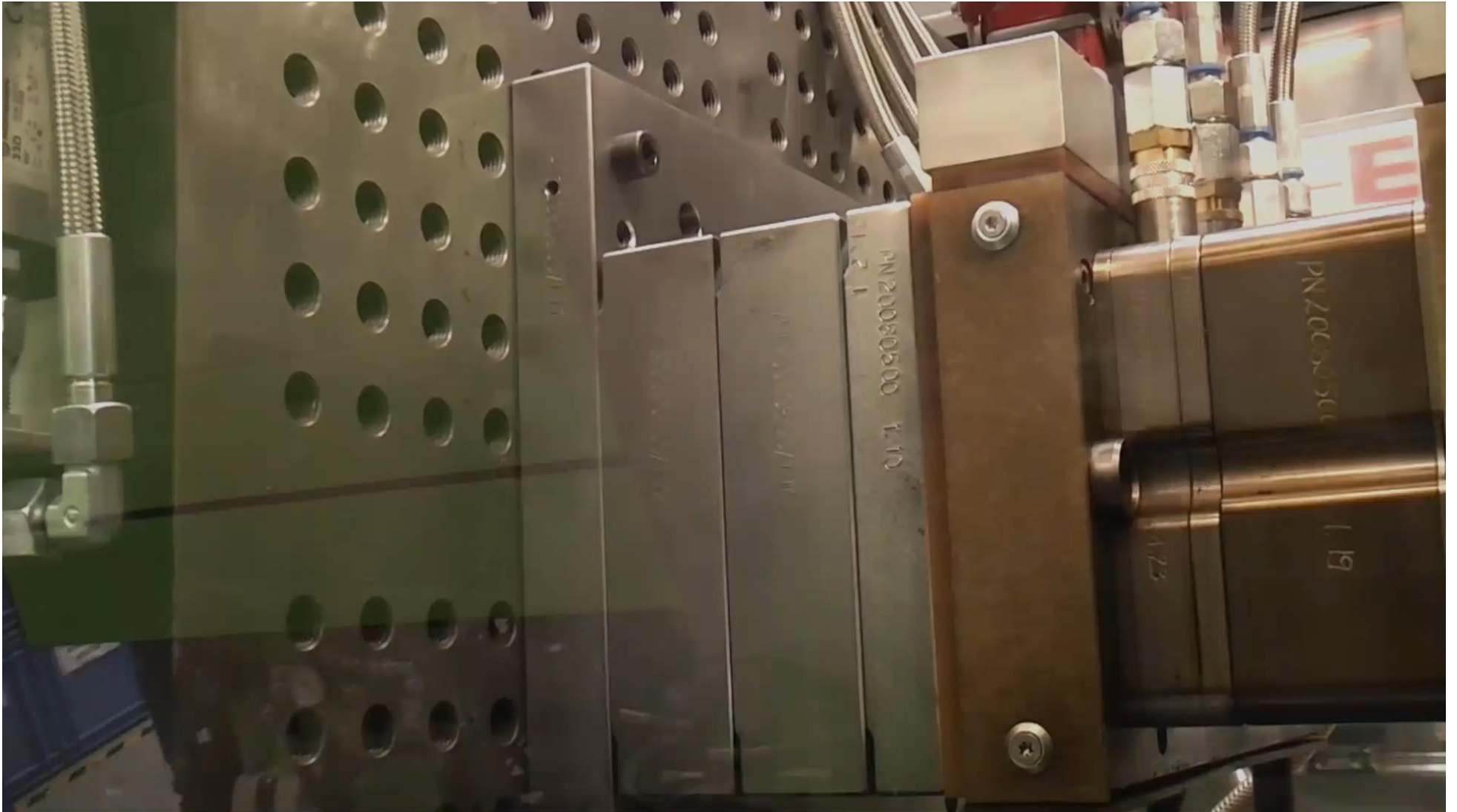
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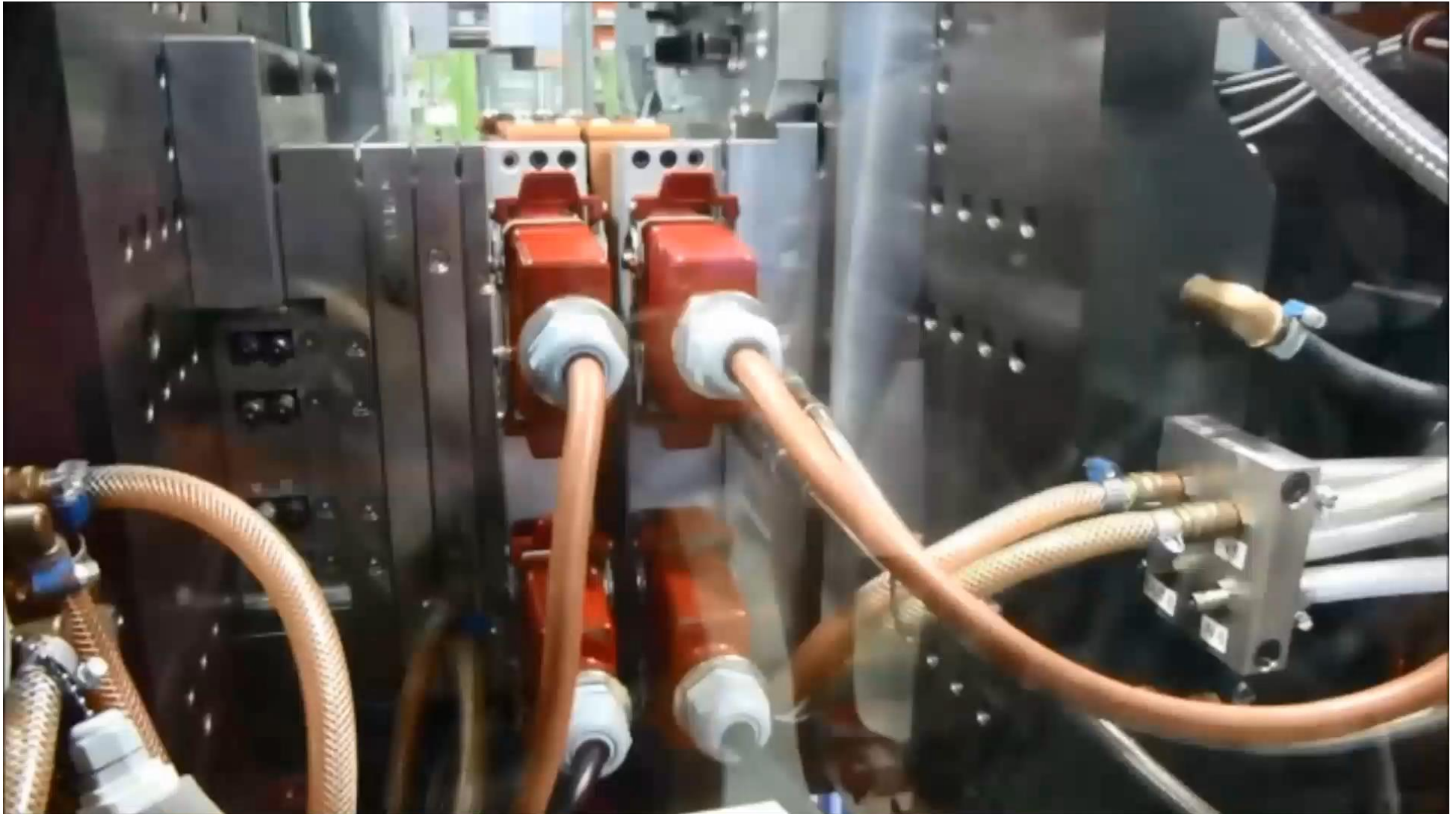


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LSR Molding



LSR Molding



LSR Molding



주 제: 액상실리콘(LSR) 이중 사출성형 기술 (LSR 2K-Injection molding)

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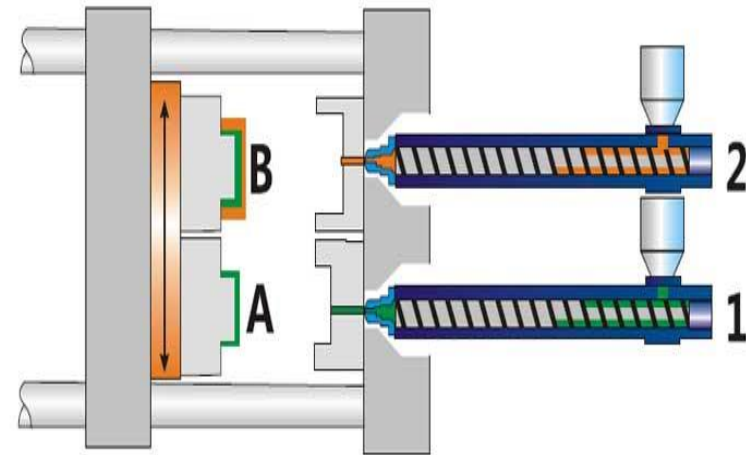
- **Silicone & Silicone history**
- **LSR** (Liquid Silicone Rubber)
- **LIM** (Liquid Injection Molding)
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 - Why to use LSR LIM system
 - **LSR molding**
- **2K Injection molding & ETC(called name)**
- **LSR 2K Injection Molding**
 - What is **LSR 2K Injection Molding**
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2K Injection molding & ETC

2K injection (commonly **called name**)

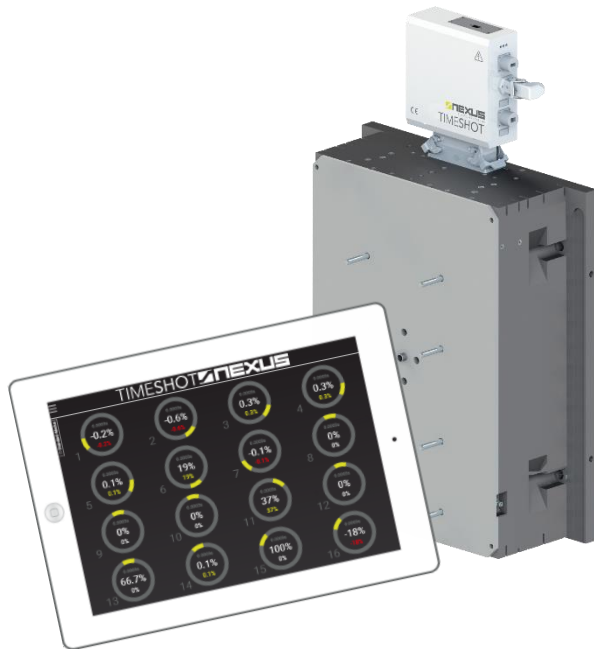
Two **different materials** into **different locations** in the same mold

- 2C injection molding (C : color, component)
- 2M injection molding (M : materials)
- 2 shot injection molding
- Multi component injection molding
- Multi shot injection molding
- Multi-injection molding
- Over molding
- Dual shot molding
- **2K injection molding** (K: kunststoffe, 쿤스타페, 플라스틱의 독일어)
(The “K” comes from the German word “kunststoff” which means “plastics”)
3년마다 독일 뒤셀도르프에서 열리는 “K-Show”의 K 의미는 플라스틱



주 제: 액상실리콘(LSR) 이중 사출성형 기술 (LSR 2K-Injection molding)

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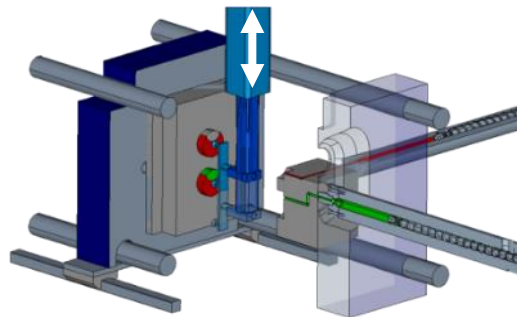
LSR 2K Injection molding

What is LSR 2K Injection molding

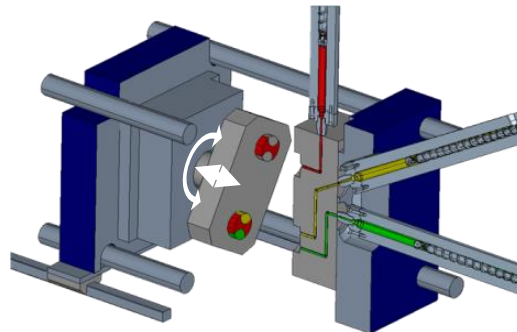
Two different materials into different locations in the same mold

(같은 몰드안에 두개의 각기 다른 소재가 다른 위치에,.... 단단함과 부드러움이 모두 필요한 곳에..)

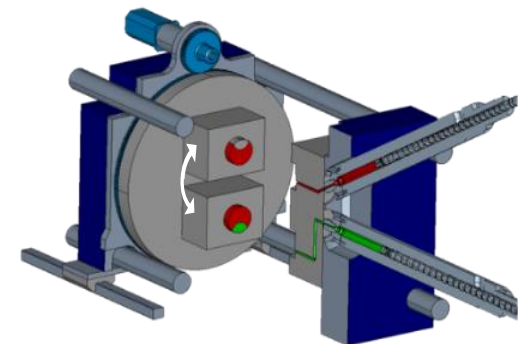
- 2K 사출성형은 두가지 재료나, 색상을 하나의 복합부품으로 생산할 때 적용되는 혁신적 성형기법
- 1차 사출물은 2차 사출물이 주입(사출)될 때 금형 코어와 같은 역할을 해야 함으로, 1차 사출재료는 2차 사출재료보다 강한(고경도, 고내열등,...) 성질의 재료를 사용한다



transfer



Index plate



Rotary plate

LSR 2K Injection molding

Where is LSR 2K Injection molding used

Products need **LSR 2K** injection molding(same without LSR)

(2K 사출성형은 몇가지 특수 기능 또는 외관을 충족해야 하는 제품에 사용된다)

- Product must be **water-proof** (방수(수밀성)가 필요 제품)
- Product must be **moisture proof** (방습(내습성)이 필요 제품)
- Product must be **dust-proof** (방진(충격흡수)이 필요 제품)
- Product must be **drop-resistant** (충격방지(충격흡수) 필요 제품)
- Product must **have a variety of colors** (다양한 칼라구현(투톤등,..)이 필요 제품)
- Product need **good grip and touch** (좋은 그립감과 터치감 필요 제품)
- Product need **anti-slip** (non-slip, 미끄럼 방지 필요 제품)
- Product need **multi-layer** (여러 겹의 몰딩 필요 제품)

LSR 2K Injection molding

Where is LSR 2K Injection molding used



Membrane

Sealing gasket

Baby parts



LSR 2K Injection molding

Where is LSR 2K Injection molding used



Shower head

Housing seal

Rain Sensor



LSR 2K Injection molding

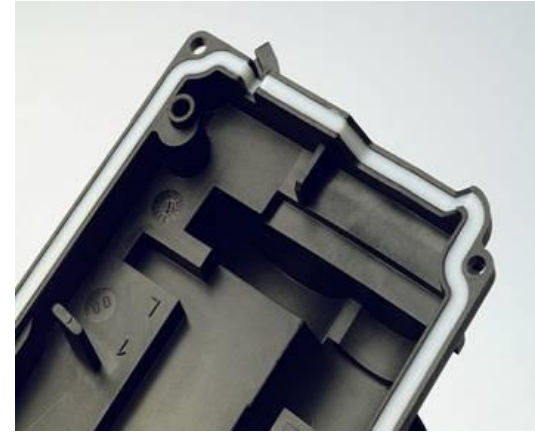
Where is LSR 2K Injection molding used



Water-proof

Housing seal

Housing gasket



LSR 2K Injection molding

Where is LSR 2K Injection molding used



Rain sensor



Housing gasket



grip and touch

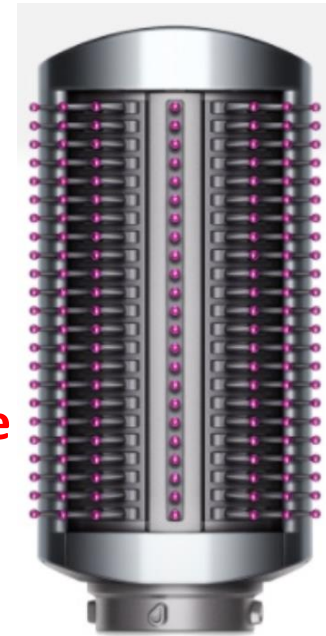


LSR 2K Injection molding

Why to use LSR 2K Injection molding

Benefits of 2-shot molding

- **High Precision and stable quality**
(높은 정밀도와 안정적인 품질)
- **Good structural strength and long service life**
(높은 내구성(구조적 강도)과 다기능, 긴 수명)
- **Good appearance**
(복잡한 구조, 외관구현으로 제품가치 증가)
- **Great for mass production**
(대량 생산에 아주 유리, 생산성 향상, 잠재적인 조립결함과 관련된 비용절감)
- **It lowers production costs and increases the value of composite products**
(조립시간 단축, 단위 생산비용을 낮추고 복합 제품의 가치를 높일 수 있다)



2K injection

안정적인 품질 확보
내구성 향상
좋은 외관
낮은 생산비용
대량생산에 유리
제품가치 상승

다양한 소재 혼용
다기능 구현

다양한 색상 적용
상품성 증대

개발예시: 다이슨 스무딩-브러쉬

LSR 2K Injection molding

Why to use LSR 2K Injection molding

Dis-advantage of 2-shot molding

- **High cost** than 1K injection mold
(단사출 금형 보다 **높은 금형 개발 비용**)
- **High cost** than 1K injection machine & equipment
(단사출 보다 **높은 사출기 및 주변기기 비용**)
- **Difficult recycling**
(두개의 다른 소재가 결합되어 있어 **재활용이 어렵거나, 불가능하다**)

2K 사출성형제품 개발을 진행할 경우

높은 개발비용 등이 소요되지만, 복잡한 구조가 요구되는 제품의 개발이 가능하며, 다수의 부품 조립관련 투자비용(JIG, 자동화 조립 라인등,,)과 인건비등의 절감이 이루어져 결과적으로는 투자비용이 회수된다

주 제: 액상실리콘(LSR) 이중 사출성형 기술 (LSR 2K-Injection molding)

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LSR 2K Injection molding

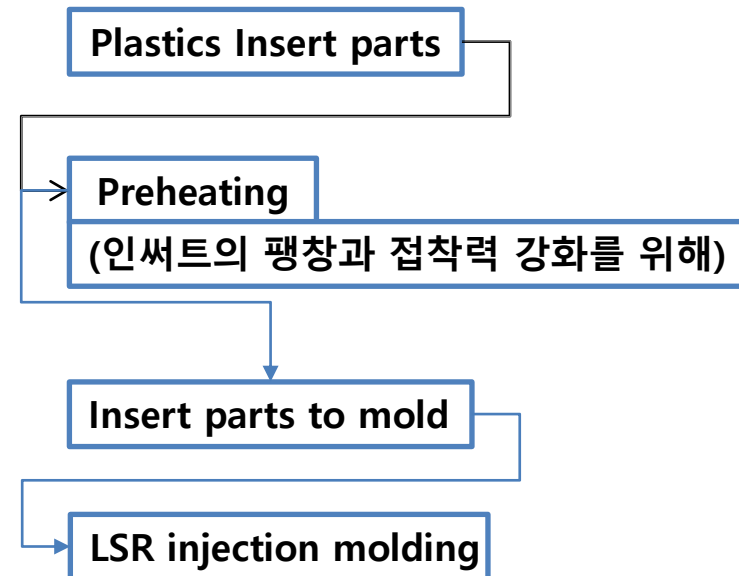
How to make LSR 2K Injection molding 1/4

- **Mechanical coupling**

(인서트 오버몰딩, 구조적 결합(접착), 접착제(프라이머) 사용 안함)



Process



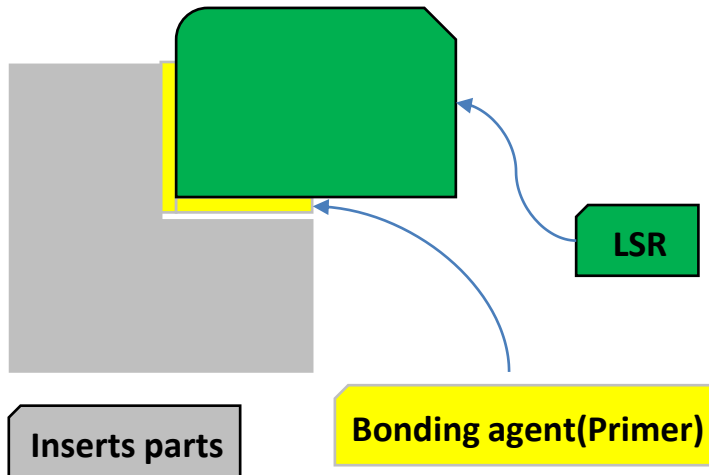
- **LSR**

Standard LSR with mechanical bonding

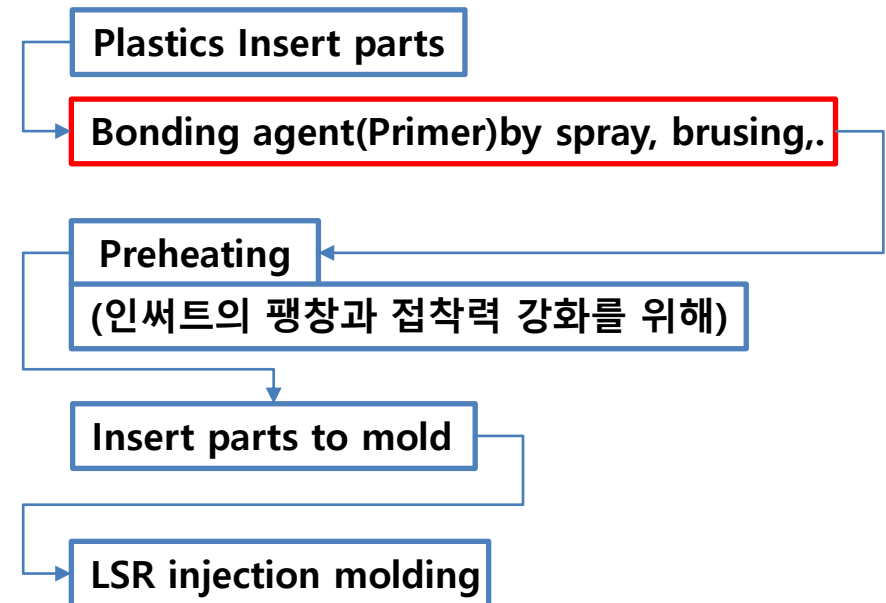
LSR 2K Injection molding

How to make LSR 2K Injection molding 2/4

- **Chemical adhesion using bonding agent(primer)**
(인서트 오버몰딩, 화학적 접착, 접착제(프라이머)를 이용한 접착,)



Process

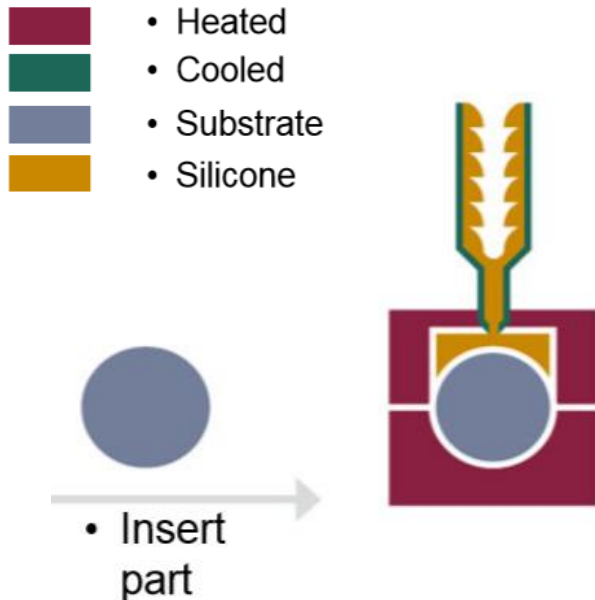


- LSR
Standard LSR with chemical bonding

LSR 2K Injection molding

How to make LSR 2K Injection molding 3/4

- **Chemical adhesion using self adhesive(self bonding) LSR**
(인서트 오버몰딩, 화학적 접착, 자가 접합형 LSR 을 이용한 접착)



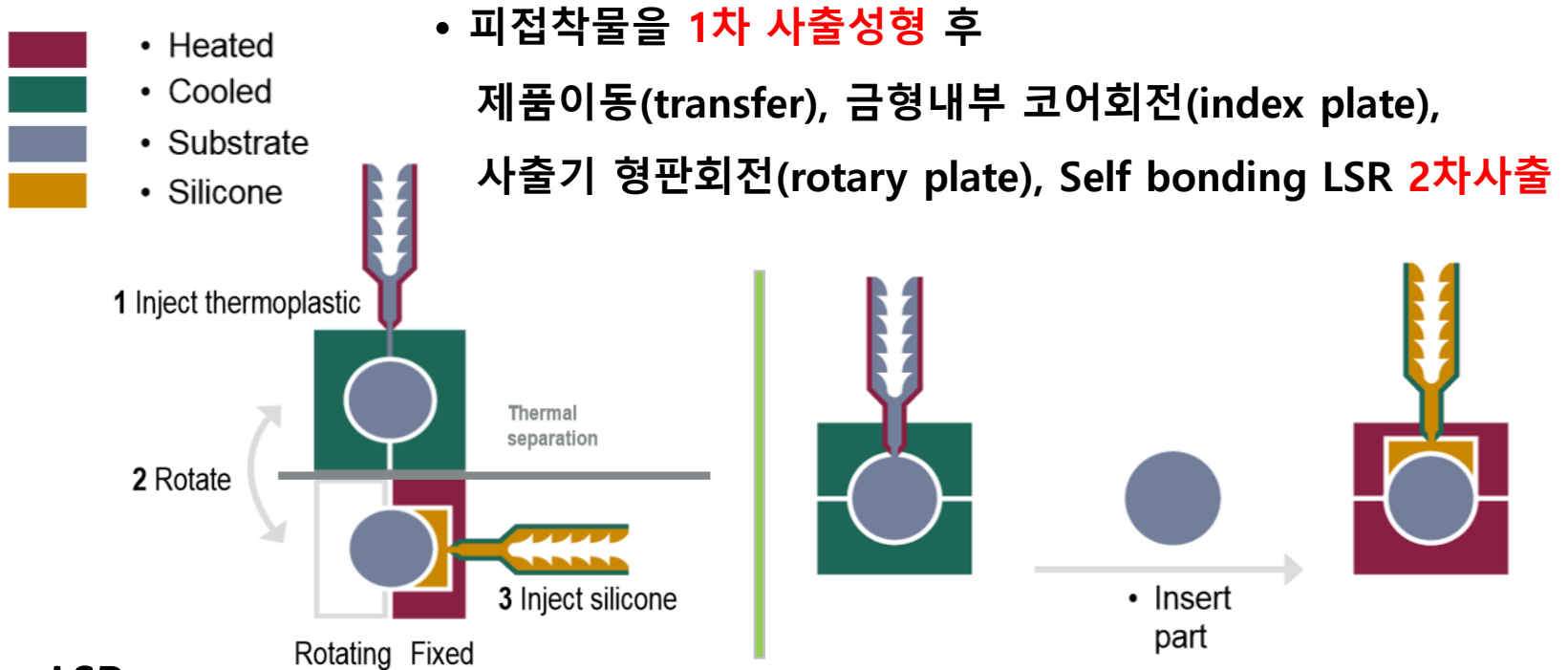
- 피접착물을 LSR 금형에 인서트(자동/수동)한 후 Self bonding LSR을 1차 사출하여 접착 성형하는 방법(Insert over molding)

- LSR
Self adhesive LSR with chemical bonding

LSR 2K Injection molding

How to make LSR 2K Injection molding 4/4

- Chemical adhesion using **self adhesive(self bonding) LSR**
(2-shot molding, 화학적 접착, 자가 접합형 LSR 을 이용한 접착)

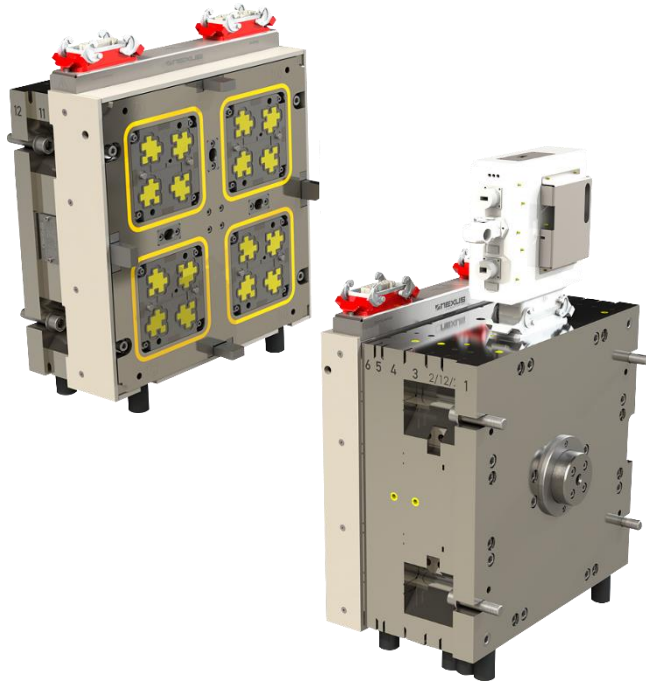


- LSR

Self adhesive LSR with chemical bonding

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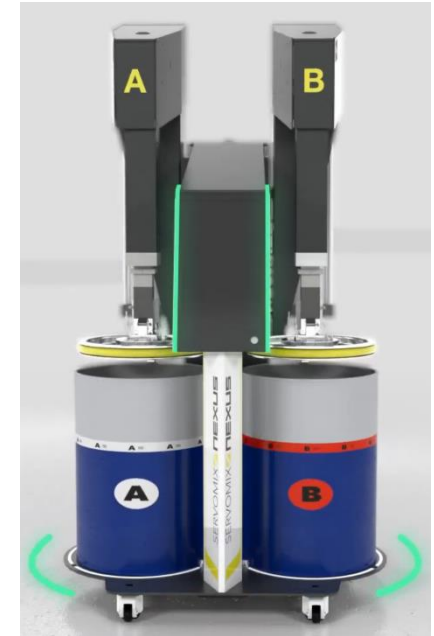


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self bonding LSR(자가접합형 액상실리콘)

Packing(self bonding LSR)

- **Two parts** at 1:1 ratio
Base polymer in both parts: vinyl terminated silicone oil,
 $\text{ViMe}_2\text{SiO}(\text{Me}_2\text{SiO})_n\text{SiMe}_2\text{Vi}$
- **Filler** in both parts:
- Catalyst in **Part A: Pt compound**(백금촉매)
- **Crosslinker** in **Part B**: * hydride containing silicone oil,
 $(-\text{Me}_2\text{SiO})_n(\text{MeHSiO}-)_m$
* **Inhibitor**(경화 지연제) in Part B
- **Adhesion promoter**(접착부여제, Silane류)
- Additives(기타첨가제)



Part A
Vinyl polymer
Filler

Pt-cat.

Part B
Vinyl polymer
Filler

Adhesion promoter(접착부여제)
Inhibitor(경화지연제)

Cross-linker

self bonding LSR(자가접합형 액상실리콘)

Mixing rate(self bonding LSR)

- $A : B = 1 : 1$ 구조적으로 가장 안정적 (최상의 접착력, 기계적 물성, 화학적 상태)
- $A > B = A$ 제가 많이 들어갈 경우(축매반응 빨라짐, 접착력 떨어짐=> 사출조건 틀어짐)
(경화지연제와 접착부여제 부족으로 경화시간이 빨라지고, 접착력 떨어짐)
- $A < B = B$ 제가 많이 들어갈 경우(축매반응 늦어짐=> 사출조건 틀어짐)
(경화지연제 과다투입으로 경화시간이 느려지고,
비닐폴리머(경화용 폴리머) 결합이 줄어들어, 경도가 낮아지는 현상이 나타나며,
접착부여제가 과다투여 된다하더라도 접착력이 높아지지는 않는다)
- $(A : B) + C(\text{color ink})$ A, B 배합시 칼라잉크를 투입할 경우 비반응성 오일베이스의 칼라잉크이거나, 반응성 오일베이스의 칼라잉크라 하더라도 **투입비율이 4%**를 넘게되면 경화 속도가 늦어지거나, 경화가 일어나지 않을 수 있다

Part A
Vinyl polymer
Filler

Pt-cat.

Part B
Vinyl polymer
Filler

Adhesion promoter(접착부여제)
Inhibitor(경화지연제)

Cross-linker

self bonding LSR(자가접합형 액상실리콘)

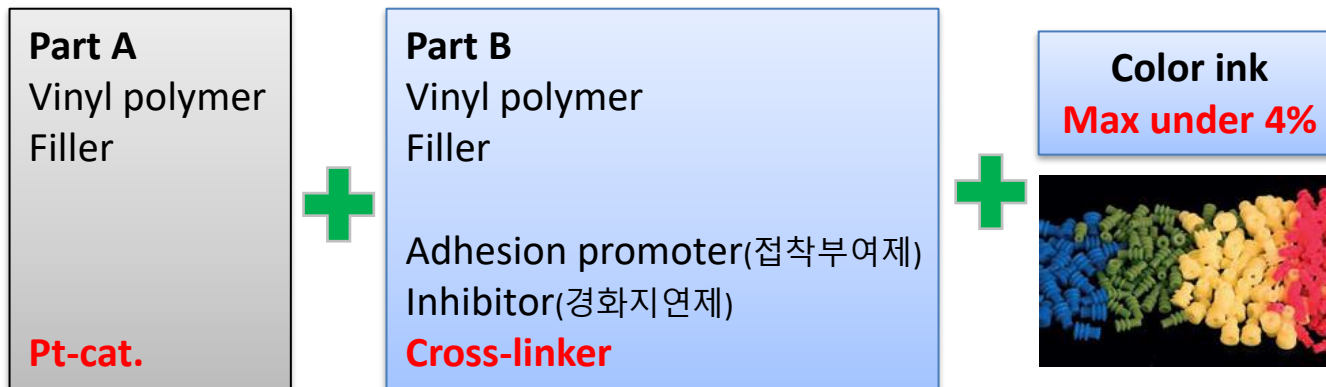
Color Mixing rate(self bonding LSR)

- (A : B) + C(color ink)

칼라잉크를 투입(A+B+C)할 경우 비반응성 오일베이스(페닐계 오일)의 칼라잉크, 또는 반응성 오일베이스(디메틸계 오일)의 칼라잉크라 하더라도 **투입비율이 4%를** 넘게 되면 경화 속도가 늦어지거나, 경화가 일어나지 않을 수 있다

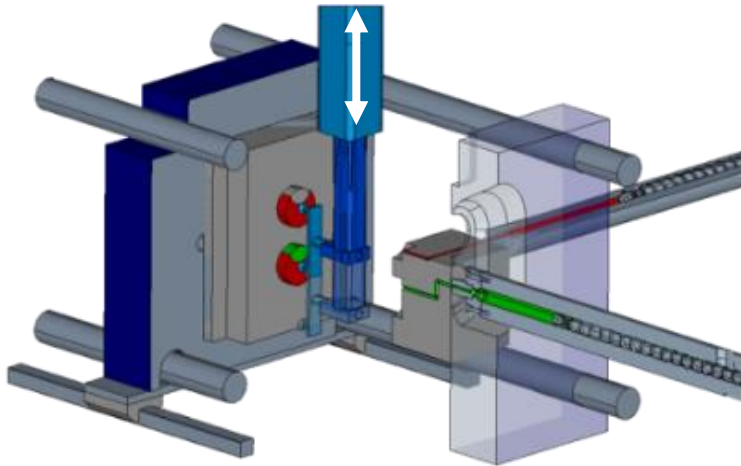
- 실리콘 제조사별 추천 칼라혼합비율(최대 4% 미만 혼입, 2% 미만 혼입 추천)

- wacker : 0.5 ~ 4 %
- momentive : 0.5 ~ 2 %
- nusil : 0.5 ~ 2 %

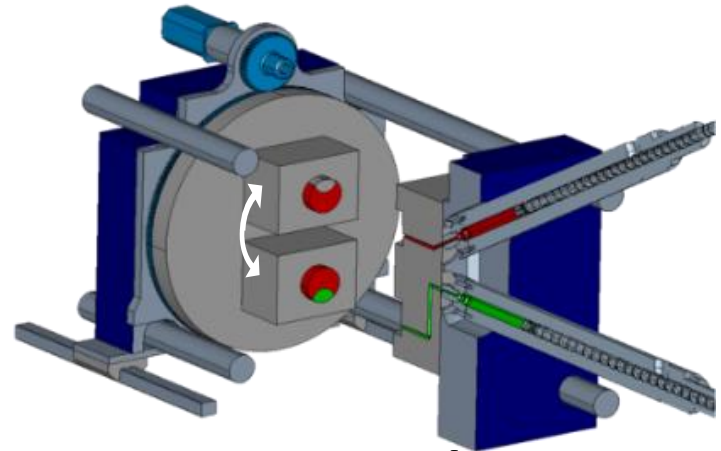


LSR 2K Injection molding

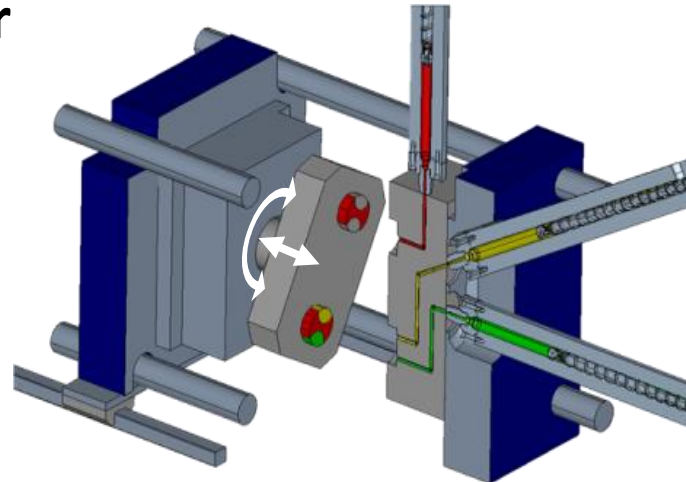
How to make LSR 2K parts



Parts transfer



Rotary plate



Index core plate

LSR 2K Injection molding

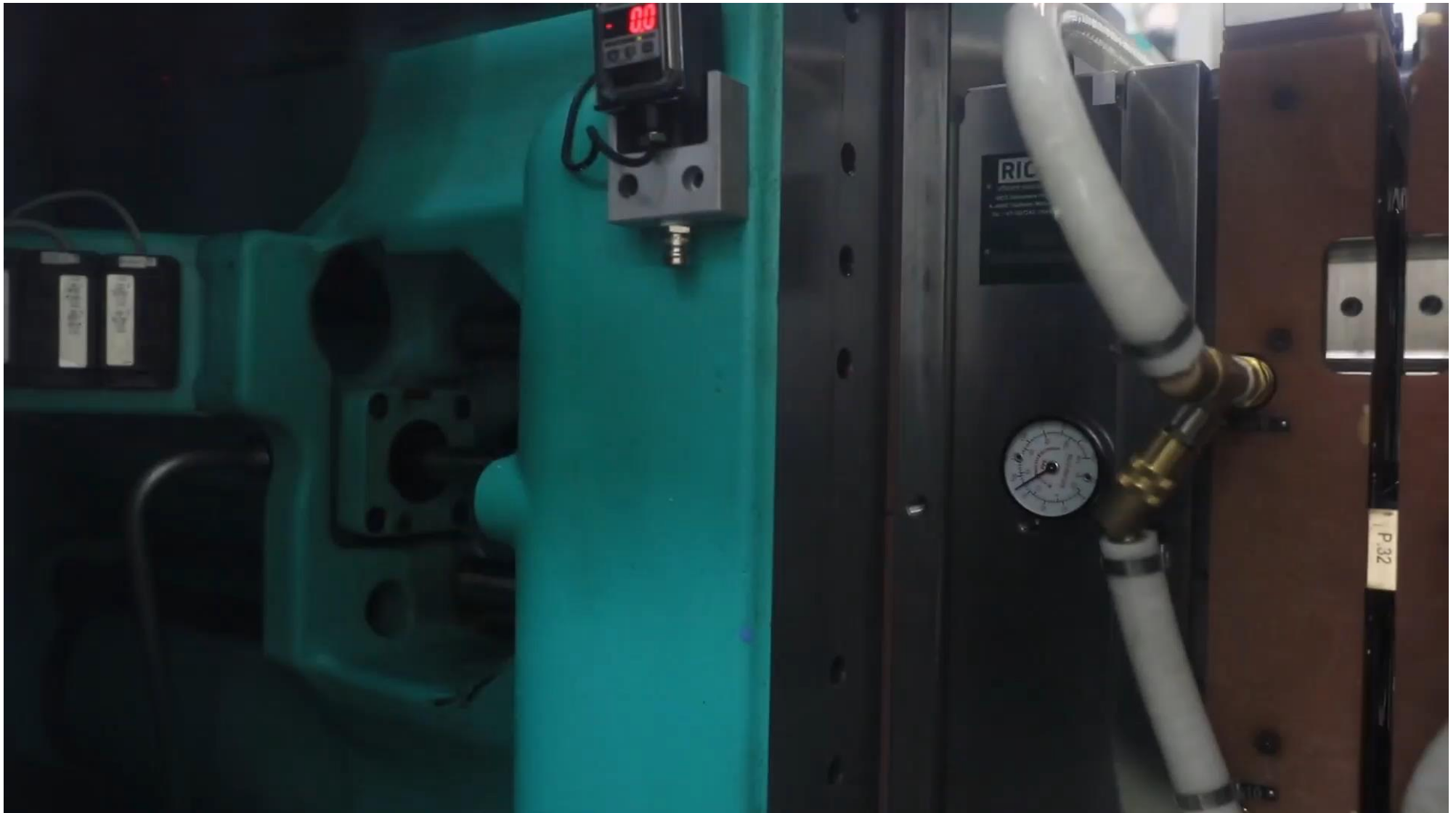
Two-Shot Injection Transfer Process

LSR 2K Injection molding

WACKER



LSR 2K Injection molding



LSR 2K Injection molding

Choice of materials(소재선택)

- Thermo-plastics

High temperature resistant types(내열플라스틱)

PA6, PA66, PBT, PET, PEEK, PMMA, PC, PPSU, PPA, ,,,

** GF(glass fiber) 10~50% (접착력 증가, 내열성 증가, 기계적 강도 증가)*

** TP mold temp: 60-160°C, LSR mold temp: 160-200°C*

- LSR

Standard LSR with **mechanical bonding**

Self adhesive LSR with **chemical bonding**



LSR 2K Injection molding

Choice of materials(소재선택)

Bonding table (LSR / Substrate)

Self-adhesive 접착력 측정 자료

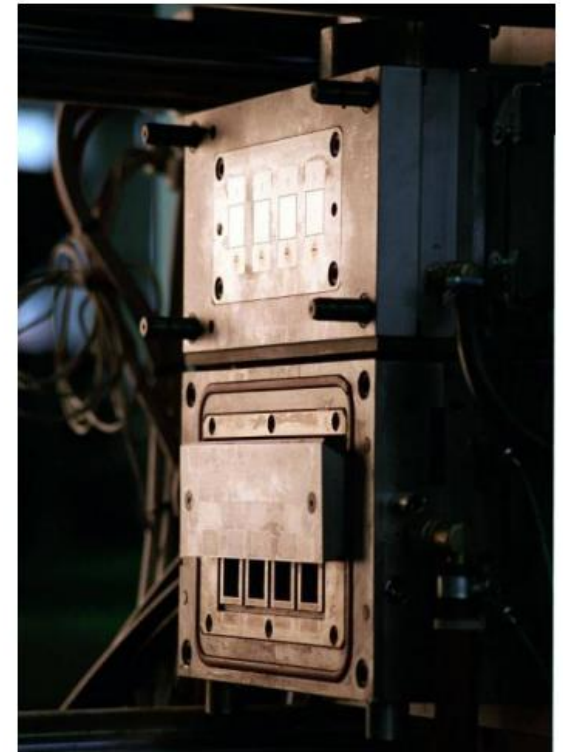
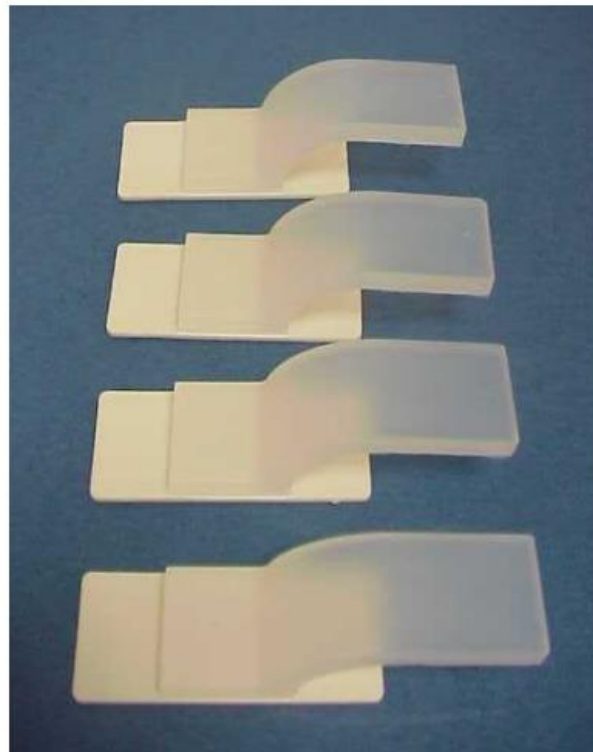
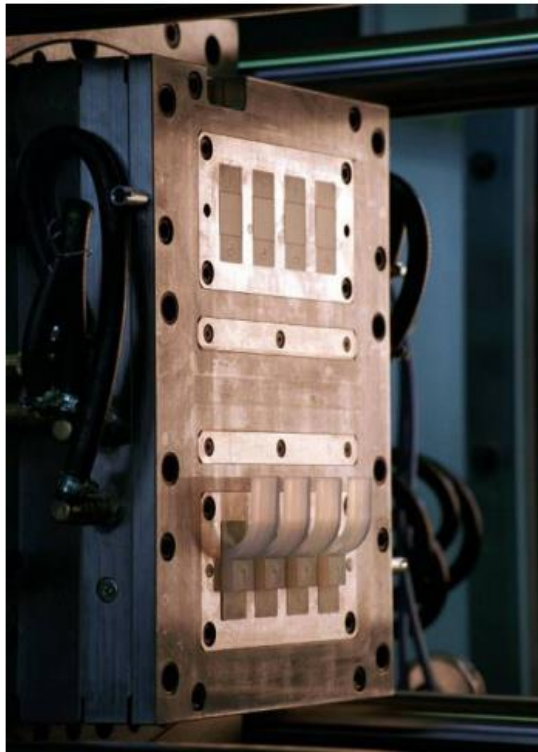
ADHE SION AFTER INJECTION MOLDING (DINISO 813),adhesion strength in N/mm*								
ELASTOSIL®			LR	LR	LR	LR	LR	LR
			3070/10	3070/20	3070/30	3070/40	3070/50	3070/60
PA 6	Miramid VE 30 CW	Leuna-Miramid			12R	15R	22R	13R
PA 6	Ultramid B3EG6	BASF				16 R	24R	
PA 6	Schulamid 6GF 30 FG4	Schulmann				18 R		
PA 6/6T	Ultramid TLR 4355 G7	BASF				12 R		
PA 63T	Trogamid T5000nf	Degussa				15 R	5RD	3RD
PA 66	Miramid SE 30 CW	Leuna-Miramid				18R	22R	16R
PA 66	Ultramid A3EG6	BASF			8R	20R	19R	
PA 66	Ultramid A3FG6 black						5D	

- D: Separation of rubber and substrate (고무와 피접착물의 분리, 접착성 실패)
- R: **Tearing of rubber (고무찢어짐, 접착성 있음)**
- 0: No adhesion (접착성 없음)

LSR 2K Injection molding

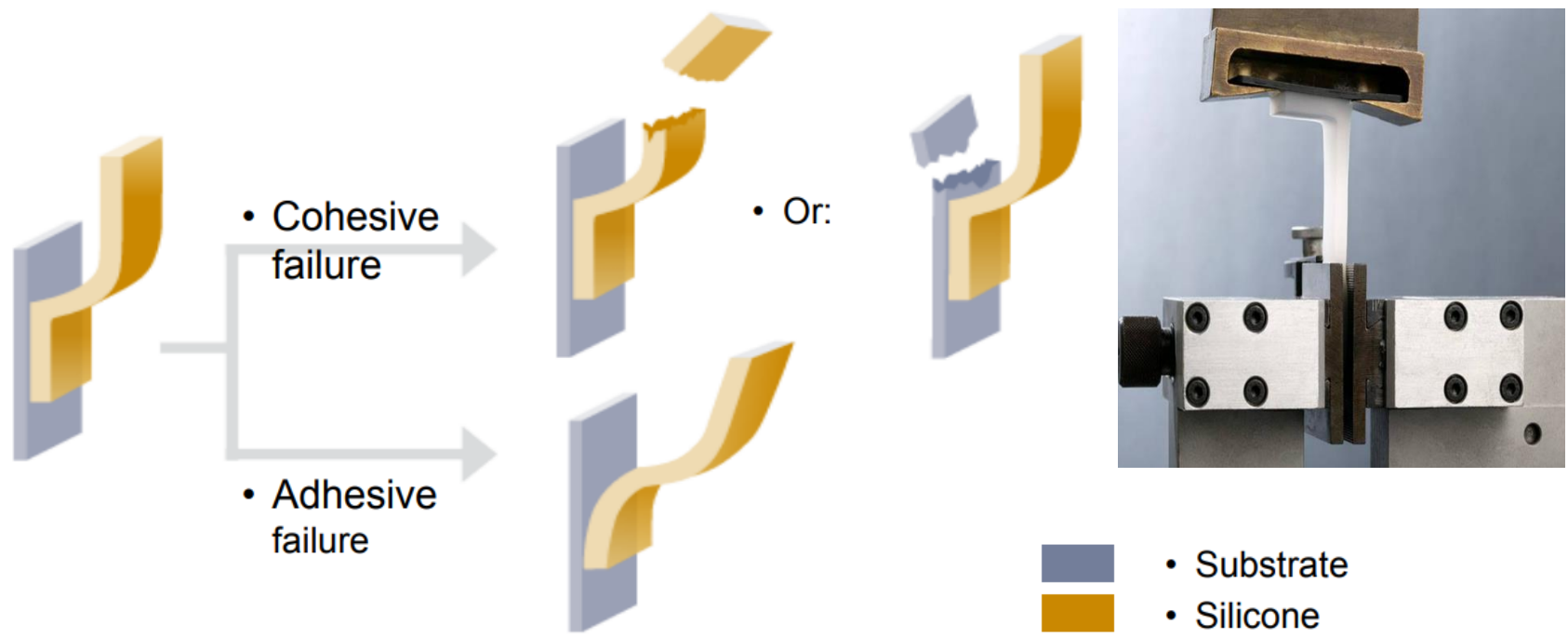
2K mold:

Open cold runner (or NSS) with vacuum

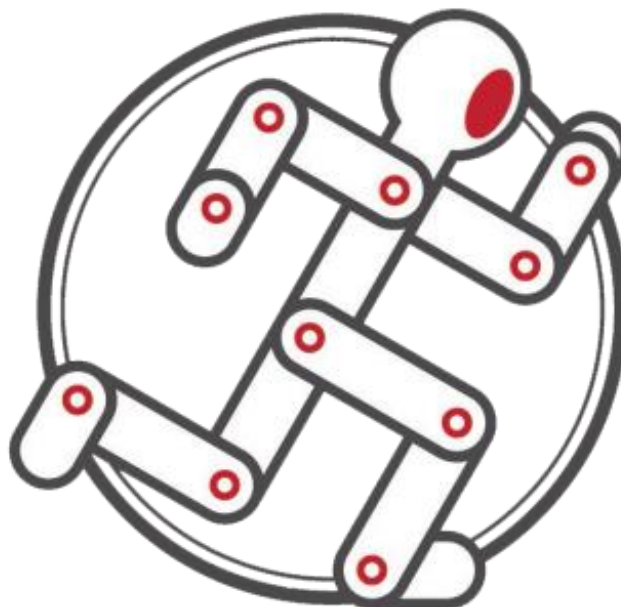


LSR 2K Injection molding

Adhesion test (DIN 53531, 접착테스트 방법)



LSR exhibit full bond strength **only** after **several days at room temperature** or **after post curing to heat (ex: 1 hr at 100 °C)**.



SILICONERS

Liquid Silicone Rubber Solution R&D

주 제: 액상실리콘(LSR) 이중 사출성형 기술 (LSR 2K-Injection molding)

CONTENTS



2-platen-concept

THE CLASSIC FOR STANDARD PARTS.
Mold with two platens for standard mold concepts.
Perfect for O-rings, axial seals etc.

DER KLASSIKER FÜR STANDARD-TEILE.
Werkzeug mit zwei Platten für Standard Mold Konzepte.
Perfekt für O-Ringe, Axialdichtungen etc.



Center platen / 3-platen-concept

FOR MORE POSSIBILITIES.
Mold with 3 platens for push-out & blow-out concepts.
Perfect for frame seals.

FÜR MEHR MÖGLICHKEITEN.
Werkzeug mit 3 Platten für Ausdrück- & Ausblaskonzepte.
Wie zum Beispiel für Rahmendichtungen.



Slider concept

THE MOLD FOR COMPLEX GEOMETRIES.
Thanks to additional movement against the closing direction
within the mold, components with difficult geometries are
molded in.

DAS TOOL FÜR KOMPLEXE FORMEN.
Dank zusätzlicher Bewegung gegen die Schließrichtung
innerhalb der Form werden Bauteile mit schwieriger
Entformung erzeugt.

- **Silicone & Silicone history**
- **LSR (Liquid Silicone Rubber)**
- **LIM (Liquid Injection Molding)**
 - What is LSR LIM system
 - Why to use LSR LIM system
 - **LSR molding**
- **2K Injection molding & ETC**
- **LSR 2K Injection Molding**
 - What is **LSR 2K Injection Molding**
 - Why to use **LSR 2K Injection Molding**
 - How to make **LSR 2K Injection Molding**
- **Self bonding LSR (자가접합형 액상실리콘)**
- **Introduction SILICONERS**

액상실리콘 전체 프로세스 솔루션 제공



LSR 제품생산



LSR 금형제작



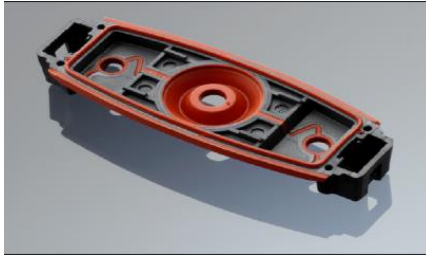
LSR 장비개발



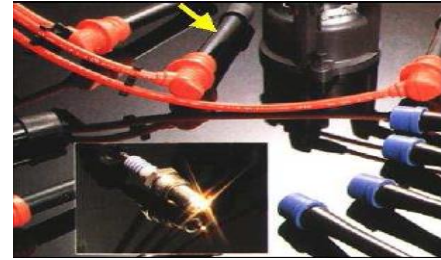
LSR 개발 컨설팅

SILICONERS

LSR 제품생산



전기/전자 제품



자동차



유아용품



의료용품



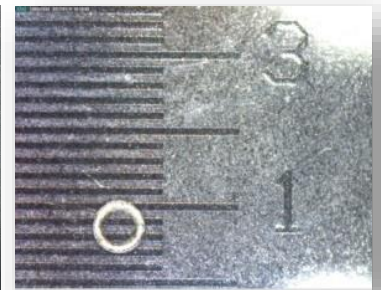
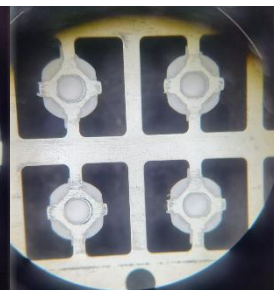
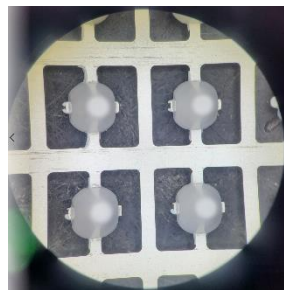
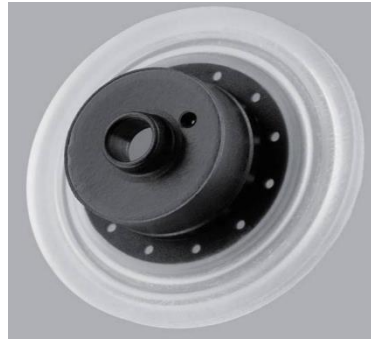
위생용품



생활용품

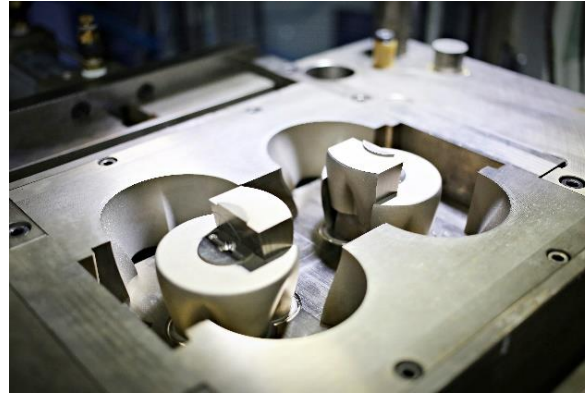
SILICONERS

2K-제품
Micro-제품



SILICONERS

LSR
금형제작



LSR Hot mold

LSR Cold mold

de-molding unit

Inspection unit



SILICONERS

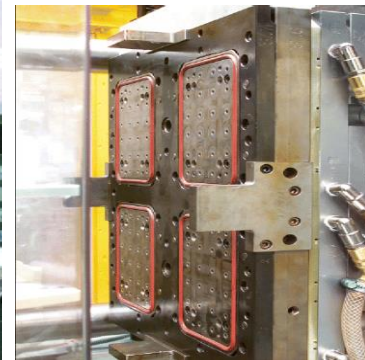
LSR
금형제작

LSR Hot mold

LSR Cold mold

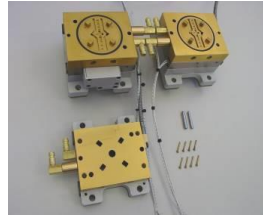
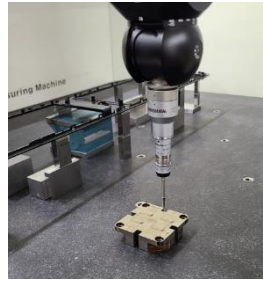
de-molding unit

Inspection unit



SILICONERS

Micro
금형제작



SILICONERS

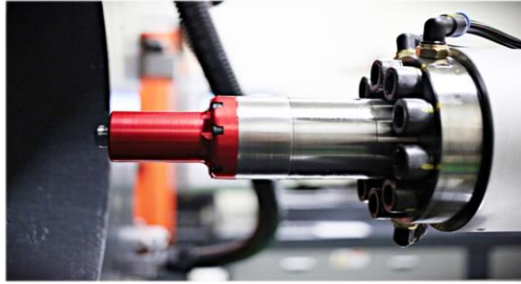
LSR 장비개발

금형노즐

장비노즐

프로세싱 유닛

도징 시스템



SILICONERS

개발
컨설팅

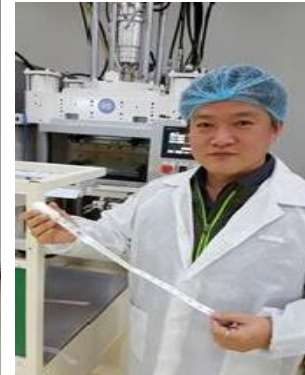
제품 개발

원재료 선정

금형 제작

장비 운용

대량 생산



SILICONERS

NEXUS dosing system **독점공급**

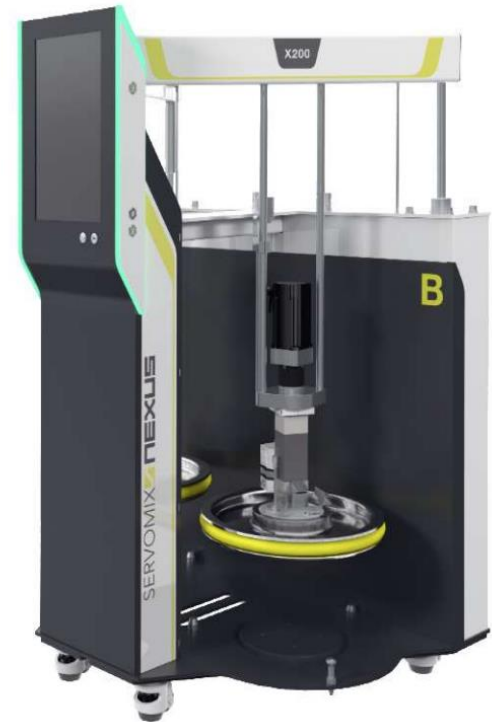


TRUEFLOW HIGH PRECISION

CLOSED LOOP CONTROL PRECISE PROCESSING UNIT



ServoMix X-20



ServoMix X-200

Thank you for your attention



Materials



LSR Mold

LSR Total Solution

Provider



LSR Machine & Automation

SILICONERS

Liquid Silicone Rubber Solution R&D

주소 : 경기도 부천시 오정구 삼작로 171번길 22

Tel : 032-675-5113

E-mail: siliconers@siliconers.com