

# ***Sigma Manufacturing Solution***



# General Information

Established

Aug 2007

Business

Automotive

Location

Mieumsandan-ro  
Gangseo-gu,  
Busan, Korea

Employees

80 employees



25 Kilometers

## Location Advantages

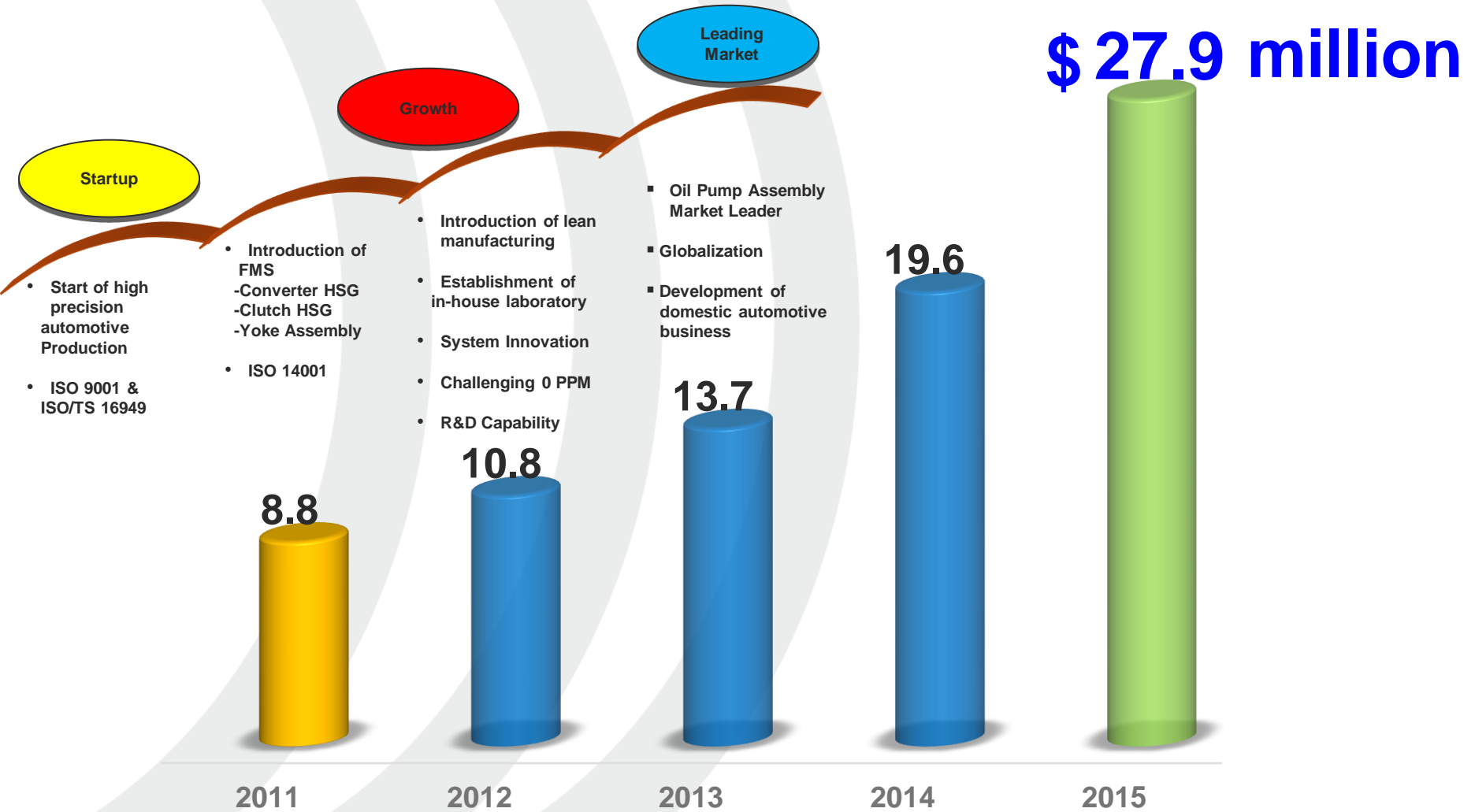
**Airport and Busan Port** are all less 25 Kilometers away from **SMS** and quickly accessible

**By sea :**

The Port of Busan is South Korea's leading export base, with the largest container terminal

# Sales Trend

Unit :M USD



# Facilities

## What we do

- Machining line
- Oil pump ASS'Y line
  - Quality Lab
  - R&D Center
  - Warehouse

Design + Manufacturing  
+Quality + Logistics service



**Your One-Stop Source for manufacturing**

# Facilities – Machining line

*We have full capabilities in Manufacturing and Engineering.*

*We also offer efficient, excellent services with the most economic solutions.*

## Equipments

**: H-MCT, V-MCT, CNC, TAPPING CENTER, Assembling M/C, Washing M/C, Laser Marking M/C**



# Facilities – Machining line

*We have full capabilities in Manufacturing and Engineering.*

*We also offer efficient, excellent services with the most economic solutions.*

**Computerized manufacturing systems**

*: Remote Monitoring  
E-Invoice System  
Automated SPC System(2017)*



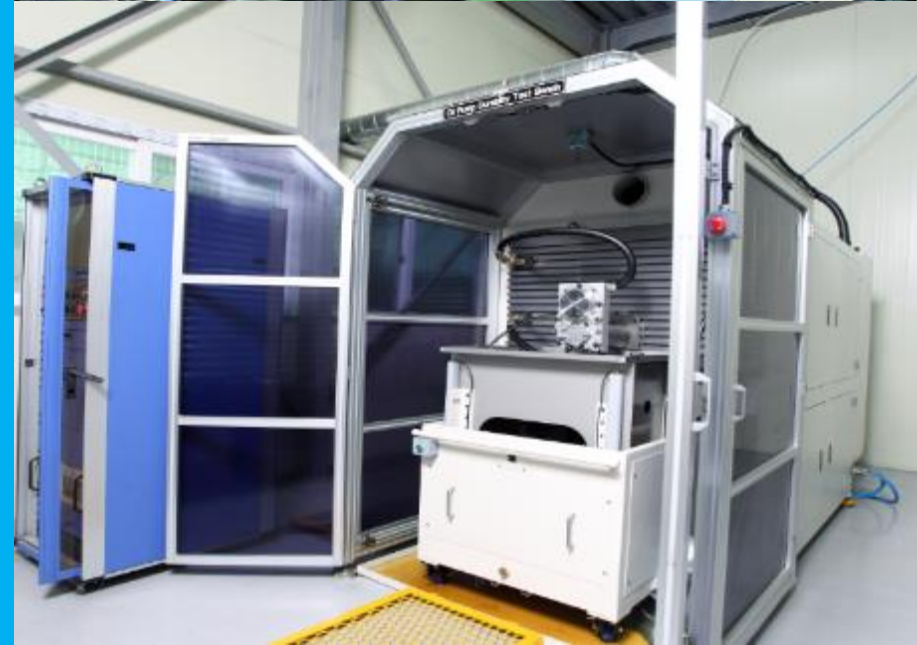
# Facilities - Oil Pump Assembly

*We have full capabilities in  
Design, Engineering  
and Manufacturing*

*We also offer efficient, excellent  
services with the most economic  
solutions.*

## Capabilities

- : CFD (Computational Fluid Dynamics)
- Validation test & analysis
- Casting flow analysis
- GE-rotor design
- Relief valve system design



# Products

**AUTOMOTIVE PASSANGER CAR**  
**SUPERCHARGER COMPONET**  
**AL-PMDC**

Jaguar.  
Supercharger  
Cover V6/ V8



**GM Supercharger  
Cover**

**COMMECIAL VEHICLE**  
**TRANSMISSION COMPONET**  
**AL-PMDC / IRON CASTING**



**CLUTCH HOUSING**



**RANGE CYLINDER**



**FRONT BEARING COVER**



**COVER CYLINDER**



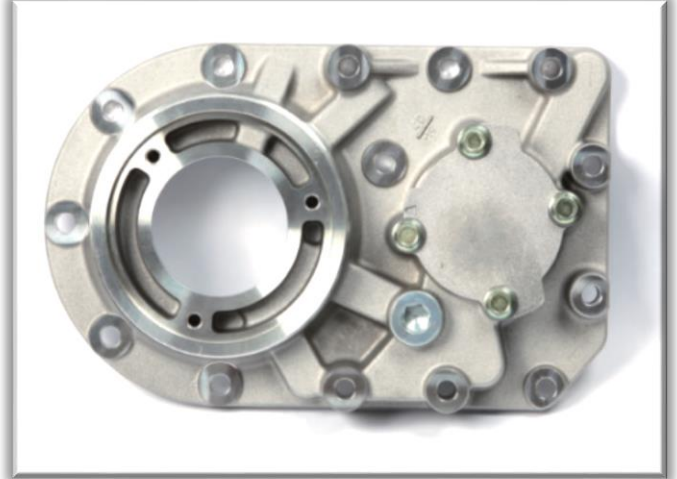
**REAR BEARING COVER**



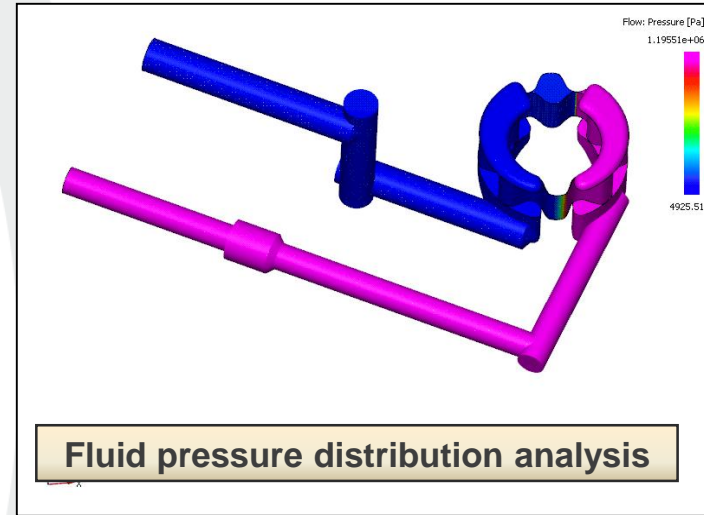
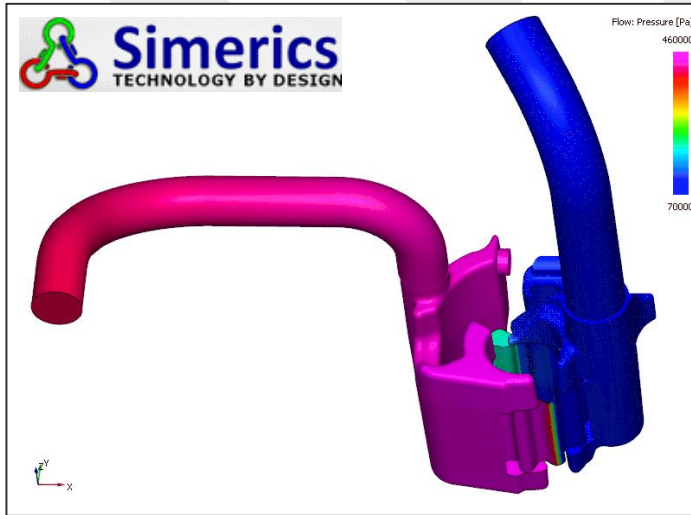
# OIL PUMP



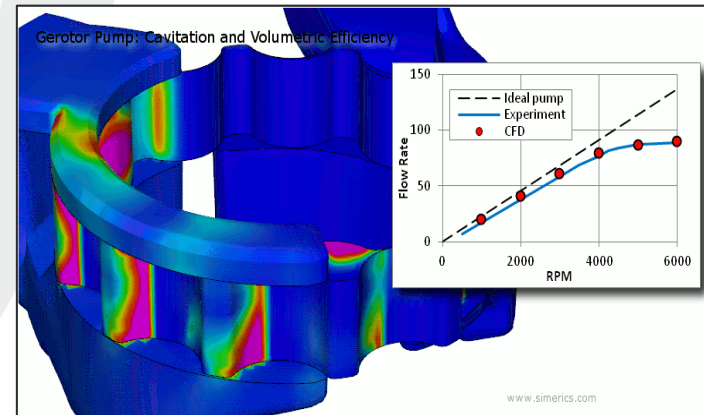
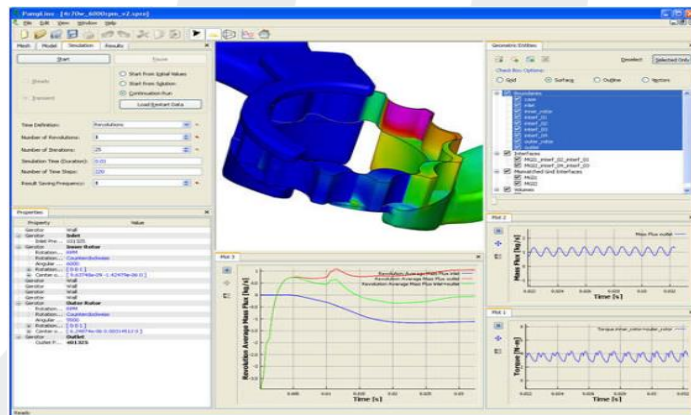
# Truck - T/M Lubrication Pump



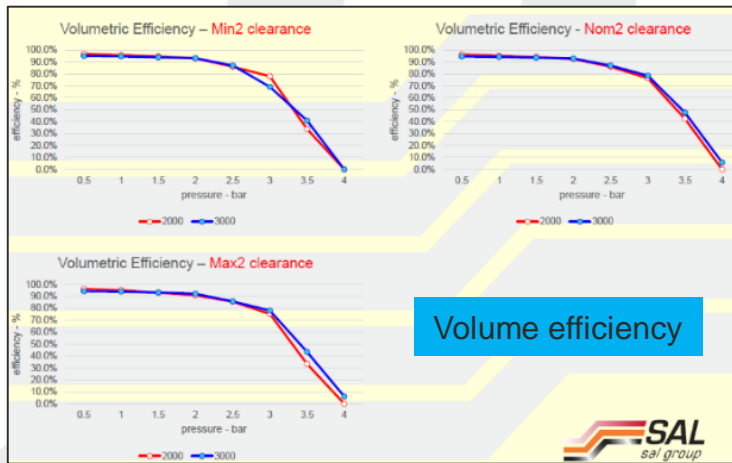
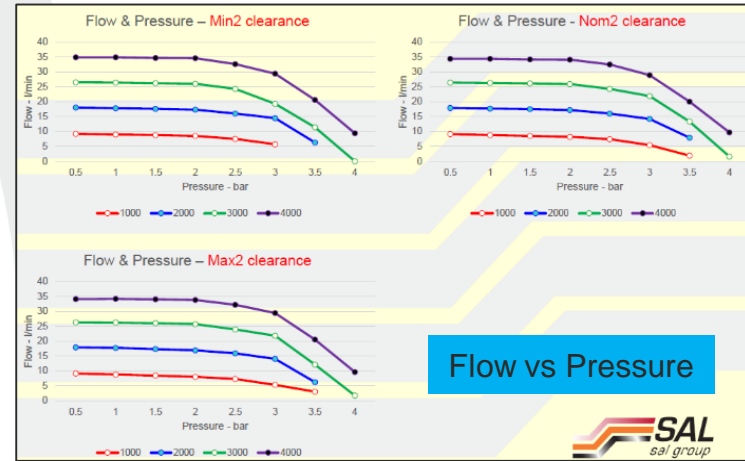
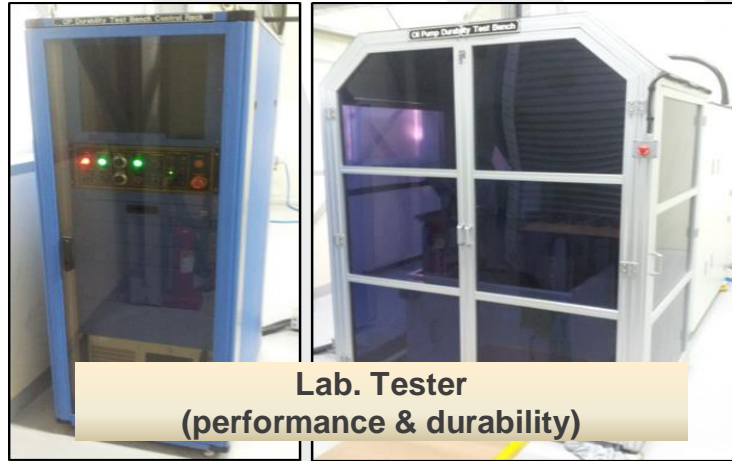
# R&D Capability – CFD (Computational Fluid Dynamics)



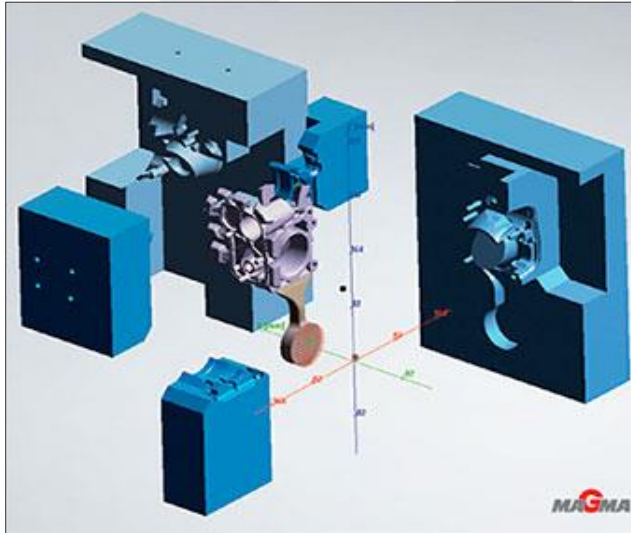
Fluid pressure distribution analysis



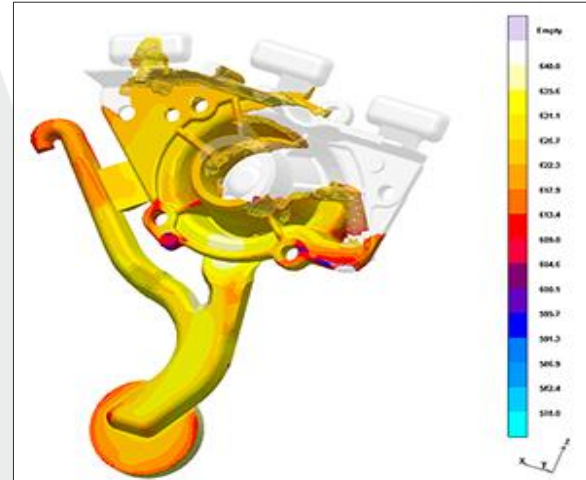
# R&D Capability – Validation Test & Analysis



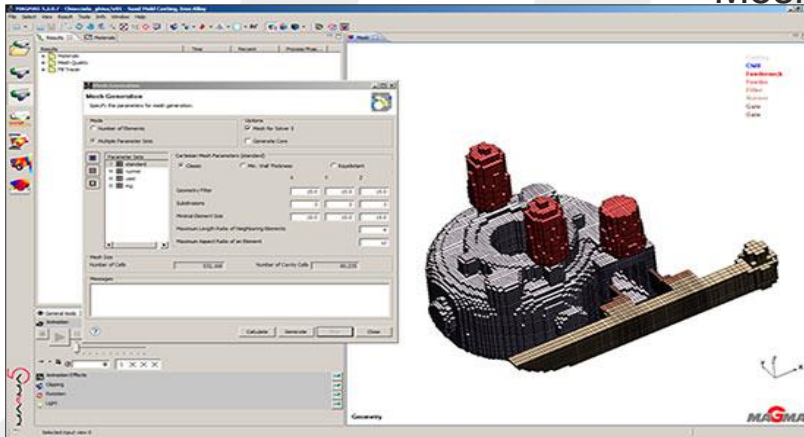
# R&D Capability – Casting Flow Analysis



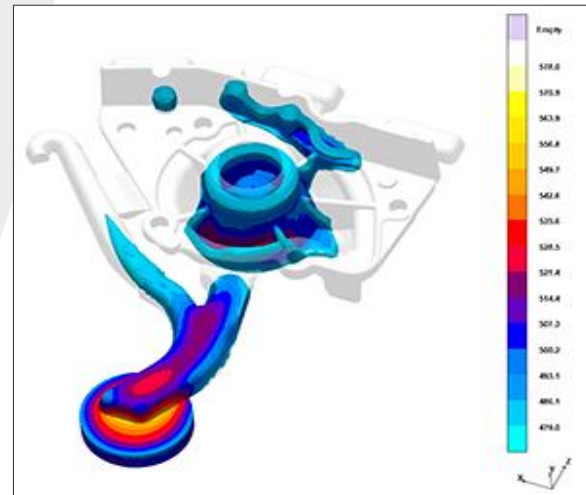
Geometry



Fill

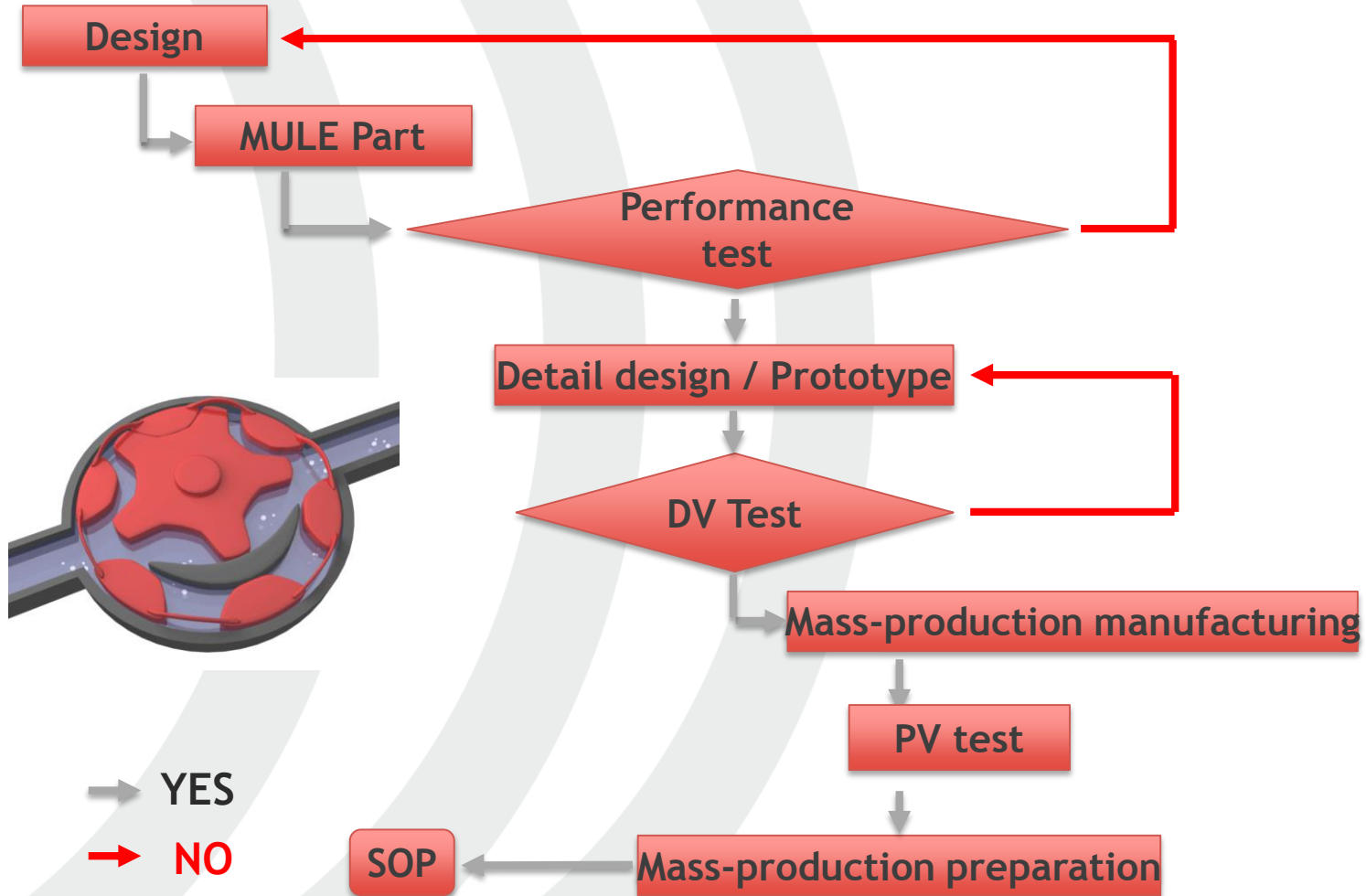


Mesh



Solid

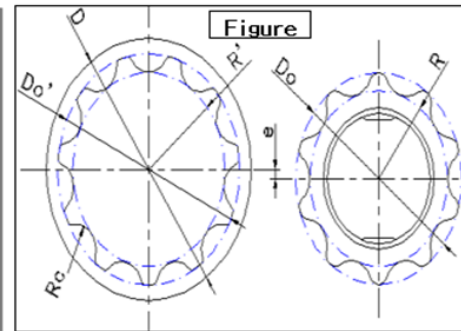
# R&D Capability – Black Box Design Flow



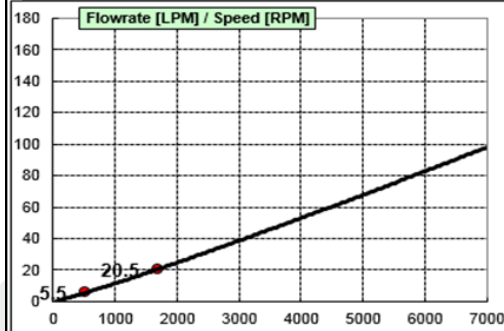
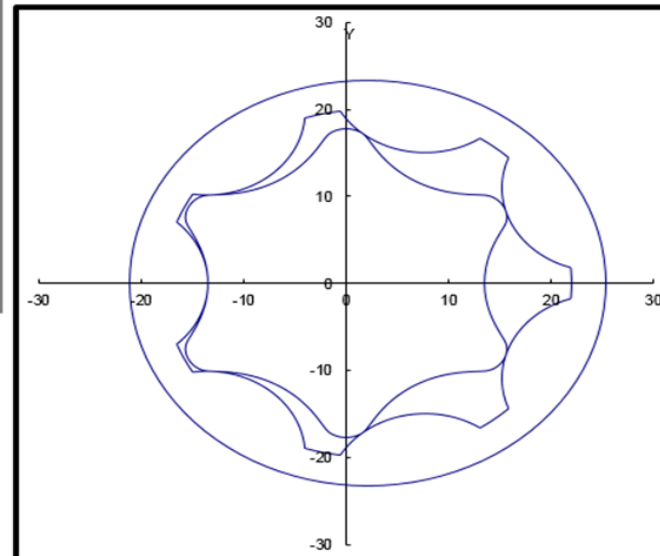
# R&D Capability – GE-Rotor Design



Trochoidal Gear Sets Design				
<b>BASIS</b>	Maker	RSM		
	Description	H4M-k		
	Engine speed [rpm]	504	1680	
	Pump speed/engine speed ratio	1.00	1.00	
	Pressure [bar]	-	-	
	Temperature [°C]	-	-	
	Flow Rate [lpm]	5.2	-	
<b>INPUTS</b>	Outer OD [mm]	D =	46.50	
	Radius [mm]	Ra =	21.60	
	Lobe radius of outer gear [mm]	Rc =	9.60	
	Eccentricity [mm]	e =	2.100	
	Number teeth on inner gear	N =	6	
	Gear thickness [mm]	H =	33.00	
	Tip Clearance [mm]	tc =	0.100	
	Do'/2 + add	add =	0.100	
	Corner radius of outer gear	r =	1.000	
	Volume Efficiency		80%	90.0%
<b>RESULTS</b>	Pump speed [rpm]	n =	504	1680
	Theory [cc / rev]	Flow'(a) =		
	[cc / rev]	Flow'(b) =	13.530	13.530
	Flow Rate [lpm]	Flow(a) =		
	[lpm]	Flow(b) =	5.455	20.457
	Inner Teeth root, IR [mm]	R =	13.500	
	Inner Gear OD [mm]	Do =	35.400	
	Outer Gear IR [mm]	R' =	15.650	
	Outer Teeth Root, OD [mm]	Do' =	39.800	
	Radius of rolling circle [mm]	Rb =	3.600	
Max. Shaft Dia		17.0		



**AEMS**  
R&D CENTER  
by SungJong Cha  
2014.04.01

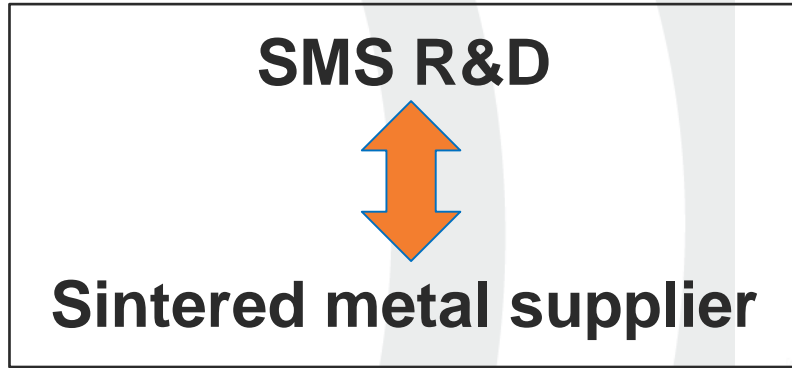


To calculate Ra and Rb from a drawing or competitor pump.

Inputs	
N =	6
R =	10.6
Rc =	10
e =	2.6
Outputs	
Ra =	19.885714
Rb =	3.3142857

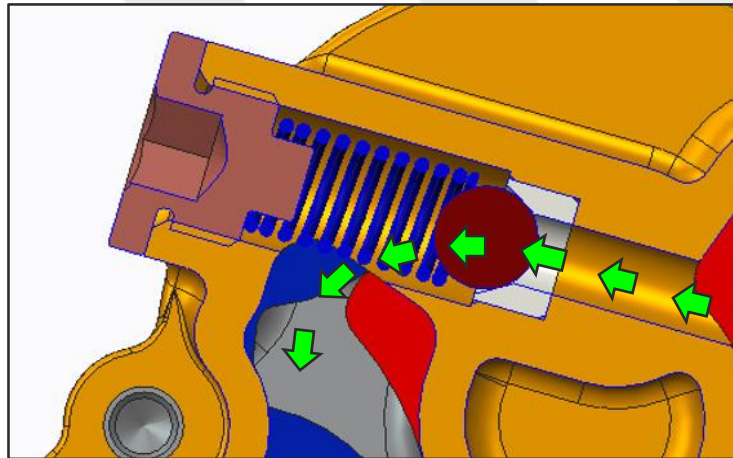
# R&D capability – GE-rotor design

## ➤ Technical cooperation

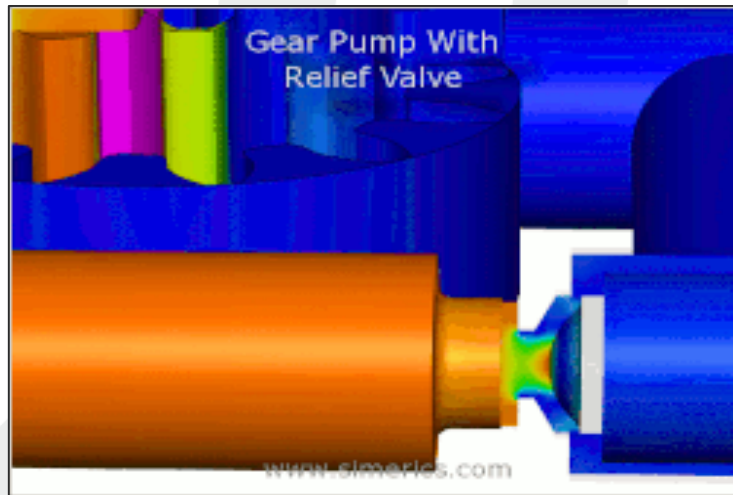




# R&D Capability – Relief Valve System Design



## Design for pump driving efficiency



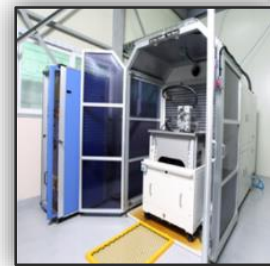
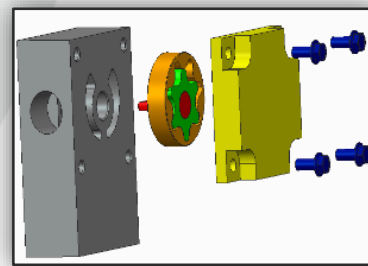
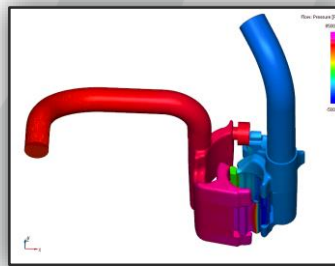
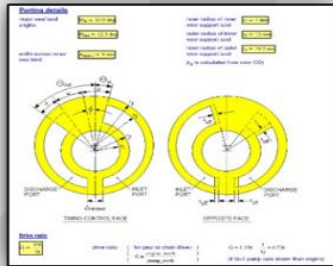
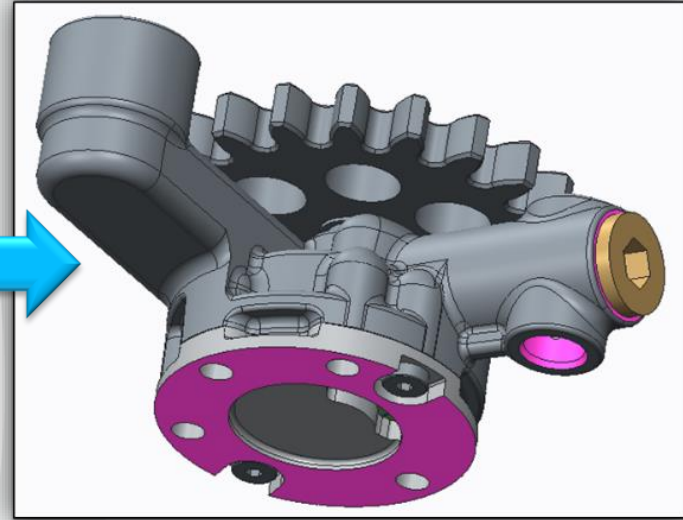
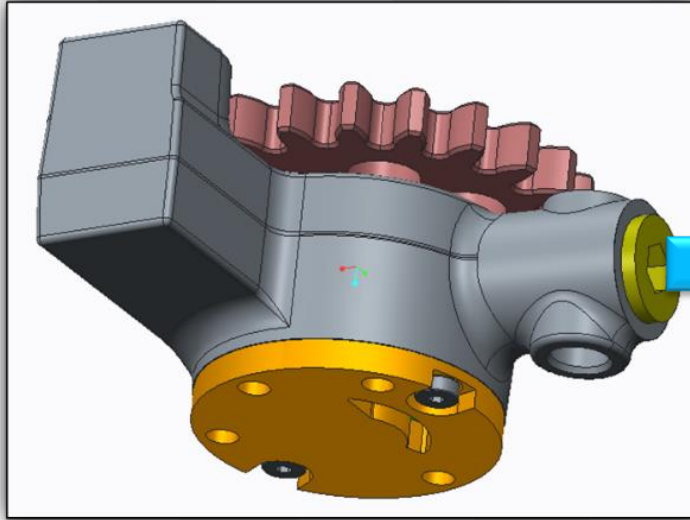
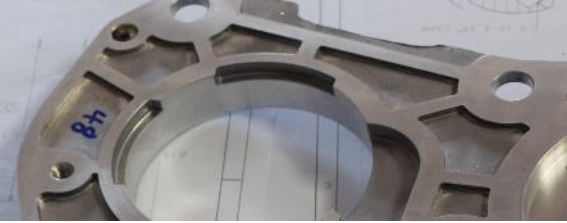
## Spring design calculation

### Helical compression spring-Requirements for design

압축 원통 코일 스프링 설계 기준

기호	기호의 명칭	허용기준 치수	단위	비고
d	재료의 지름	1.500	mm	
D <sub>o</sub>	코일 바깥지름	12.000	mm	
D <sub>i</sub>	코일 안지름	9.000	mm	
D	코일 평균 지름	10.500	mm	D = (D <sub>o</sub> +D <sub>i</sub> )/2
N <sub>t</sub>	총감길수	14.00		
X <sub>1,2</sub>	코일 양 끝부 각각의 자리 감길수	1.00		다른 자유코일에 접하고 있을 경우 : 1 접하지 않고, 자리 감길부의 길이 3/4 감길 경우 : 0.75
N <sub>s</sub>	유도 감길수	3)		
H <sub>t</sub>	자유 높이 (길이)	44.40	mm	
H <sub>r</sub>	장착 하중시 높이	28.42	mm	H <sub>t</sub> -H <sub>r</sub> 12.40
H <sub>o</sub>	작동 하중시 높이	27.17	mm	H <sub>t</sub> -H <sub>o</sub> 1.26
H <sub>m</sub>	최대 하중시 높이	25.91	mm	H <sub>o</sub> -H <sub>m</sub> 1.26
H <sub>s</sub>	밀착 높이	19.50	mm	H <sub>m</sub> -H <sub>s</sub> 6.41
p	피치	4)	3.575	mm
C	스프링 지수	1)	7.0	C = D/d
G	가르 탄성 계수	8000	kgf/mm <sup>2</sup>	재질 : SWOSC-V KS B 2400, 표3 가르 탄성 계수
P <sub>l</sub>	스프링에 걸리는 장착 하중	5.824	kgf	57.1 N
P <sub>o</sub>	스프링에 걸리는 작동 하중	6.281	kgf	
P <sub>m</sub>	스프링에 걸리는 최대 하중	6.738	kgf	66.0 N
P <sub>s</sub>	밀착 높이에 걸리는 하중	9.074	kgf	88.9 N
δ <sub>l</sub>	스프링의 처짐량 (장착 하중)	15.980	mm	
δ <sub>o</sub>	스프링의 처짐량 (작동 하중)	17.235	mm	
δ <sub>m</sub>	스프링의 처짐량 (최대 하중)	18.490	mm	
δ <sub>s</sub>	스프링의 처짐량 (밀착 높이)	24.900	mm	
k	스프링 상수	0.364	kgf/mm	3.571 N/mm
τ <sub>l</sub>	장착 비틀림 응력	46.137	kgf/mm <sup>2</sup>	
τ <sub>o</sub>	작동 비틀림 응력	49.760	kgf/mm <sup>2</sup>	
τ <sub>m</sub>	최대 비틀림 응력	53.384	kgf/mm <sup>2</sup>	
τ <sub>s</sub>	밀착 비틀림 응력	71.890	kgf/mm <sup>2</sup>	
τ <sub>i</sub>	장착 비틀림 수정 응력	55.957	kgf/mm <sup>2</sup>	548.4 N/mm <sup>2</sup>
τ <sub>o</sub>	작동 비틀림 수정 응력	60.352	kgf/mm <sup>2</sup>	
τ <sub>m</sub>	최대 비틀림 수정 응력	64.747	kgf/mm <sup>2</sup>	634.5 N/mm <sup>2</sup> 반복하중을 받을 시, 설계 용량 검토
τ <sub>s</sub>	밀착 비틀림 수정 응력	87.193	kgf/mm <sup>2</sup>	854.5 N/mm <sup>2</sup>
x	응력 수정 계수	1.213		
f	진동수	404	Hz	재질이 강이고 양단자유 또는 고정인 경우의 1차
U	스프링에 저장되는 에너지	46.531	kgf·mm	
r	가르 세로비	2)	4.2	
τ <sub>a</sub>	허용 비틀림 응력	108	kgf/mm <sup>2</sup>	KS B 2400, 압축 스프링의 허용 비틀림 응력
σ <sub>a</sub>	재료의 인장 강도	195	kgf/mm <sup>2</sup>	
S	안전계수	5)	0.6	τ <sub>a</sub> / τ <sub>m</sub>
γ	γ의 사선	6)	0.9	KS B 2400, 피로 강도 선도
τ <sub>o</sub> /σ <sub>a</sub>	상한 응력 계수	6)	0.332	KS B 2400, 피로 강도 선도

# Design Optimization For Cost Saving

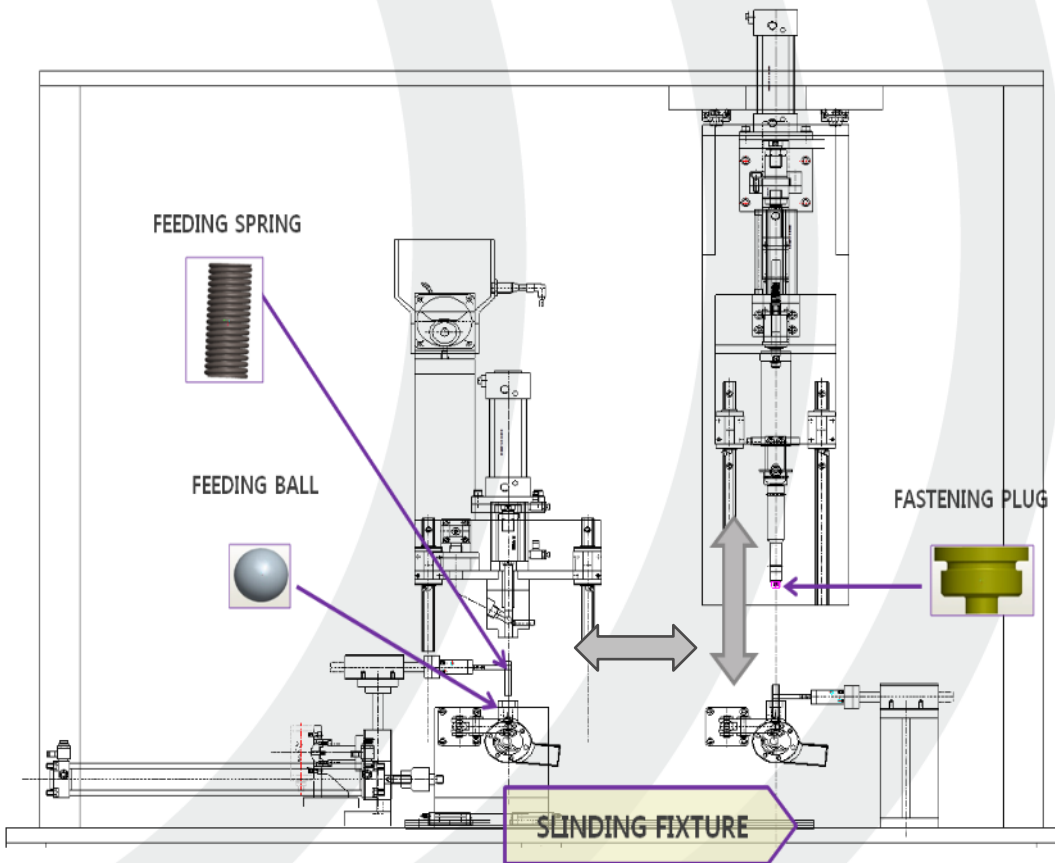


# Process Design

- Assembly automation – Relief valve system

Design work

Machine build



# Process Design

## ■ Performance testing in process (EOL tester)



- PLC control
- Automatic data acquisition
- Data storage in computer
- OK marking for good parts
- Air purge for oil removal

# Process Design



## ■ Key control in assembly line

- Error proofing for missing components (Poka-yoke)
  - . Prevent by auto-feeding systems
- Assembly force control
  - . Fastening torque by nut-runners
  - . Fitting force by load cells
- 100% performance testing in process
  - . Check discharge pressure & flow rate
  - . Check relief valve open pressure
  - . Check drive torque & missing component



# 신속대응 추적표 [ Fast Response Tracking Sheet ]

# QUALITY

R	Required but not initiated
Y	Initiated but not completed
G	Complete [조치완료]
N/A	Not Applicable [해당없음]

Issue Ref. No.	Issue Ref. No.	Issued Place	Issue Operation	Part Number	문제내용 Issue Discription	Issue Date	recurrence	Department	Owner	수량 Quantity	EXIT CRITERIA [완료기준일, 진행상태, Green 획기일]					조치사항 Action	완료 예정일					
											24H	7D	14D		34D			35D		40D		
											Containment	Root Cause	Corrective Action	Error Proofing	Layered Audit			Action Validated	PFMEA/CP	Standard Work	Operation Training	Lessons learned
16-007	16-007	16-007	16-007	16-007	16-007	16-007	16-007	16-007	16-007	16-007	G	G	G	N/A	N/A	N/A	N/A	1. 16.07.19 2. 16.07.19 (100%)	2/1			
16-008	16-008	16-008	16-008	16-008	16-008	16-008	16-008	16-008	16-008	16-008	G	G	G	N/A	N/A	G	Y	Y	N/A	N/A	1. 16.07.19 2. 16.07.19 (100%)	

# Inspection Capability

## ➤ Metallurgical analysis (In house & key supplier)

- SEM, Microscope, Hardness tester, UTM
- Metal powder analysis, X-ray

## ➤ Precision layout (In house)

- CMM(3 x Carl Zeiss with contour measurement)
- Profile tester, Roughness tester, & etc.

## ➤ Pump performance testing (In house)

- In-process testers (EOL tester)
- Durability & performance tester (Laboratory)



# Certificates

**CERTIFICATE**  
QUALITY MANAGEMENT SYSTEM

**kfg** Korean Foundation for Quality

**SMS CO., LTD.**  
HEAD OFFICE AND FACTORY : 28, Meusandae-ro 70beon-gil, Gangseo-gu, Busan, 615-250, Korea

Registration Date: 2014. 06. 23  
Expiry Date: 2017. 06. 27  
Renewal Date: 2016. 07. 21  
Certificate Number: 19-0409

Korean Foundation for Quality certifies that the above organization operates the Quality Management System, and complies with the requirements of the following standard

Standard: **ISO/TS 16949:2009**

Scope of certification: PRODUCTION OF MACHINED PARTS OF ENGINE AND TRANSMISSION  
(PERMITTED EXCEPTIONS : 7.3 PRODUCT DESIGN & DEVELOPMENT)

**Certificate of ISO 9001 & TS 16949**

**APPENDIX**

**kfg** Korean Foundation for Quality

**SMS CO., LTD.**  
HEAD OFFICE AND FACTORY SUPPORTING FUNCTION

Registration Date: 2014. 06. 23  
Expiry Date: 2017. 06. 27  
Renewal Date: 2016. 07. 21  
Certificate Number: 19-0409

• SUPPORTING SITE : SAL KOREA

• ADDRESS : 53, Daesopbeom-ro, Yeongsu-gu, Seoul, 140-091, Korea

• SUPPORTING FUNCTION : SALES, PURCHASING, SUPPLIER MANAGEMENT

**Certificate of ISO 9001 & TS 16949**

**CERTIFICATE**  
ENVIRONMENTAL MANAGEMENT SYSTEM

**kfg** Korean Foundation for Quality

**SMS CO., LTD.**

• HEAD OFFICE & FACTORY : 28, Meusandae-ro 70beon-gil, Gangseo-gu, Busan, Korea (Zip code : 61520)  
• SAL KOREA : 53, Daesopbeom-ro 1-gil, Yeongsu-gu, Seoul, Korea (Zip code : 14331)

Registration Date: 2014.11.12  
Expiry Date: 2016.05.14  
Initial Registration Date: 2014.11.12  
Renewal Date: 2015.02.23  
Certificate No. (ref. No.): EAC-05426 (ref. No.)

Korean Foundation for Quality certifies that the above organization has been assessed and has complied with the requirements of the following standard

Standard: **ISO 14001:2004/KS I ISO 14001:2009**

Scope of certification: PRODUCTION OF MACHINED PARTS OF ENGINE AND TRANSMISSION FOR AUTOMOTIVE APPLICATIONS

**Certificate of ISO 14001**

**IQNet**  
THE INTERNATIONAL CERTIFICATION NETWORK

**CERTIFICATE**

IQNet and KFG hereby certify that the organization **SMS CO., LTD.**

• HEAD OFFICE & FACTORY : 28, Meusandae-ro 70beon-gil, Gangseo-gu, Busan, Korea (Zip code : 61520)  
• SAL KOREA : 53, Daesopbeom-ro 1-gil, Yeongsu-gu, Seoul, Korea (Zip code : 14331)

for the following field of activities: PRODUCTION OF MACHINED PARTS OF ENGINE AND TRANSMISSION FOR AUTOMOTIVE APPLICATIONS

has implemented a full compliant Environmental Management System which fulfills the requirements of the following standard: **ISO 14001:2004**  
Issued on: 2016-11-12  
Expiry date: 2018-06-14  
Registration Number : KFC - 05426 - ( 00 )

**Certificate of ISO 14001**



# ***Sigma Manufacturing Solution***

