RAUCH
FURNACE TECHNOLOGY
GMUNDEN-AUSTRIA

Versioning: *(for a better overview in this file)*

This is a living document, you must always use the latest version.

- Version 1: Overview; Detail MVE; Detail MDO; Detail GMD
- Version 2: Shot Sleeve; preparations

MAIN CONTENT

1 | OVERVIEW

2 | EQUIPMENT DETAILS MVE

3 | EQUIPMENT DETAILS MDO

4 | EQUIPMENT DETAILS GMD

5 | SHOT SLEEVE HEIGHTS AND LENGTH

6 | PREPARATIONS LIST

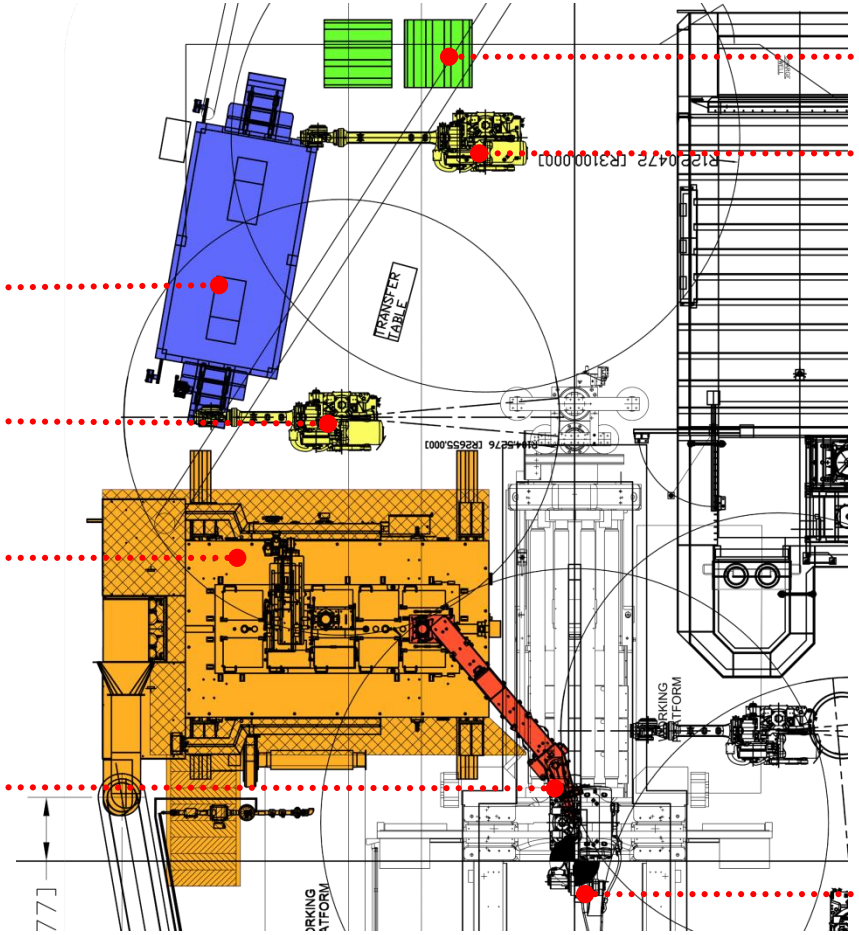
Detailed Rauch definition: http://www.rauch-ft.com/fileadmin/downloads/Def_Rauch_Equipment_en_V1.pdf

1 | OVERVIEW

1 | OVERVIEW

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

LAYOUT OVERVIEW:



MG INGOT STACK*

INGOT DESTACKING UNIT*

PREWARMING UNIT (MVE1200E)

INGOT FEEDING UNIT*

MG MELTING AND DOSING FURNACE (MDO1100R)

DOSING SYSTEM (ADSL)

DIE CASTING MACHINE*

1 | OVERVIEW

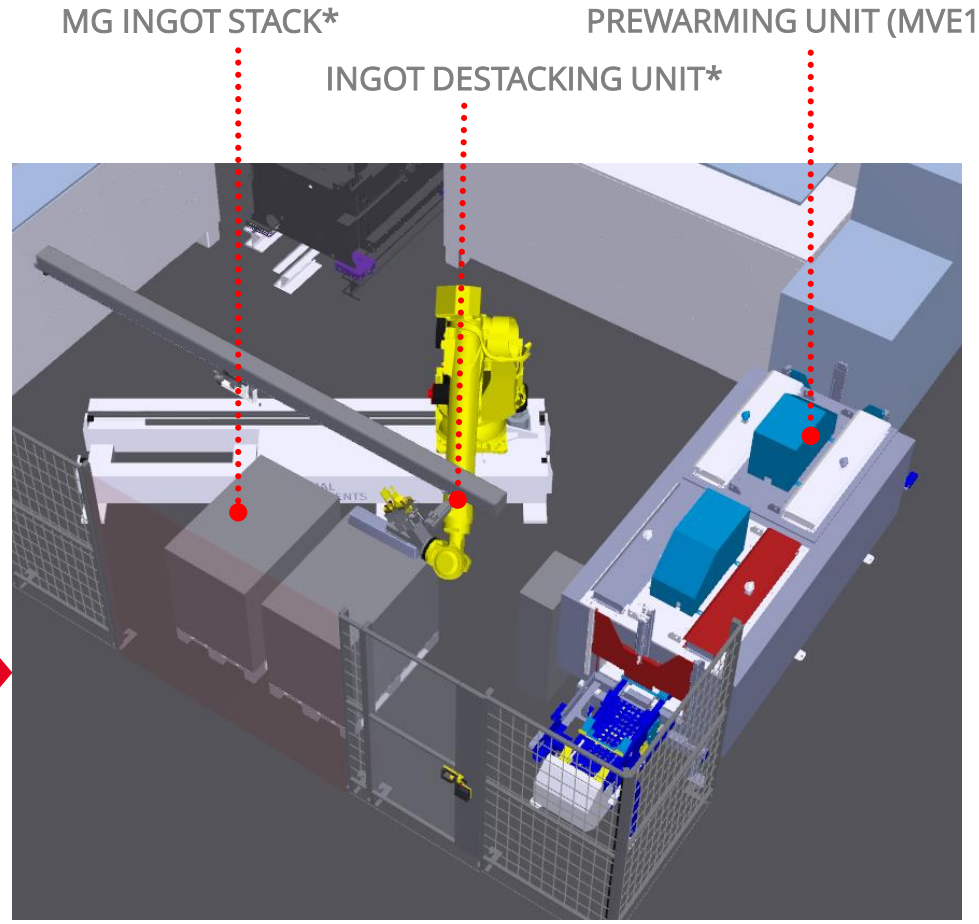
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

PROCESS OVERVIEW:

1. Destacking Magnesium ingots (not in scope of Rauch)

The ingot position of the prepared ingot stack will be scanned by a laser system. A robot with a combined vacuum- and mechanical gripper takes a single ingot and places it on the RAUCH prewarming station MVE1200E.

The ingot moves step by step through the prewarming station, where the ingot will be prewarmed by means of hot air convection.



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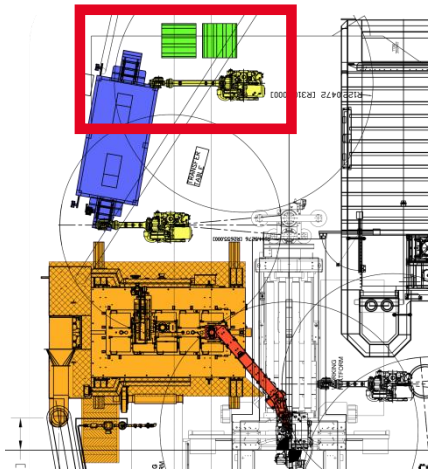


1 | OVERVIEW

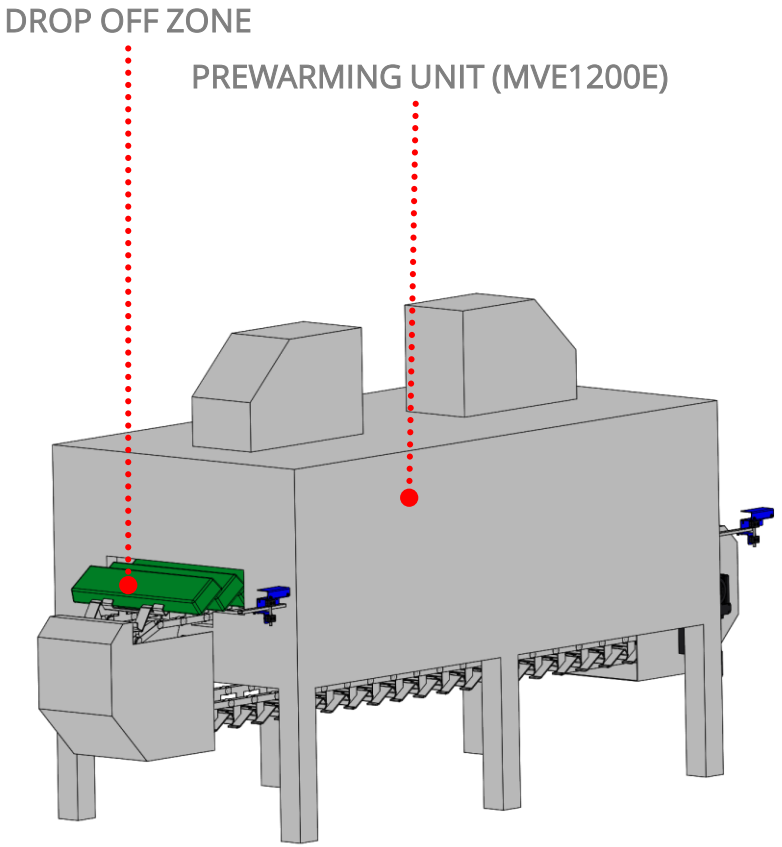
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

PROCESS OVERVIEW:

2. Prewarming ingot

The ingot moves step by step through the prewarming station, where the ingot will be prewarmed by means of hot air convection.

The ingot feeding robot picks up the ingot with the mechanical gripper on the end of the prewarming unit.



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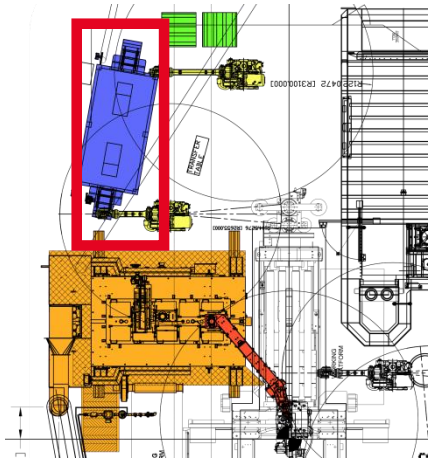


1 | OVERVIEW

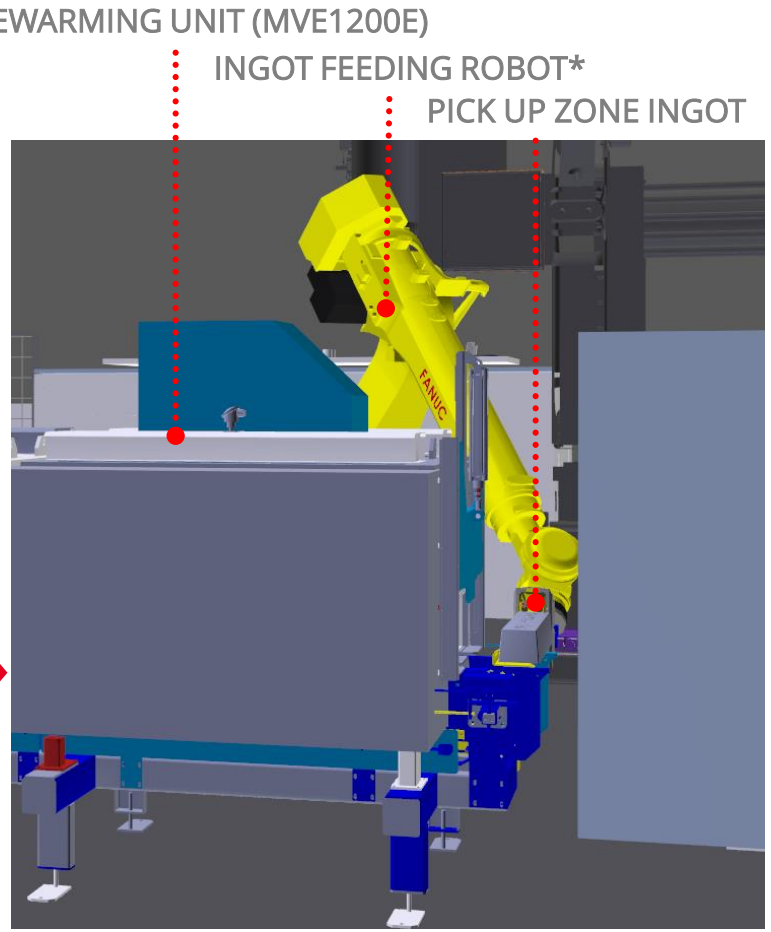
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

PROCESS OVERVIEW:

3. Pick up of prewarmed ingot

The ingot feeding robot picks up the ingot with the mechanical gripper on the end of the prewarming unit.

The feeding robot feeds the ingot directly in the melting furnace. Therefore an electric driven flap opens the crucible lid



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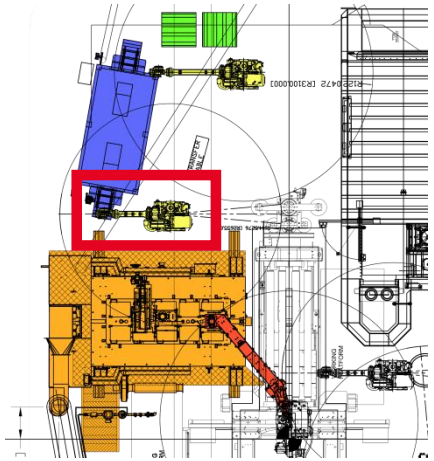


1 | OVERVIEW

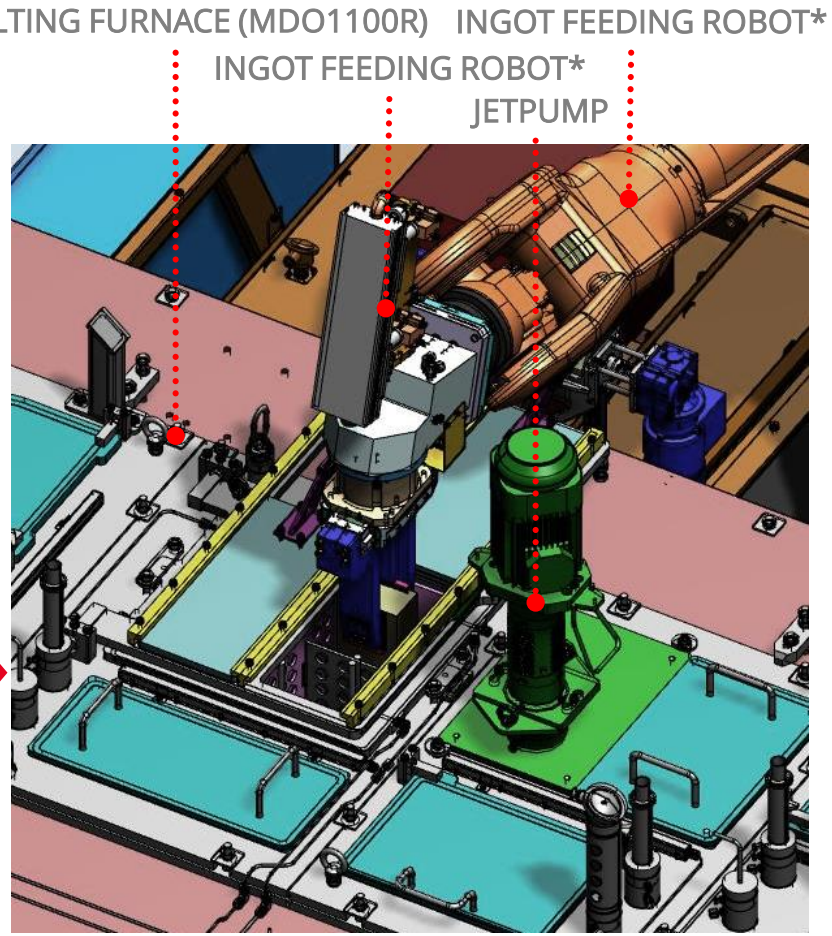
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

PROCESS OVERVIEW:

4. Feeding of prewarmed MG ingot in furnace

The feeding robot feeds the ingot directly into the melt of the furnace. Therefore an electric driven flap opens/closes the crucible lid.

Melt process of ingot in MDO1100R by recuperation burner technology and circulation pump.



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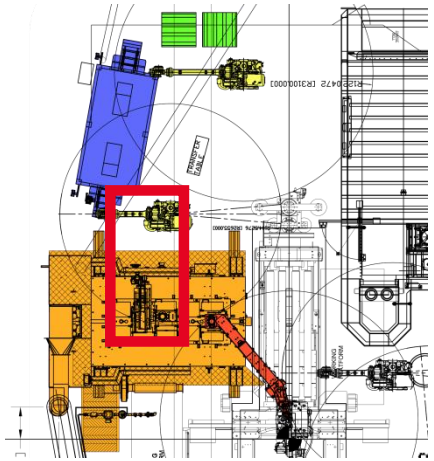


1 | OVERVIEW

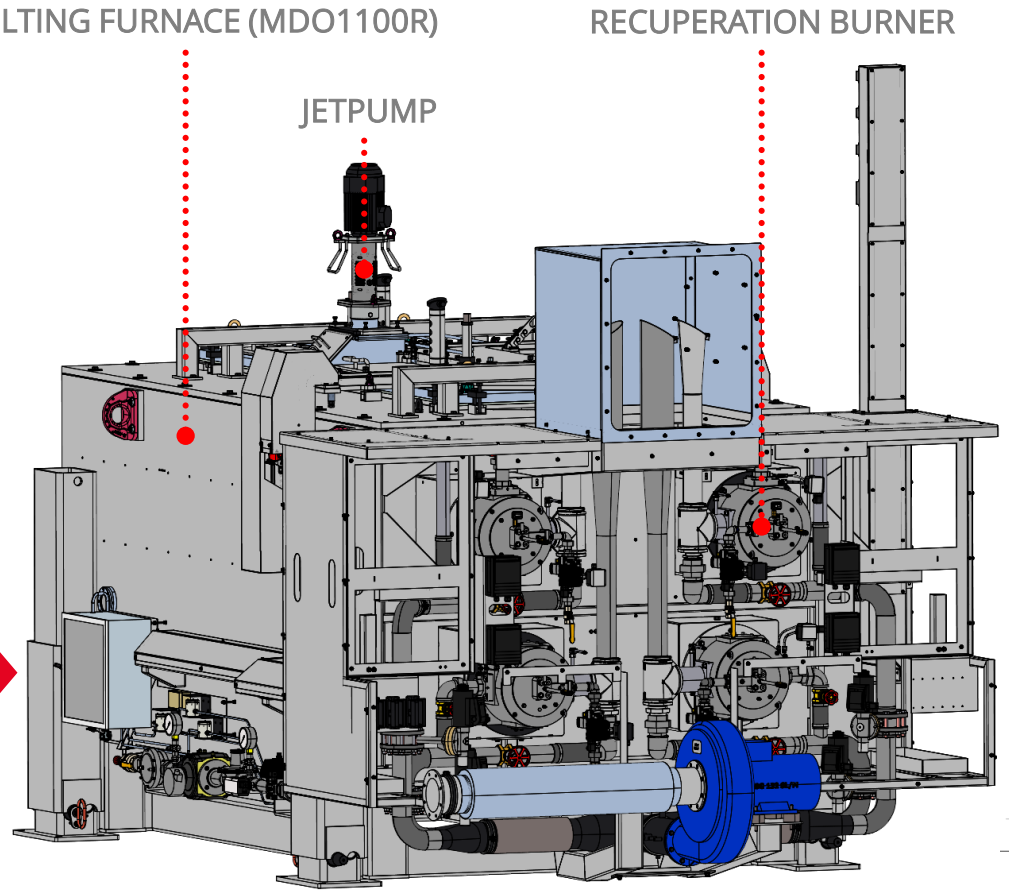
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

PROCESS OVERVIEW:

5. Melting of Mg ingots

Melting of ingots in MDO1100R with recuperation burner technology and circulation pump.

The filled Mg advanced dosing system (ADSL) pumps the melt into the shot sleeve of the DCM according the DCM signals via bus system.



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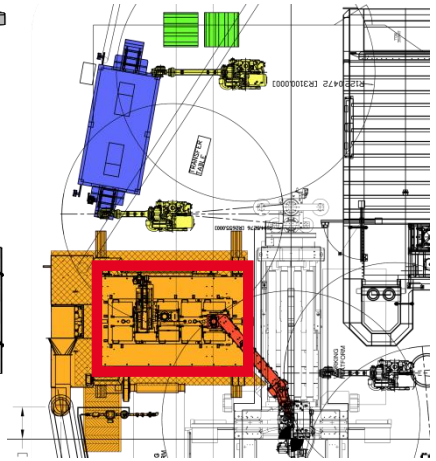


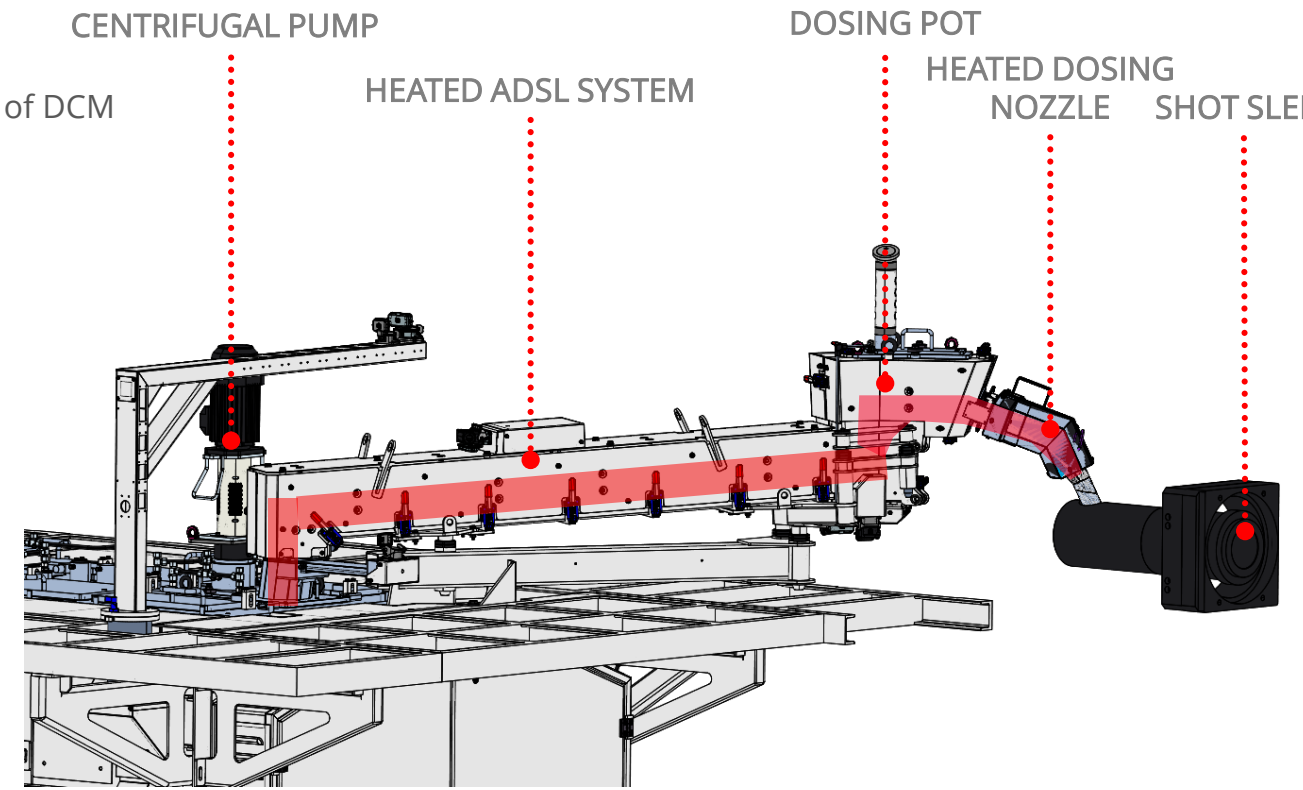
1 | OVERVIEW

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

PROCESS OVERVIEW:

5. Dosing of melt into the shot sleeve of DCM

The filled Mg advanced dosing system (ADSL) pumps the melt into the shot sleeve of the DCM according the DCM signals via bus system.



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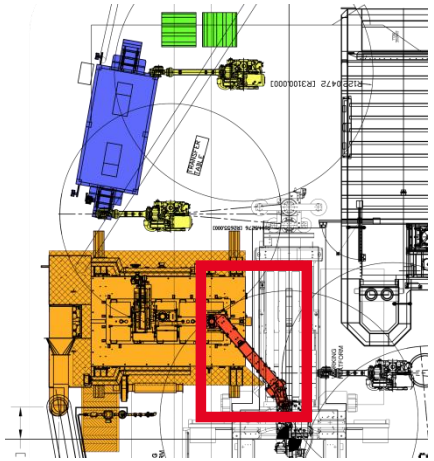
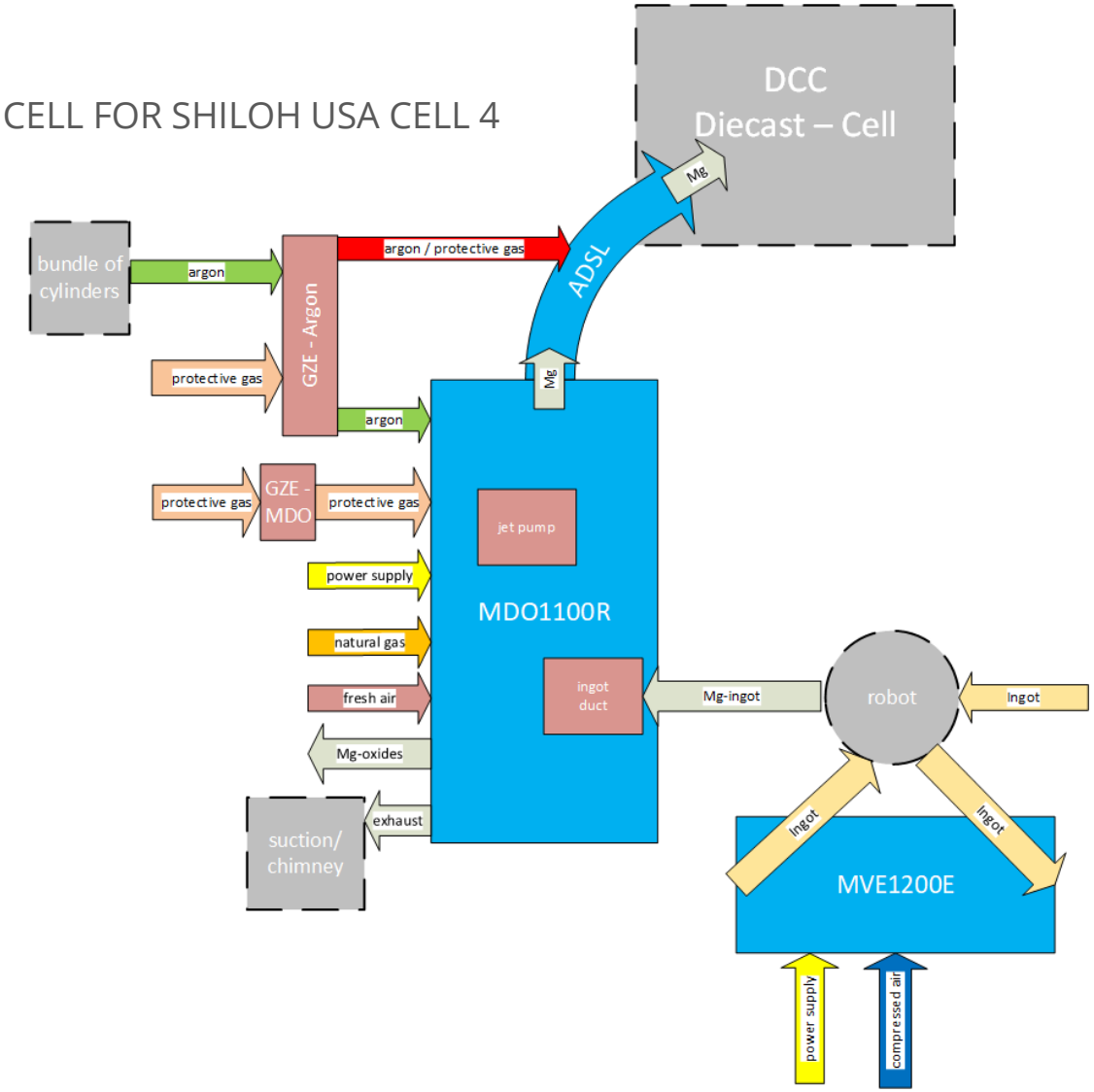


1 | OVERVIEW

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

PROCESS SCHEMATIC:



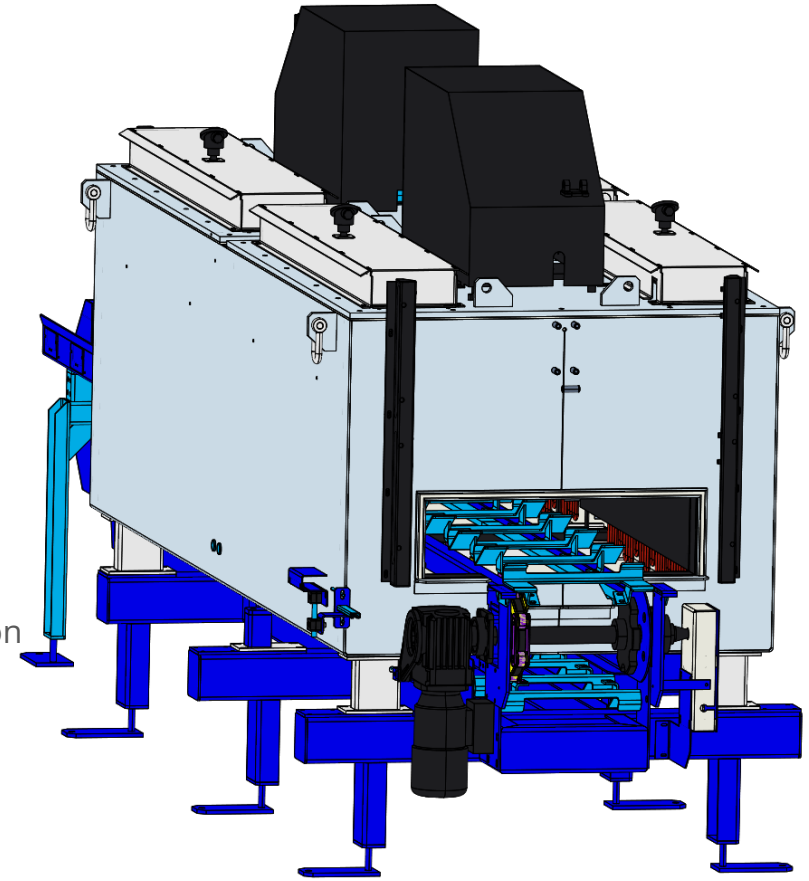
2 | EQUIPMENT DETAILS INGOT PREWARMING STATION

2 | EQUIPMENT DETAILS INGOT PRE-WARMING STATION

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

2.1. DATA

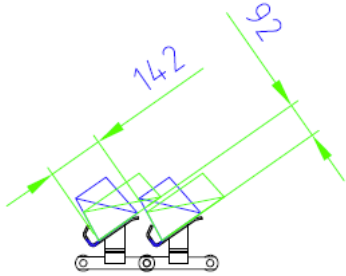
Throughput:	1200kg/h (2645 lbs/h) at 12kg (26lbs) ingots
Core temperature at output:	>120°C (248°F) based on income ingot temp. of 20°C (68°F)
Electrical connected load:	~140 kW
Electrical heating load:	~132 kW
Voltage:	3x400VAC / with ground and neutral (Solidly grounded wire)
Voltage tolerance:	± 10%
Frequency:	60Hz
Size switch cabinet:	length x weight x height: 1800x500x2200+600mm pro air condition
Transformer:	Required, in scope of supply -RAUCH



2 | EQUIPMENT DETAILS INGOT PRE-WARMING STATION
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

2.2. INGOT SIZE

Magnesium INGOTS		
Sizes in mm (inch)	Maximum	Minimum
Width	190 (7.5”)	110 (4.3”)
Height	139 (5.5”)	40 (1.6”)
Length	762 (30”)	500 (20”)



weight 12kg (26lbs) needed to fulfill the handling time of robot system.

The ingot height may only vary by 5%.

If the ingots are wider than 142mm (5.6”), the height of the ingot is limited to 92mm (3.6”).

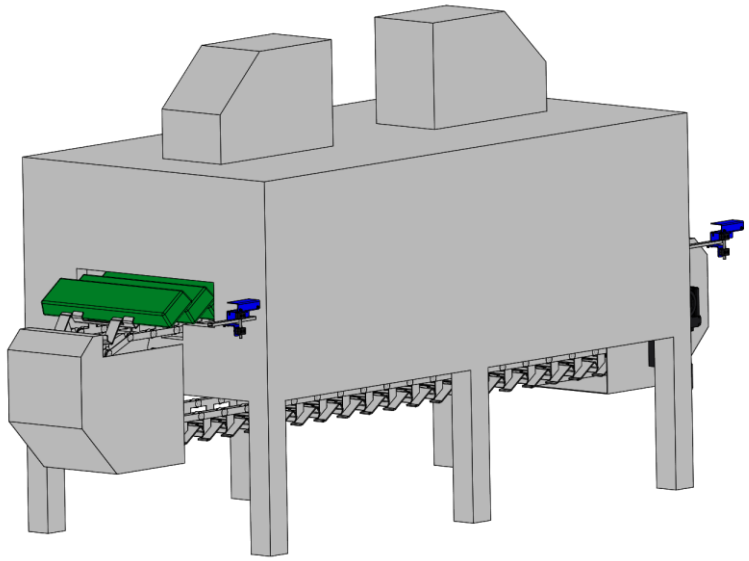
The shape of the ingot has to be checked with the de-stacking robot system.

2 | EQUIPMENT DETAILS INGOT PRE-WARMING STATION

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

2.3. INTERFACE

Interface / Items	Rauch	Shiloh	Comtec / other
Electrical supply (see 2.1)		X	
Electrical interface to melting furnace	X		
Electrical interface to safety fence	X	X	X
Electrical interface to robot destacking unit	X		X
Safety fence		X	X
Sensor ingot drop off place empty	X		
Sensor ingot in pick up position	X		
Cable trench switch cabinet / equipment		X	



3 | EQUIPMENT DETAILS MAGNESIUM DOSING FURNACE

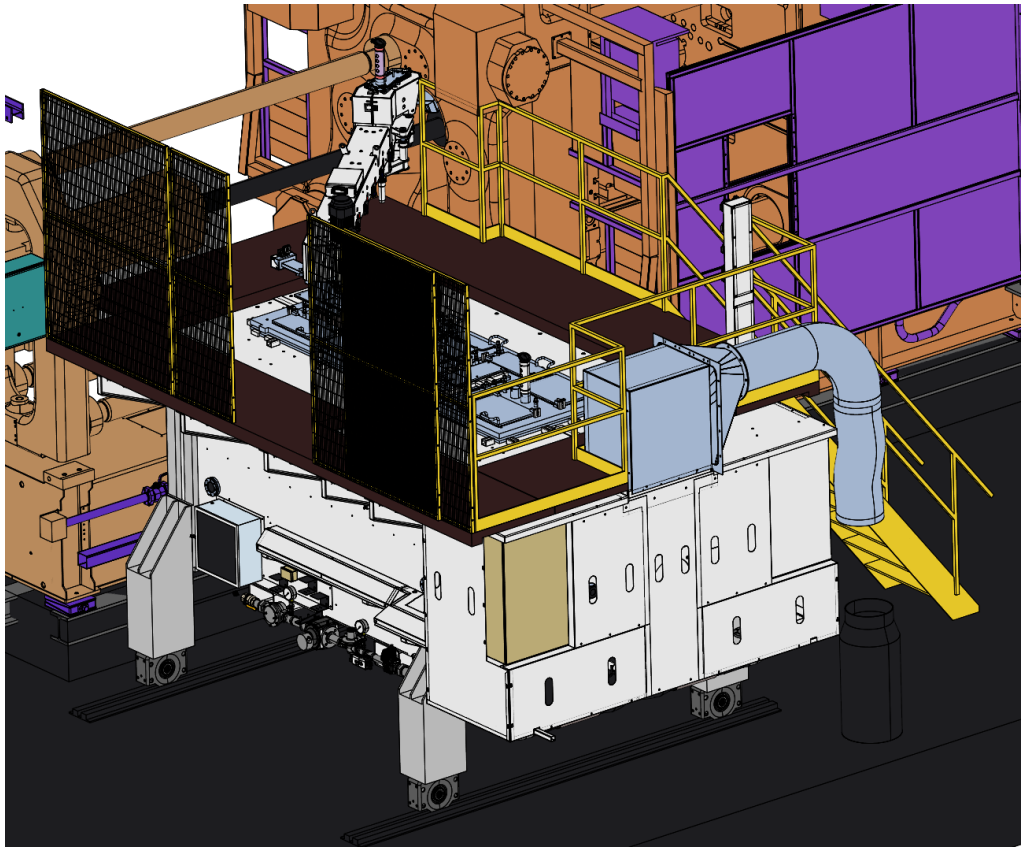
24,305
Mg
12 (Magnesium)

3 | EQUIPMENT DETAILS MAGNESIUM DOSING FURNACE

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

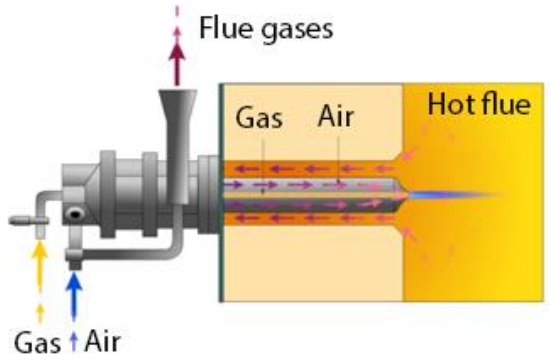
3.1. DATA

Throughput:	1100kg/h (2425 lbs/h) at 12kg (26lbs) ingots continuous feeding
Nominal melt temperature:	680°C (1256°F)
Electrical connected load:	~55 kW (exhaust fan not included)
Gas connected load:	~860 kW (natural gas)
Nominal heating load:	~745 kW (natural gas)
Voltage:	3x400VAC / with ground and neutral (Solidly grounded wire)
Voltage tolerance:	± 10%
Frequency:	60Hz
Size switch cabinet:	length x weight x height: 1800x500x2200 +600mm pro air condition
Transformer:	Required, in scope of supply - RAUCH
Crucible content total	2950 kg
Furnace weight without Mg	~10.000 kg



3 | EQUIPMENT DETAILS MAGNESIUM DOSING FURNACE

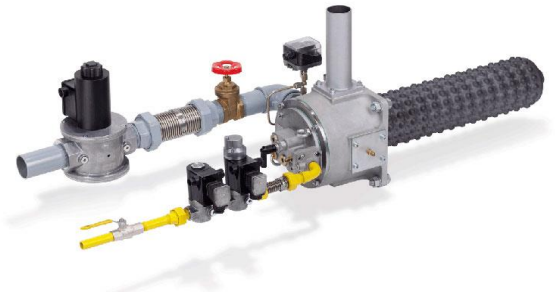
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4



3.2. RECUPERATUR BURNER

4 pcs. Ecomax recuperation burners for gas in metallic execution with cast steel ribs recuperator with high efficiency. Energy efficiency realized by means of pre-warming the combustion air.

The efficiency improvement is achieved by preheating the combustion air prior to ignition, since the exhaust gases can pass over the heat content at a temperature level that could otherwise not be used in terms of process technology.



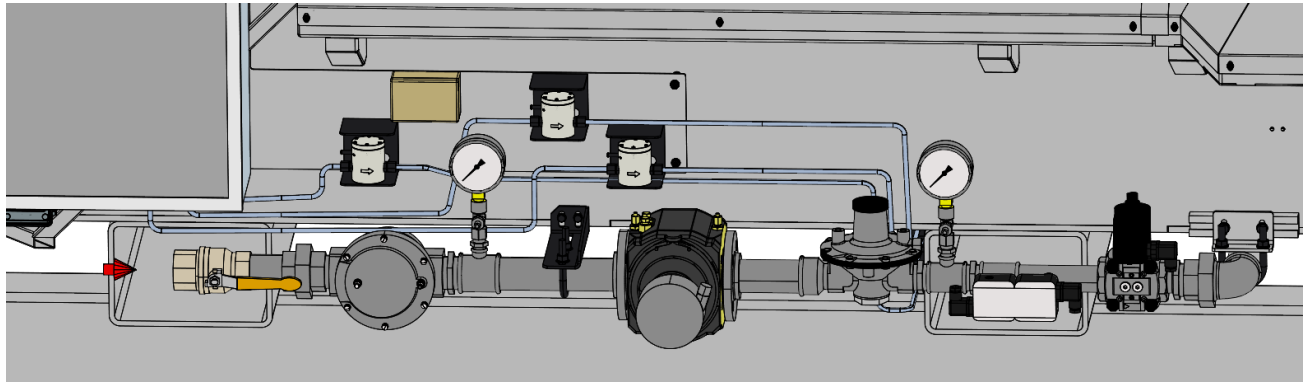
The used burner technology will reach a thermal efficiency* between 69 to 75%.
Standard burner technology can reach a maximum of only 50%

*Definition thermal efficiency: remaining power in the furnace housing (to cover the heat loss of the equipment and to cover the melt energy for the magnesium) divided by consumed power.

3 | EQUIPMENT DETAILS MAGNESIUM DOSING FURNACE
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

3.3. GAS SUPPLY

Medium:	Natural Gas
Calorific value:	10 kW/Nm³ (unconfirmed)
Input pressure:	200-450mbar (g) (2.9-6.5 psi)
Max pressure:	500mbar (g) (7.2 psi)
Max gas consumption:	86 Nm³/h (53.58 scfm) based on calorific value
Supply connection:	2” NPT female on Rauch side
Purging line:	1” NPT female on Rauch side



The purging line should run outside over the hall roof.

Our equipment is designed for the use of gases in gaseous state only.

A free and easy accessible stopcock outside of the hall/building should be placed in the gas supply line to switch off the gas supply in an emergency case.

For safety regulation an overpressure control valve should be implemented in the gas supply line with a working range of 500 mbar (g) (7.2 psi).

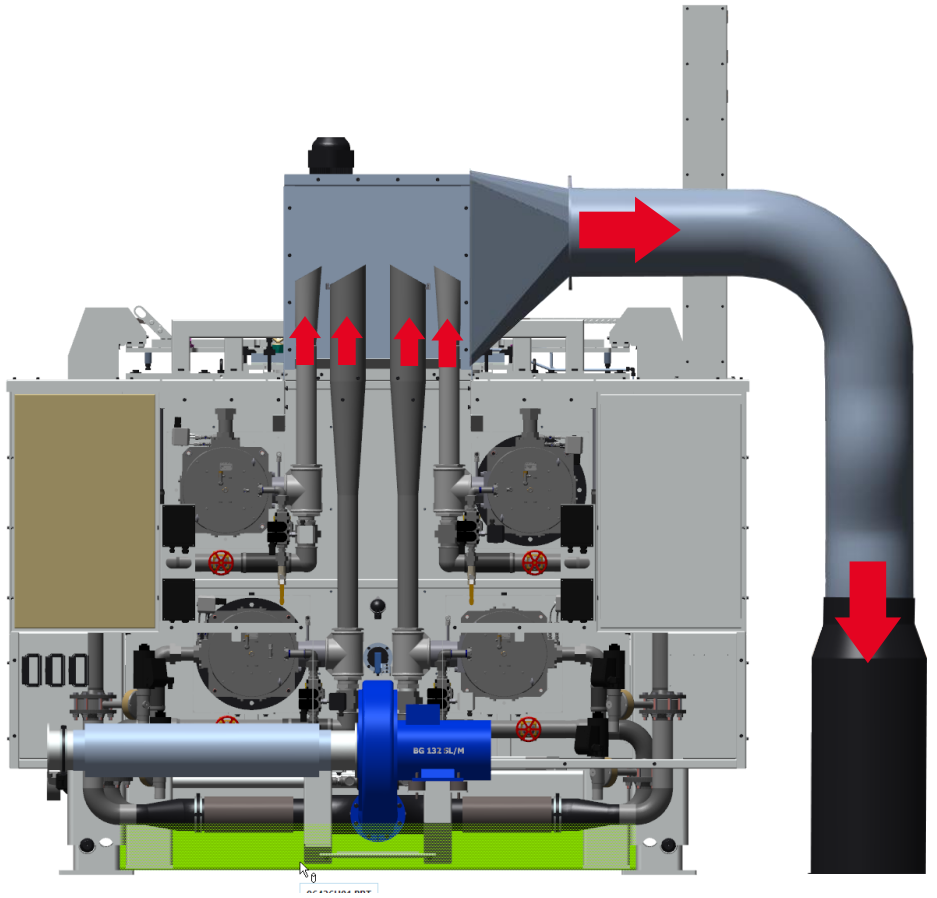
All national rules for gas supply needs to be observed!

3 | EQUIPMENT DETAILS MAGNESIUM DOSING FURNACE
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

3.4. EXHAUST SYSTEM

The exhaust gases of the burner system will be collected in the exhaust hood on top of the furnace. An exhaust fan evacuates the flue gases from the collection hood via isolated exhaust piping system in the floor.

After the exhaust fan the flue gases will be transported by chimney over the roof of the plant.



Exhaust gases data:

Gas volume of 8828 m³/h (5597 SCFM) with 200°C (392°F) =
5096 Nm³/h (3231 SCFM) with 20°C (68°F)

Exhaust fan specification:

Flue gas volume 8828 m³/h (5597 SCFM) with 200°C (392°F)

The under pressure on the fan should be minimum 8mbar (0,116 psi), according to the pressure loose of the piping between fan and collecting hood.

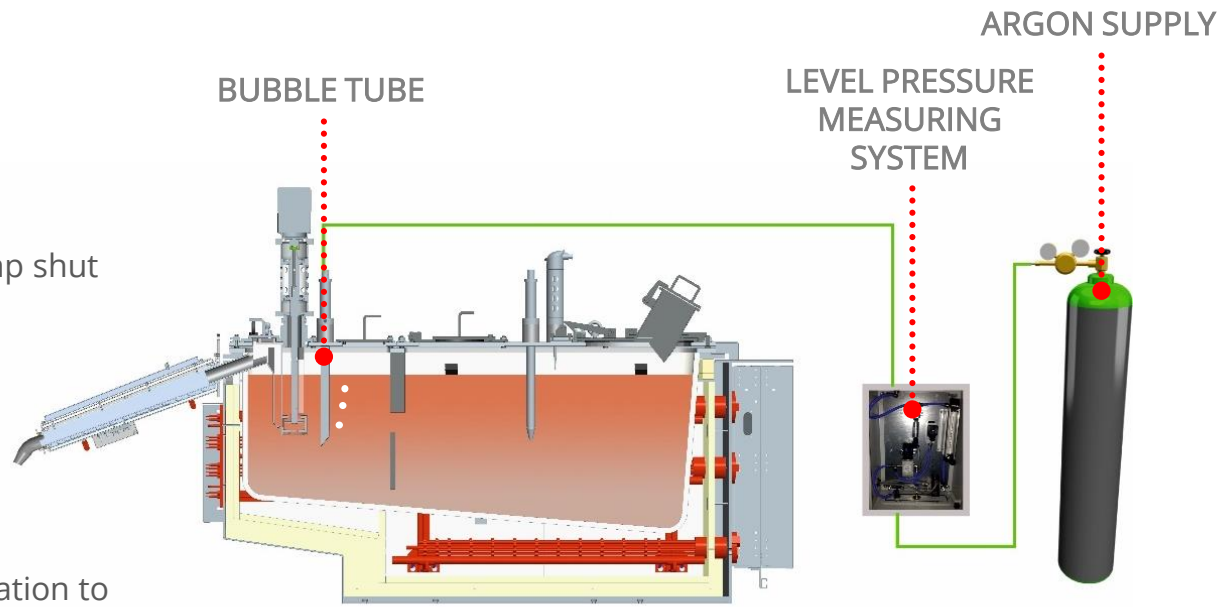
The fan should have the possibility to run up in cold condition (motor needs to be stronger, heavier air movement)

Temperature rating of the fan should be 250°C (482°F)

3 | EQUIPMENT DETAILS MAGNESIUM DOSING FURNACE
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

3.5. GAS SUPPLY

Argon medium supply:	Level pressure measuring system Additional protective gas for ADSL system
Argon pressure:	5bar (g) (72,5 psi)
Argon consumption:	2 Nl/h (0.53 gph) Level system 200 Nl/h (53 gph) ADSL, only when the pump shut down
Argon quality:	> 99,98% Ar < 5ppm H2O Filter 5 µm



Permanent supply should be guaranteed! (Optional automatic switch over station to emergency supply)

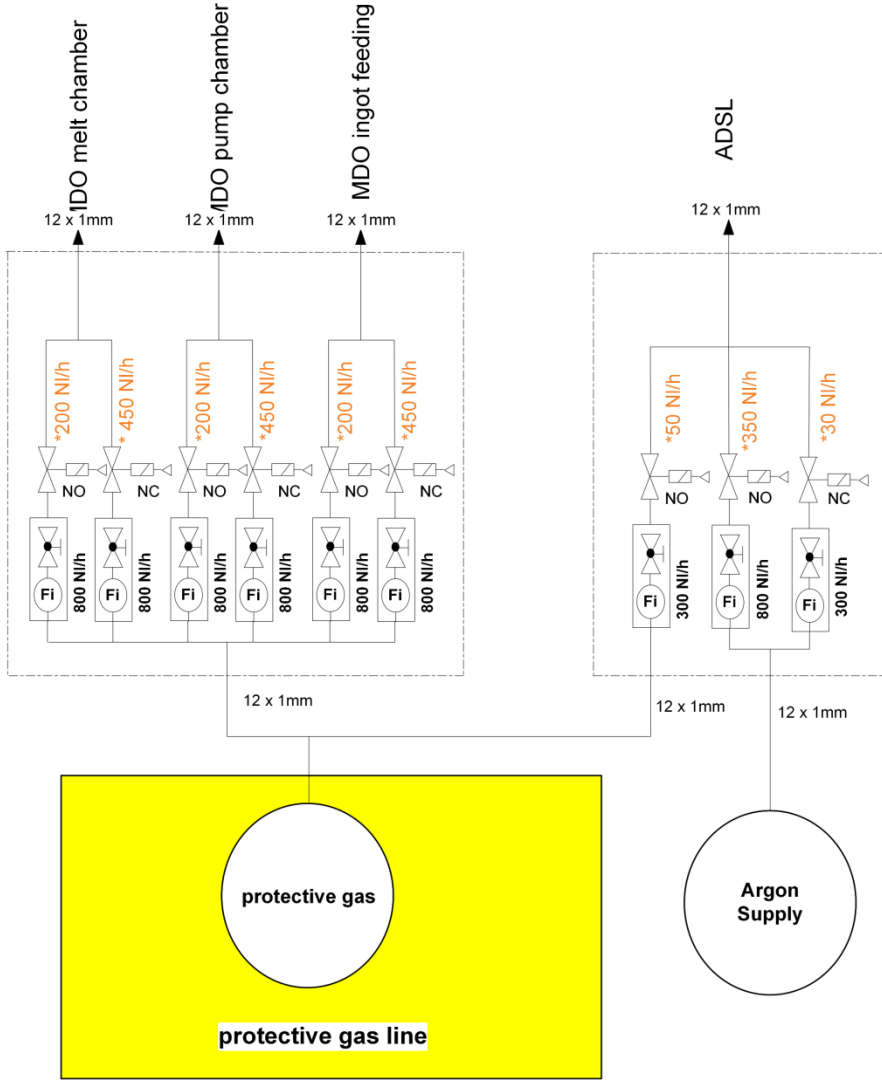
Our equipment is designed for gases in gaseous state only

3 | EQUIPMENT DETAILS MAGNESIUM DOSING FURNACE

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

3.6. PROTECTIVE GAS SUPPLY

Protective gas medium supply:	Protective gas is supplied by the gas mixing cabinet
Protective gas pressure:	0,5 - 1 bar (g) (7,5 - 15 psi)
Protective gas consumption:	~2500 Nl/h (~88 ft3/h)
Protective gas quality:	See gas mixing equipment < 5ppm H2O Filter 5 µm



Based on the maximum protective gas flow (2500Nl/h) for one furnaces , the piping should be min. 1” pipe (25,4mm x 1,65mm wall thickness) according imperial unit.

Material: Stainless stainless steel tube: 1.4404 / UNS S31603 (316L)

Hardness: max. 70 - 90 HR B

Surface: Ra values are not defined for the inner surface.

Outer surface: free of longitudinal and vertical scratches with a Ra value ≤ 1,00 µm (40 µin).

3 | EQUIPMENT DETAILS MAGNESIUM DOSING FURNACE
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

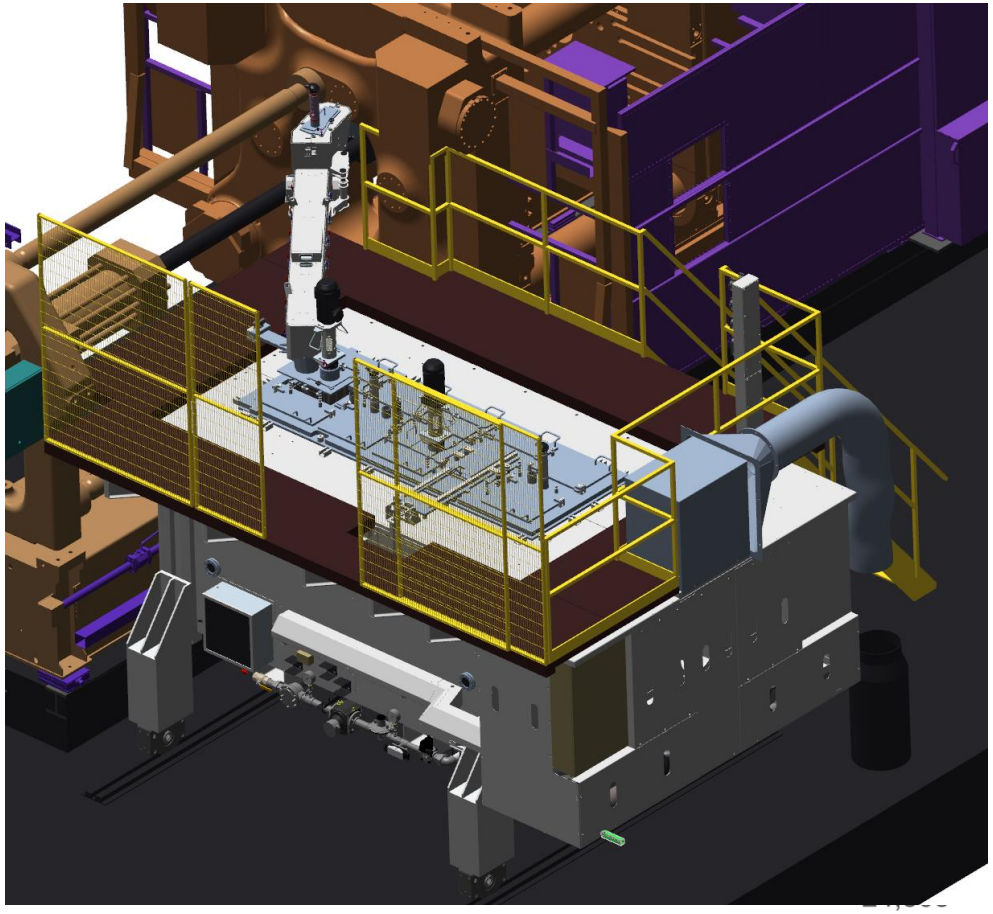
3.7. OPERATOR PLATFORM

Operator platform (not in scope of supply) would be a suggestion and can vary to national rules and on site situation (as example loads on the platform).

Rauch will deliver concept drawings with the connection points to the furnace.

Due to the different position of the furnace according to the shot sleeve position, the operator platform needs to be mounted in total on the furnace. Fixing points on the furnace for platform will be prepared.

The access stair needs to be adjustable in the height and can be realized via parallelogram system.



3 | EQUIPMENT DETAILS MAGNESIUM DOSING FURNACE

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

3.8. SAFETY CONCEPT ROBOT FEEDING

The entrance to the operator platform should be equipped with a safety sliding door and access control at the entrance. Additional at the opening for the feeding robot an pneumatic driven door should be mounted.

Steps:

a. For maintenance work, the operator stops the cycle of the feeding ingot by pushing the request button at the access control at the entrance door.
b. Then the robot drives into a safe position and the pneumatic driven hand rail/fence will close the opening for the feeding robot.
c. The entrance door will be unlocked and the operator can walk on the operator platform.
d. After the job is done, the operator closes the entrance door and locks the door at the access control.
e. Pneumatic driven hand rail/fence for robot feeding opens and robot starts with feeding process.

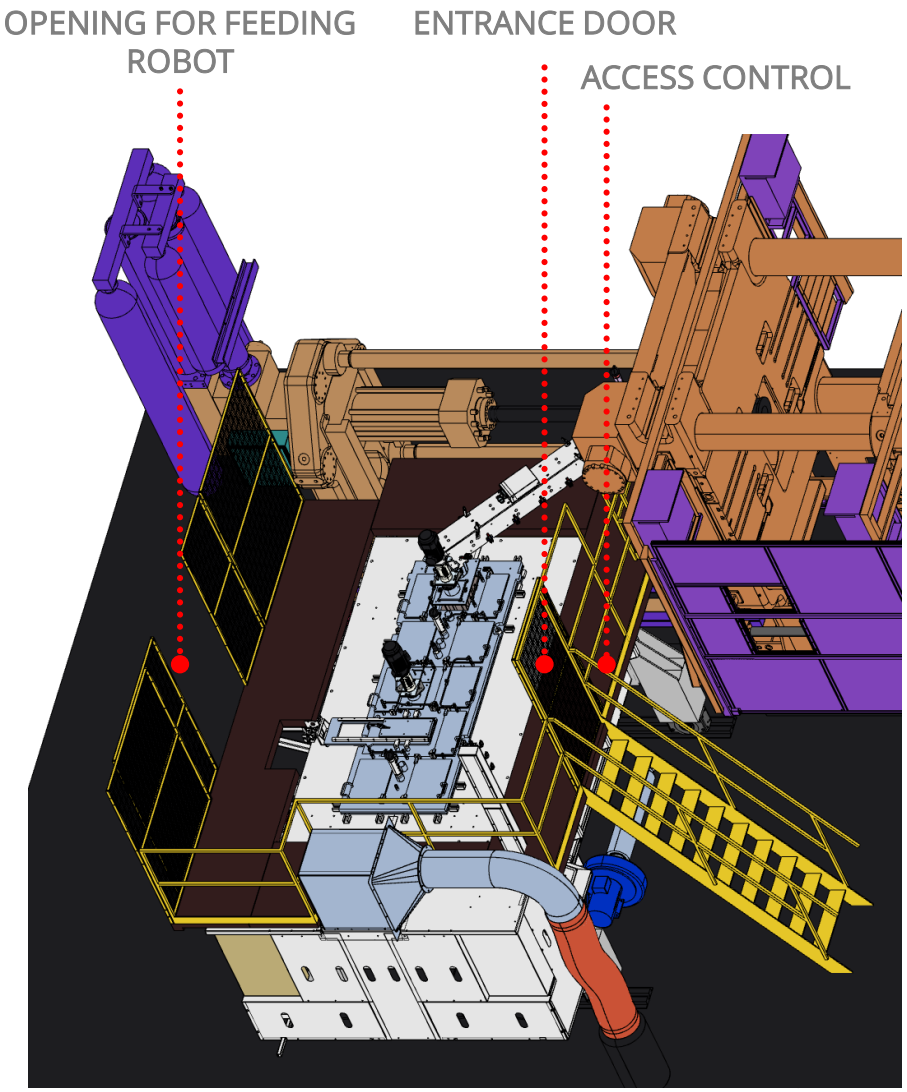
The ingots must be feed continuously.

The feeding of ingots may only be interrupted for a maximum of 10 minutes as the bath level drops too far.

With a throughput of 1000kg/h, the feeding takes almost two hours to bring the bath level back to the standard level.

The bath level may only fall 50mm, at this point it gets critical.

We would proposal that with a 5 minutes feeding stop we should be on the safe side.



3 | EQUIPMENT DETAILS MAGNESIUM DOSING FURNACE
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

3.9. ADVANCE DOSING SYSTEM LARGE (ADSL)

Dosing rate: <5 kg/s (11 lbs/s)

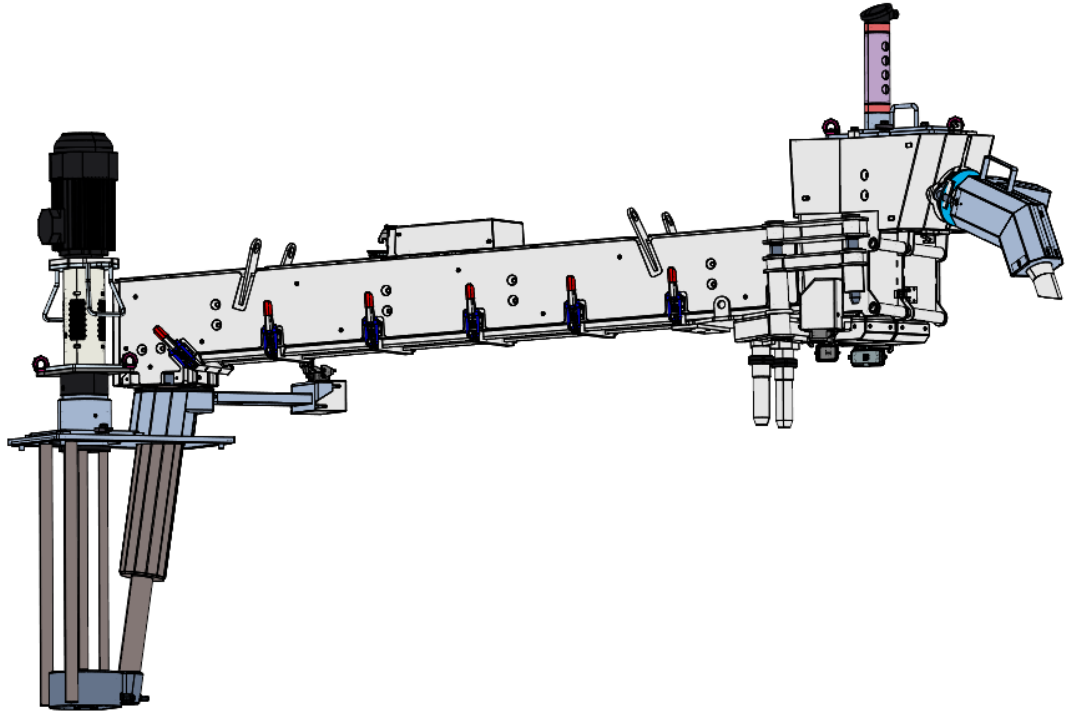
Nominal melt temperature: 680°C (1256°F)

Electrical connected load: ~25kW (included in furnace load)

The molten magnesium is always in position short in front of the shot sleeve, thus the transfer way is short. A laminar flow is made, which reduces loss of temperature and decreases oxidation.

For dis- and assembling a small manipulation crane would be recommend in the area of the ADSL system.

Performance level risk graph EN ISO 13849: D
(depending on signals from DCM Interface)



3 | EQUIPMENT DETAILS MAGNESIUM DOSING FURNACE

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

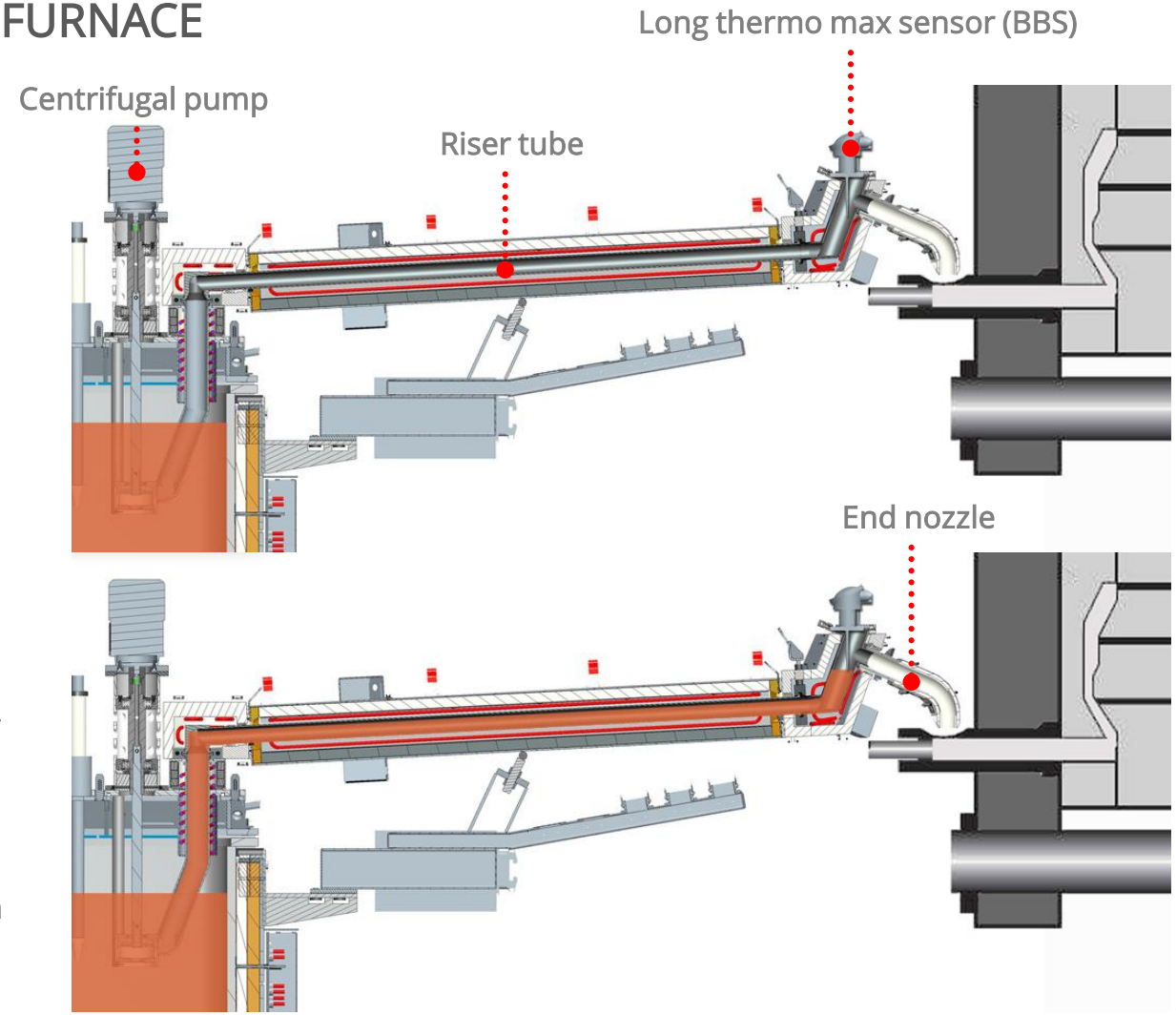
3.10 ADSL Reference Steps

The reference procedure needs to be done after every pump shut down:

1. Assemble and prewarm ADSL system
2. Mount long thermo max sensor (BBS) in system
3. Start reference process

4. Pump starts slowly and fills up the riser tube
5. Max sensor detects Mg and pump takes over actual rpm as future reference rpm
6. Dismount long max sensor (BBS) and mount operation sensor- (BBS)

The operation sensor checks an overfilling of ADSL, by blocking of the end nozzle and stops the pump immediately.
Several self control loops check the condition of the pump and if a fault is detected - pump stops immediately.



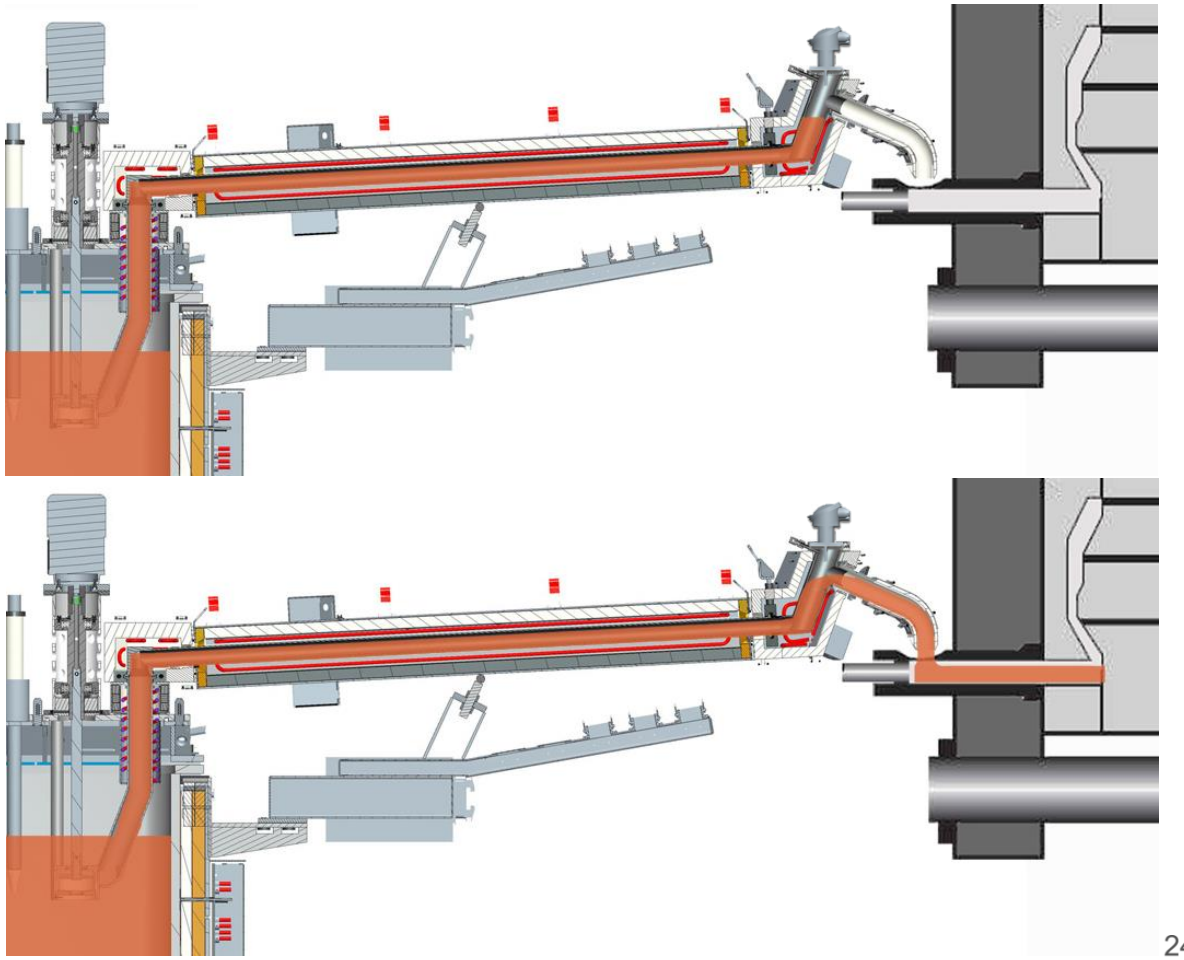
3 | EQUIPMENT DETAILS MAGNESIUM DOSING FURNACE

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

3.11. ADSL Operation Steps

After the pump runs in reference mode, the ADSL system can be switched over to automatic mode. At this moment the DCM controls the cycle via interface.

1. DCM releases dosing
2. Pump increases the rpm (dosing rpm) to lift up the level in the dosing pot. The dosing timer starts with this signal.
3. The Mg flows via the nozzle into the shot sleeve
4. After the dosing timer expires, the pump goes back to reference rotation speed.
5. A shot release timer allows the Mg to flow completely into the shot sleeve, before the shot release signal starts the shot of the DCM



3 | EQUIPMENT DETAILS MAGNESIUM DOSING FURNACE

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

3.12. Siemens PLC

Rauch operates the entire system with Siemens TIA >V15

Internal bus system: Profinet

Internal safety system (as example Emergency stop): Siemens ProfiSafe

DCM: DISPO 035 Profinet via coupler* Profibus at DCM side

DCM: Safety system (as example Emergency stop): Hardwired

Destacking: Profinet interface to Robot feeding (no Profinet coupler -> need to checked)

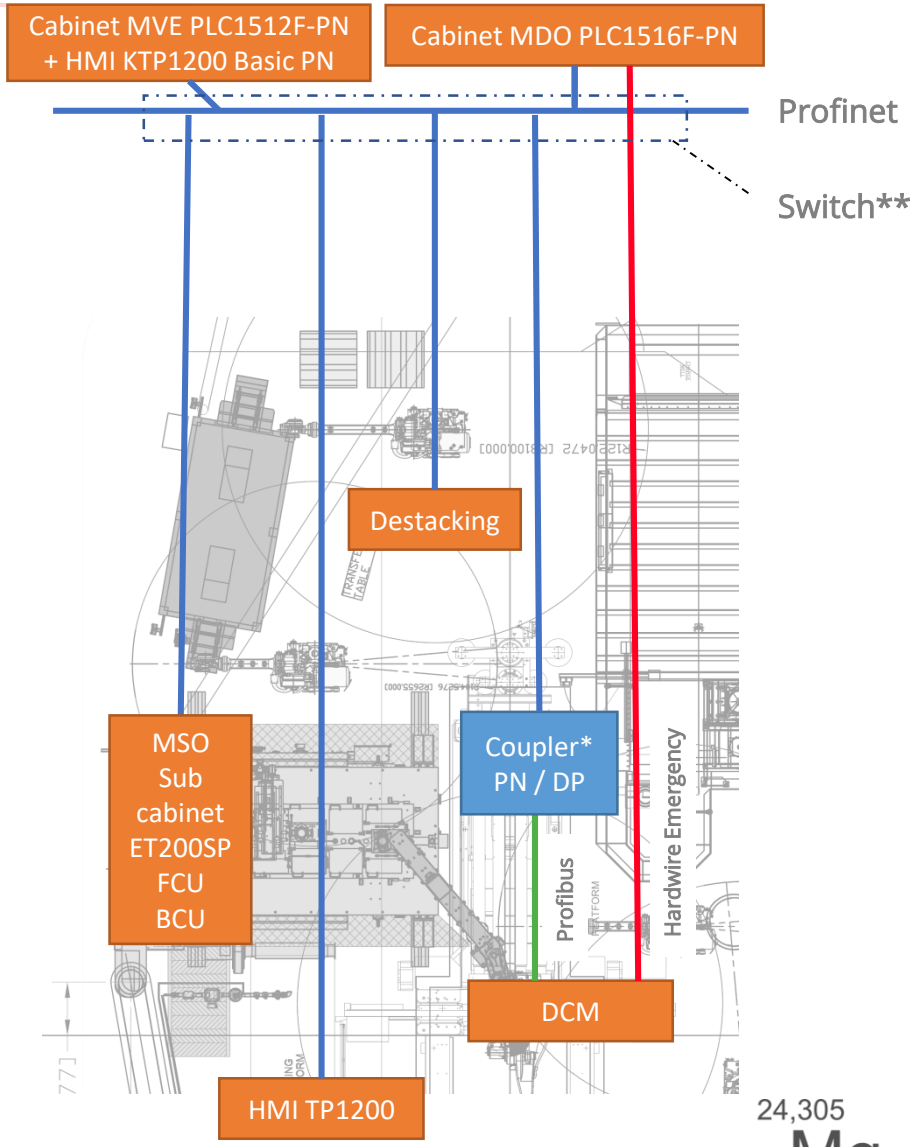
Destacking: Safety system (as example Emergency stop): Siemens ProfiSafe

Additional interface:

OPC-UA Interface -> Central system -> License need to be offered

* Coupler in scope of supply at Bühler

** Switch provide by Shiloh

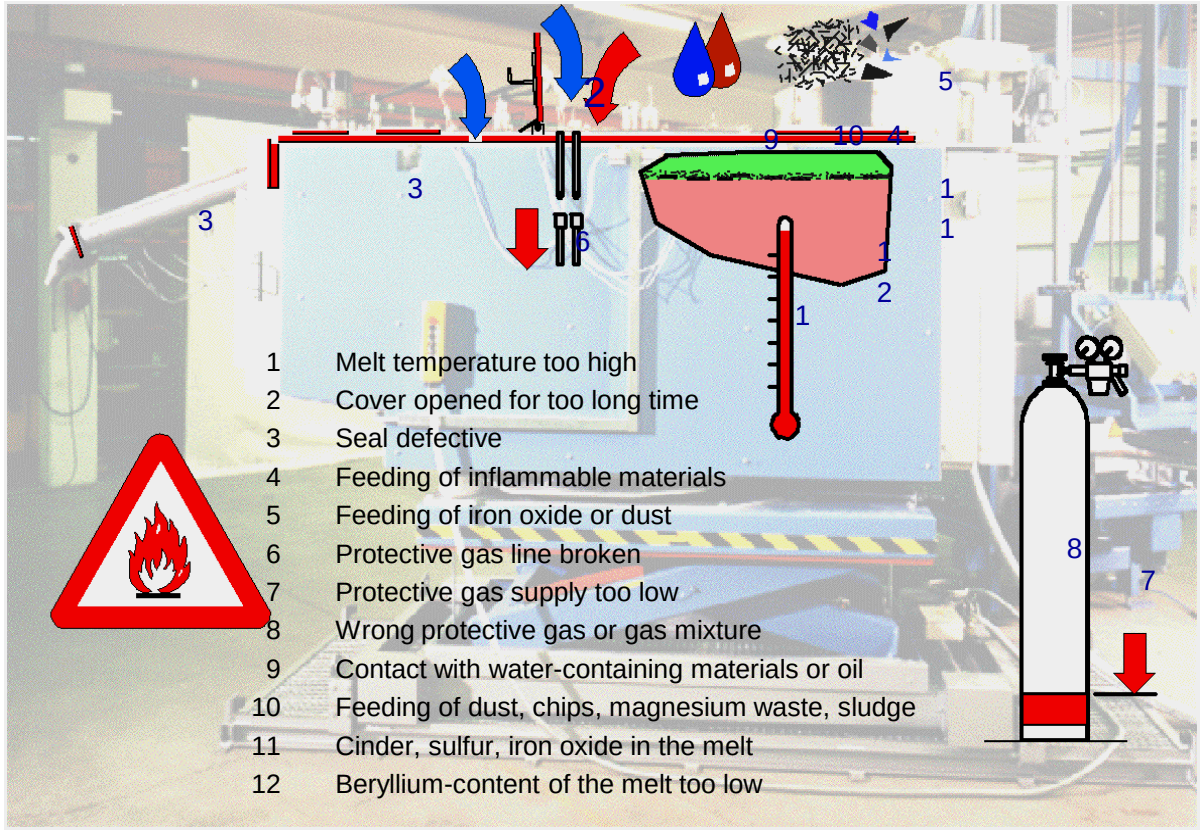


3 | EQUIPMENT DETAILS MAGNESIUM DOSING FURNACE

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

3.12. Safety function

- Redundant temperature control (double temperature sensor, second independent overtemperature device...)
- Crucible crack sensor
- Protective gas minimum flow sensor
- For ADSL pump system STO (safe torque off) and SLS (safety limited speed) of the frequency converter allows to handle a safe rotation speed of the pump
- Overflow sensor in ADSL system detects blocking of nozzle
- Siemens Profisafe system, as example “Emergency stop”, pump start, heating shut down,....
- Special furnace control unit (FCU) and burner control unit (BCU) operates and controls the complete burner system in safe condition
- Separate and self-controlled overfilling sensor (BBS) in combination with the LPS (level pressure system) ends up in a safe and high end dosing control system.
- ...

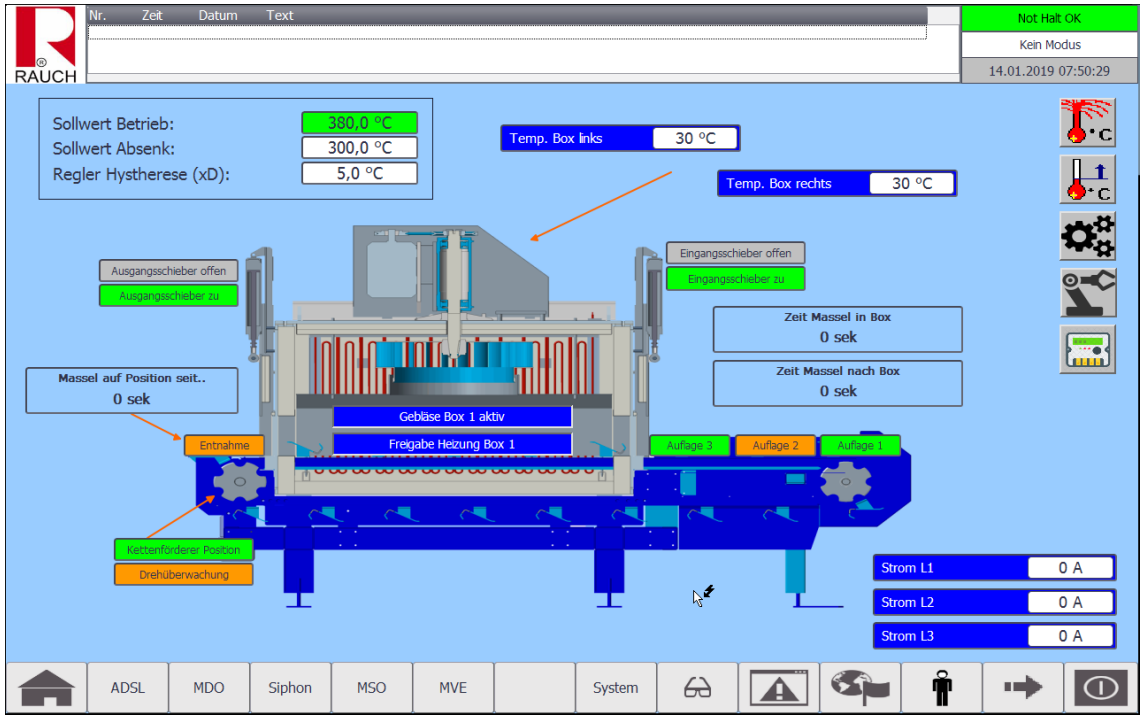


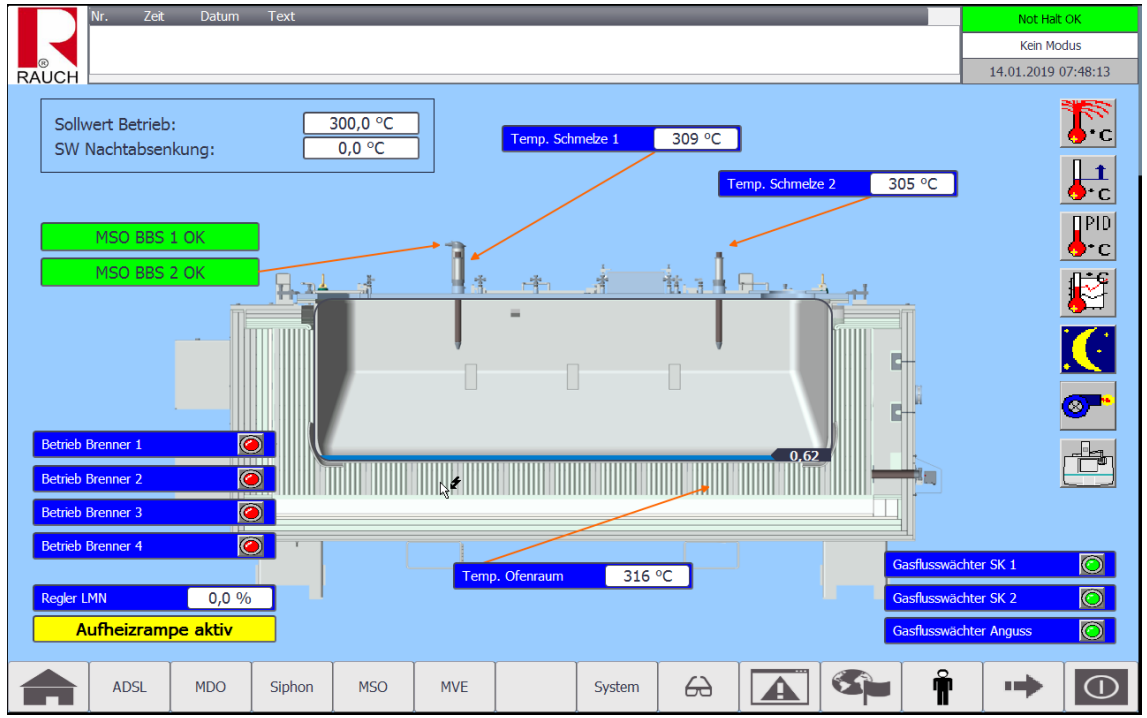
3 | EQUIPMENT DETAILS MAGNESIUM DOSING FURNACE

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

3.13. HMI picture (sample)

MDO will be controlled by external operator panel. MVE will be controlled by operator panel in the switch cabinet.



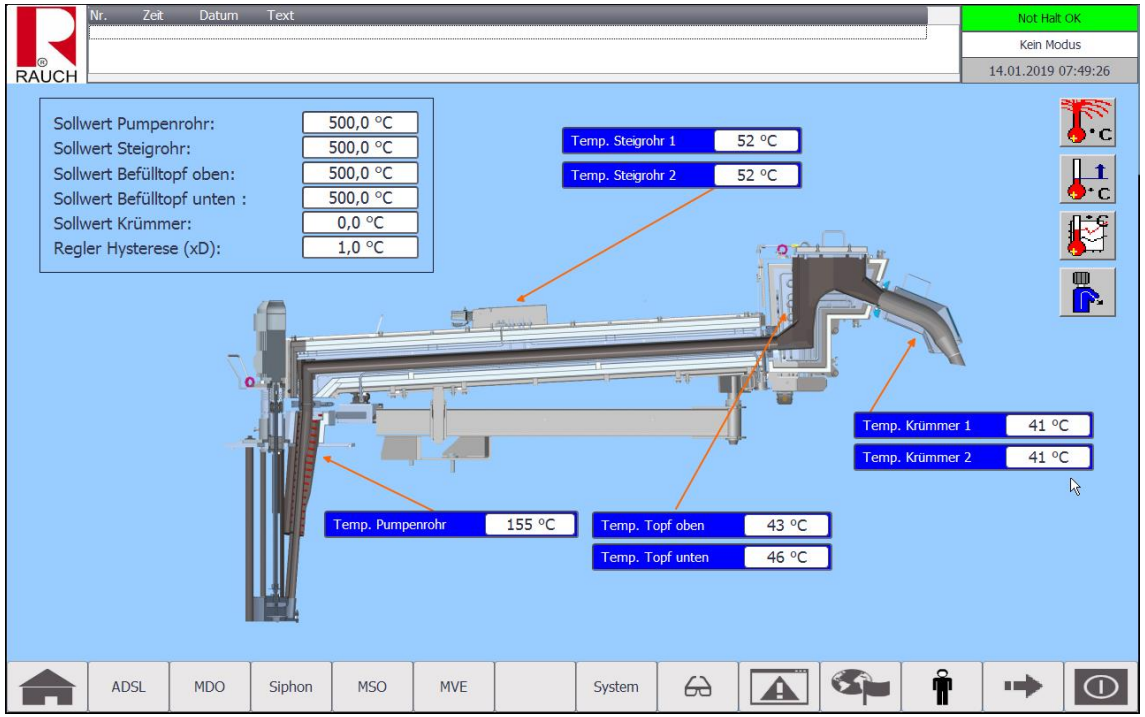


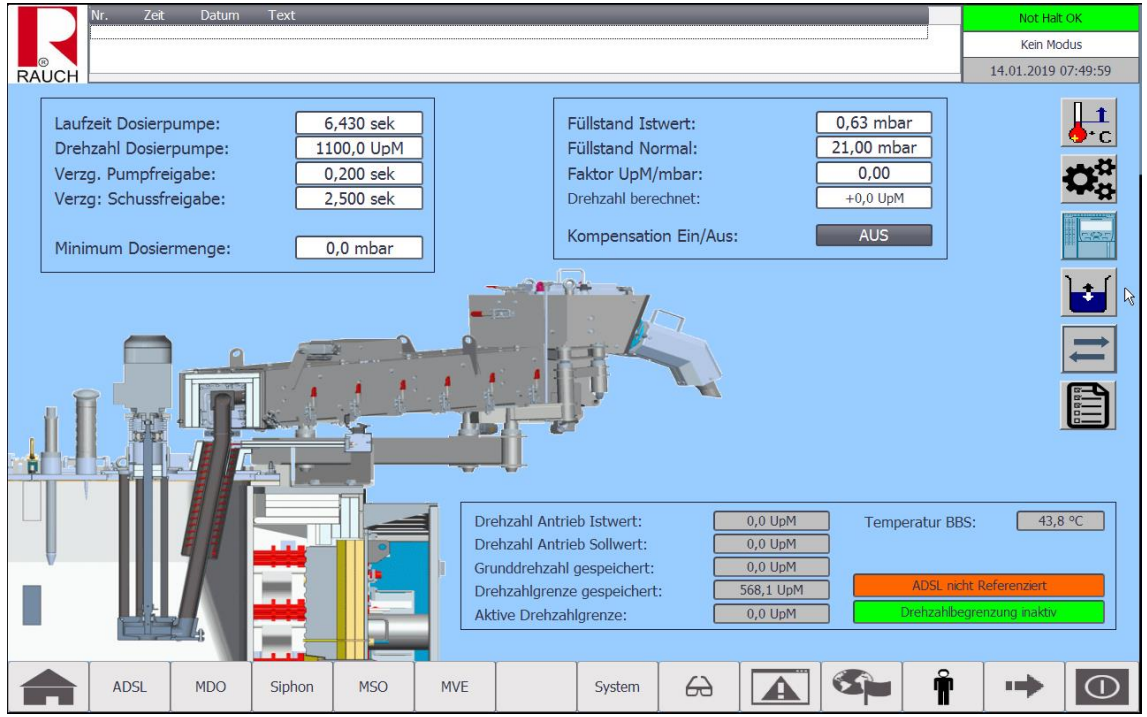
3 | EQUIPMENT DETAILS MAGNESIUM DOSING FURNACE

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

3.14. HMI picture (sample)

MDO will be controlled by external operator panel. MVE will be controlled by operator panel in the switch cabinet.

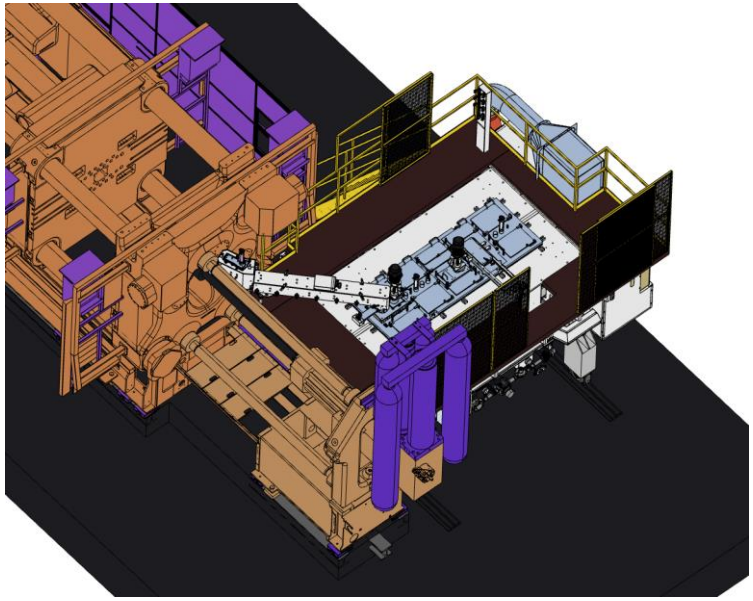




2 | EQUIPMENT DETAILS MAGNESIUM DOSING FURNACE
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

3.15. INTERFACE

Interface / Items	Rauch	Shiloh	Comtec / other	Bühler
Electrical supply (see 3.1)		X		
Electrical interface to DCM with DP/PN coupler				X
Electrical interface to safety fence			X	
Electrical interface to robot destacking unit	X		X	
Safety fence			X	
Natural gas supply (incl. purging line) (see 3.3)		X		
Exhaust system (3.4)	X	X		
Operator platform (3.7)		X		
Argon supply (3.5)		X		
Protective gas supply line (3.6)		X		



4 | EQUIPMENT DETAILS GAS MIXING UNIT

4 | EQUIPMENT DETAILS GAS MIXING UNIT
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

4.1. Data

Gas components:	N2 – Nitrogen SF6 – Sulfur hexafluoride
Max flow per module:	N2 – 2500 Nl/h (88.3 ft3/h)
Voltage:	2x120/240VAC / with ground (Ground midpoint)
Voltage tolerance:	± 10%
Frequency:	60Hz
Transformer:	Required, in scope of supply -RAUCH

4 | EQUIPMENT DETAILS GAS MIXING UNIT
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

4.5. Supply
Inlet pipelines to the mixing station

Nitrogen:

Inlet:	customer
max. flowrate:	2500 Nl/ = 2,5 Nm3/h
Supply:	customer from tank with Nitrogen supply redundant
Diameter:	di > 22 mm (distance max. 200 m)
Pressure:	5,0...8,0 barg (=73...116 psi)

4 | EQUIPMENT DETAILS GAS MIXING UNIT
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

4.6. Supply

Inlet pipelines to the mixing station

SF6 (automatic bundle switch over)

max. flowrate:	7,5 Nl/ = 0,0075 Nm3/h
Supply:	customer from two SF6-bottles recommended (more bottles as spare)
Pressure:	customer 4,0...8,0 barg (=58...116 psi) with bottle pressure regulator

4 | EQUIPMENT DETAILS GAS MIXING UNIT
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

4.7. GAS MIXING UNIT (GMD) OUTPUT

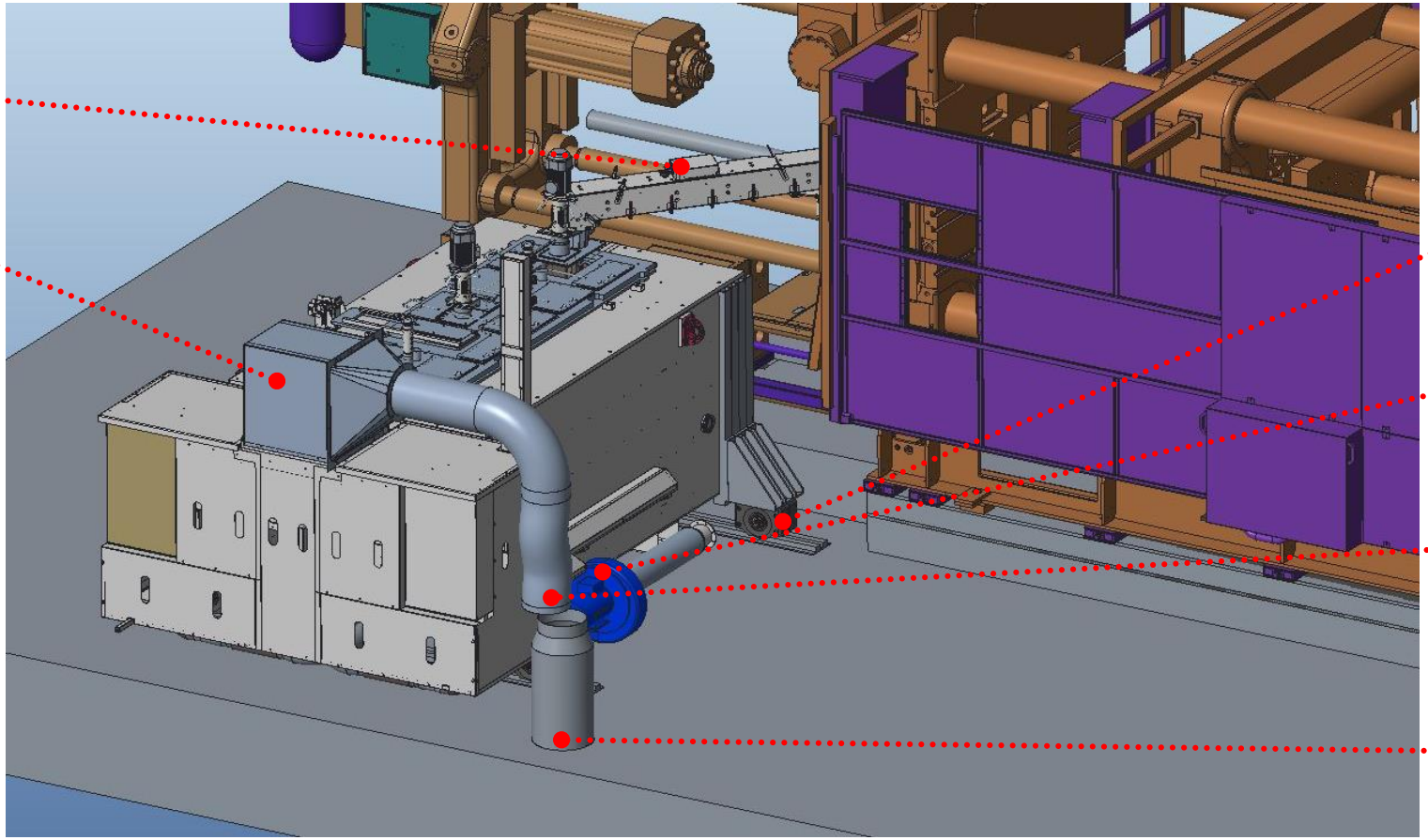
Output pipeline to the plant or over the roof

outlet: di > 15 mm (distance max. 100 m) max. flowrate: 2800 Nl/h
pressure: 0,5...1,0 barg (=7,25...14,5 psi)

5 | SHOT SLEEVE HEIGHTS AND LENGTH

5 | Overview Layout

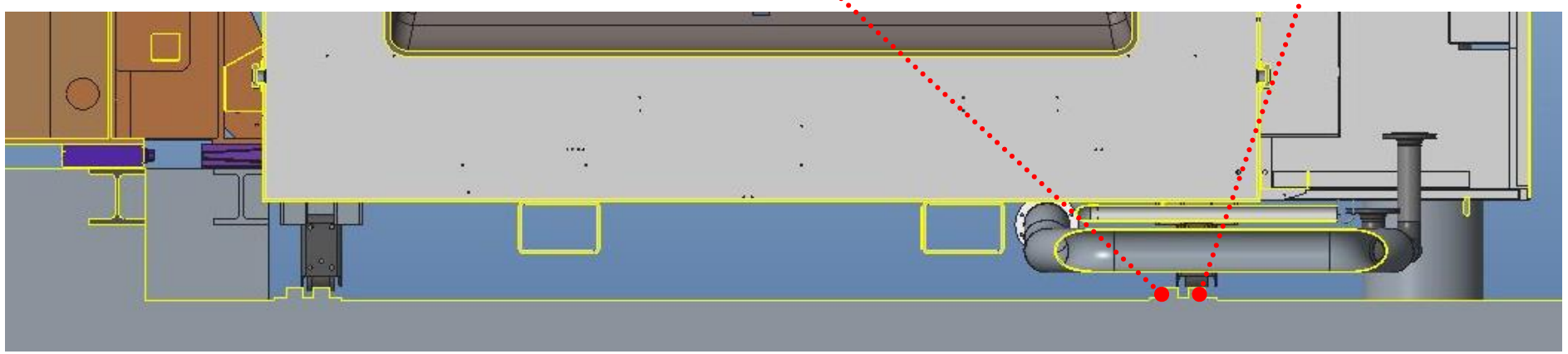
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4



5 | Overview different situation

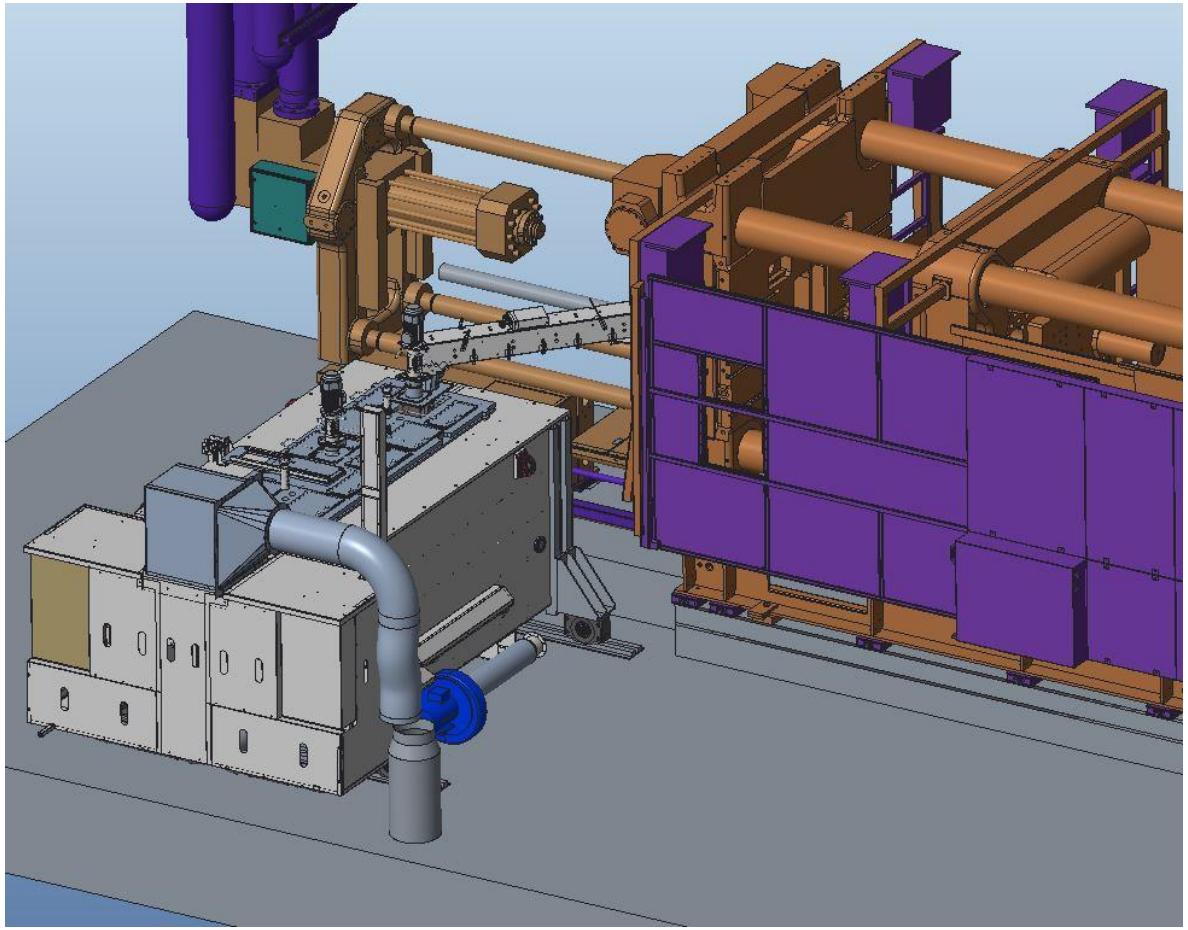
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

Shot sleeve height	312 mm Shot sleeve length		500mm Shot sleeve length	
0	Special nozzle (400mm shot sleeve)	0mm rails	Standard nozzle	+100mm rails
-150	Longer nozzle	0mm rails	Standard nozzle	+100mm rails
-560	Longer nozzle	0mm rails	Standard nozzle	+100mm rails



5 | Overview -560mm

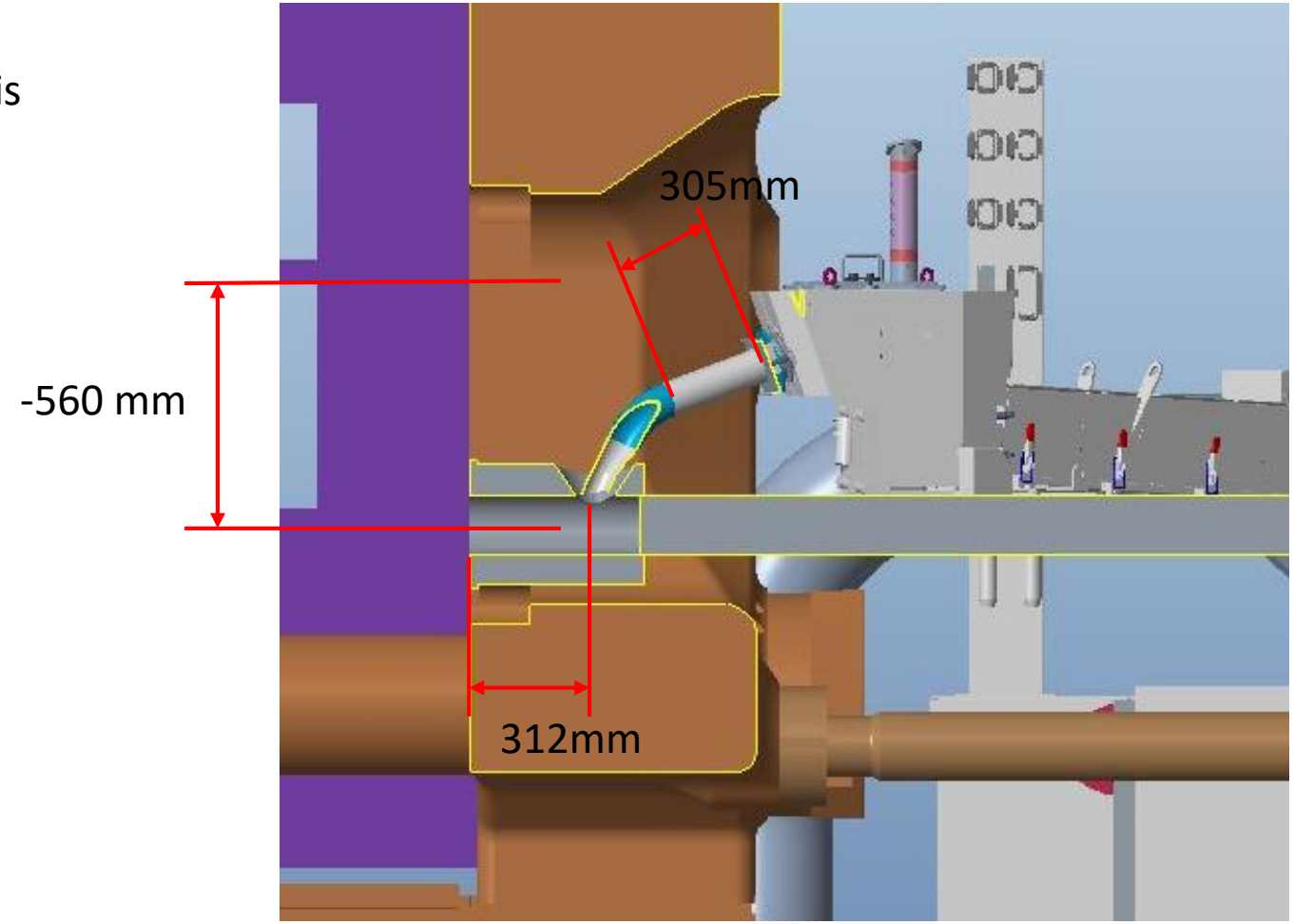
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4



5 | Detail shot sleeve situation -560mm and filling hole 312mm (rails 0mm)

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

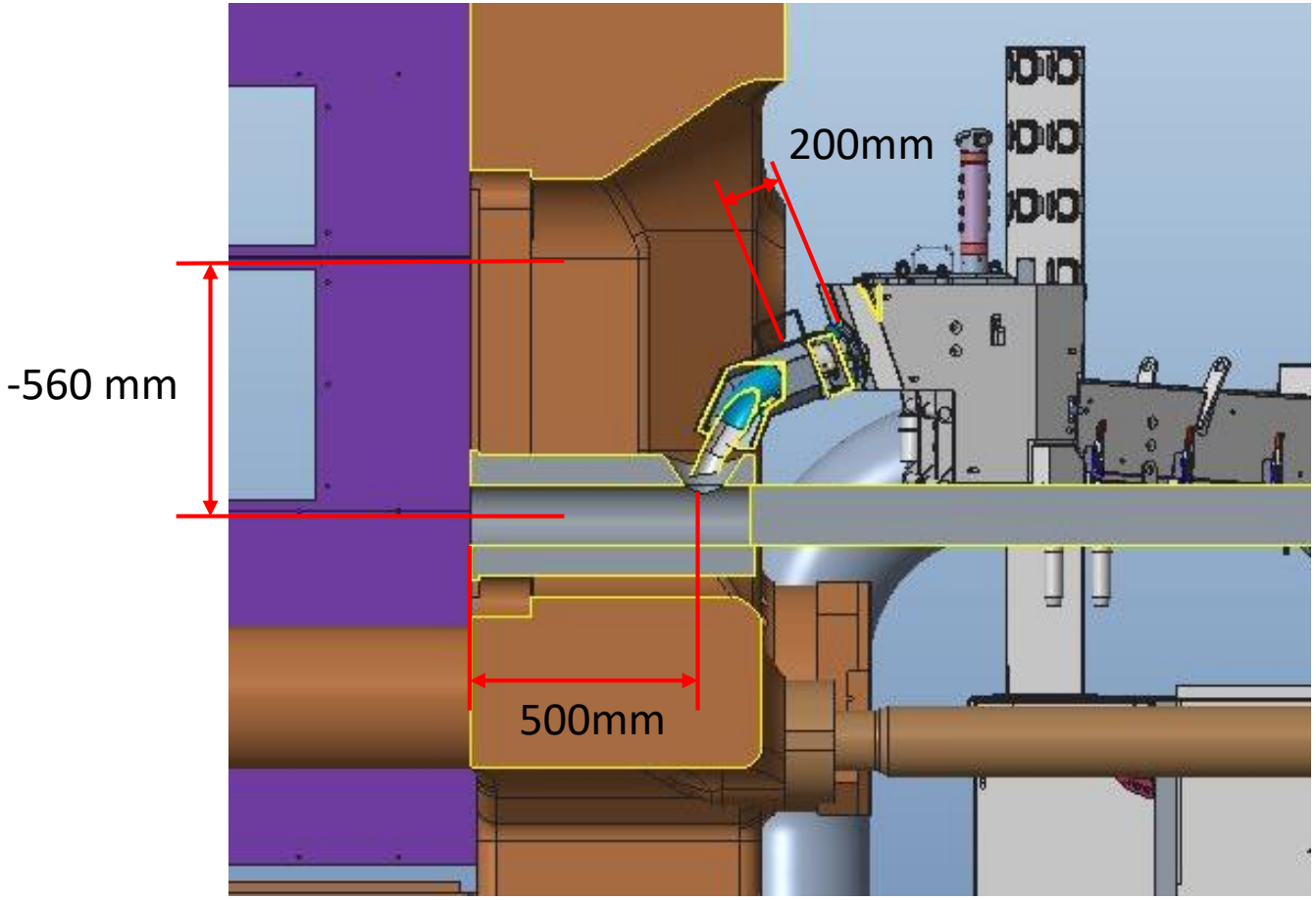
Nozzle longer length. Heating is not shown in the picture:



5 | Detail shot sleeve situation -560mm and filling hole 500mm (rails +100mm)

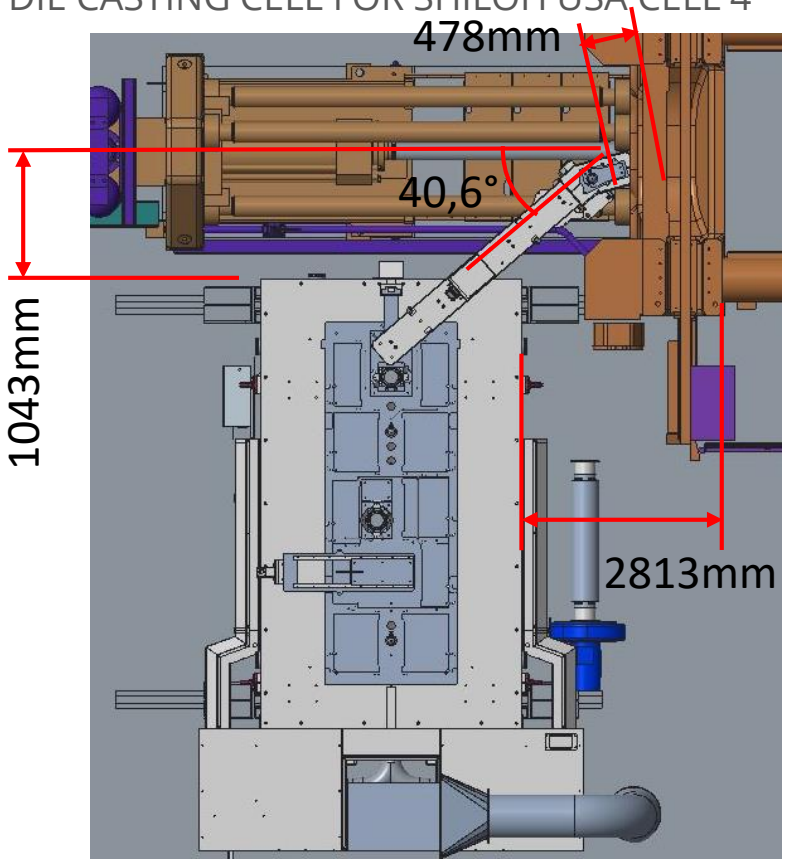
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

Nozzle in standard length:

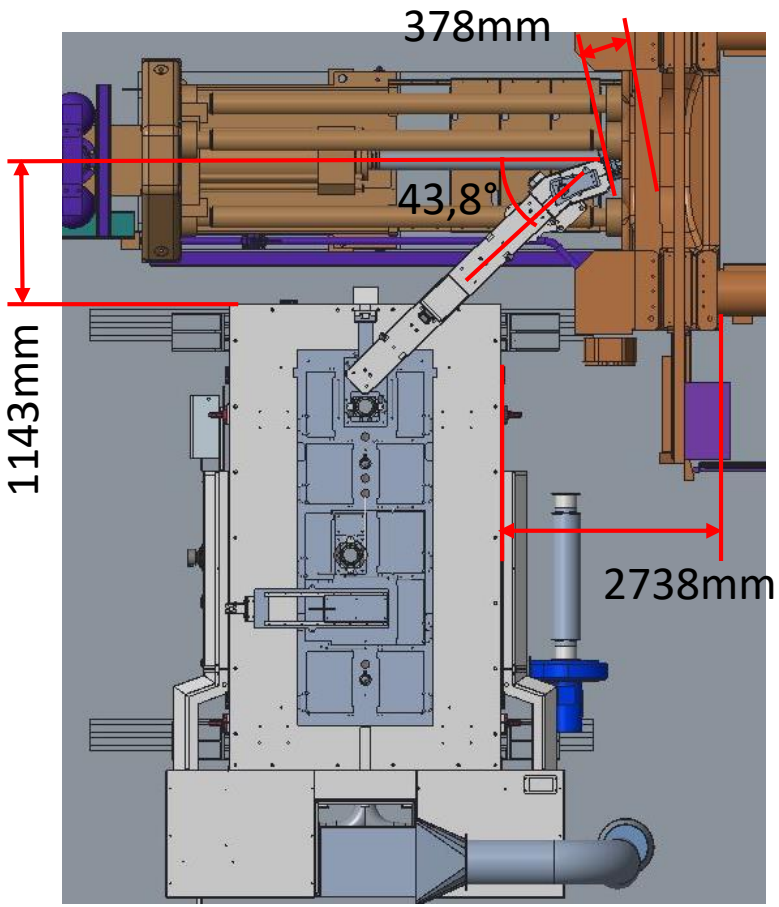


5 | Top view shot sleeve situation -560mm

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4



Shot sleeve length: 312mm
Rails: 0mm

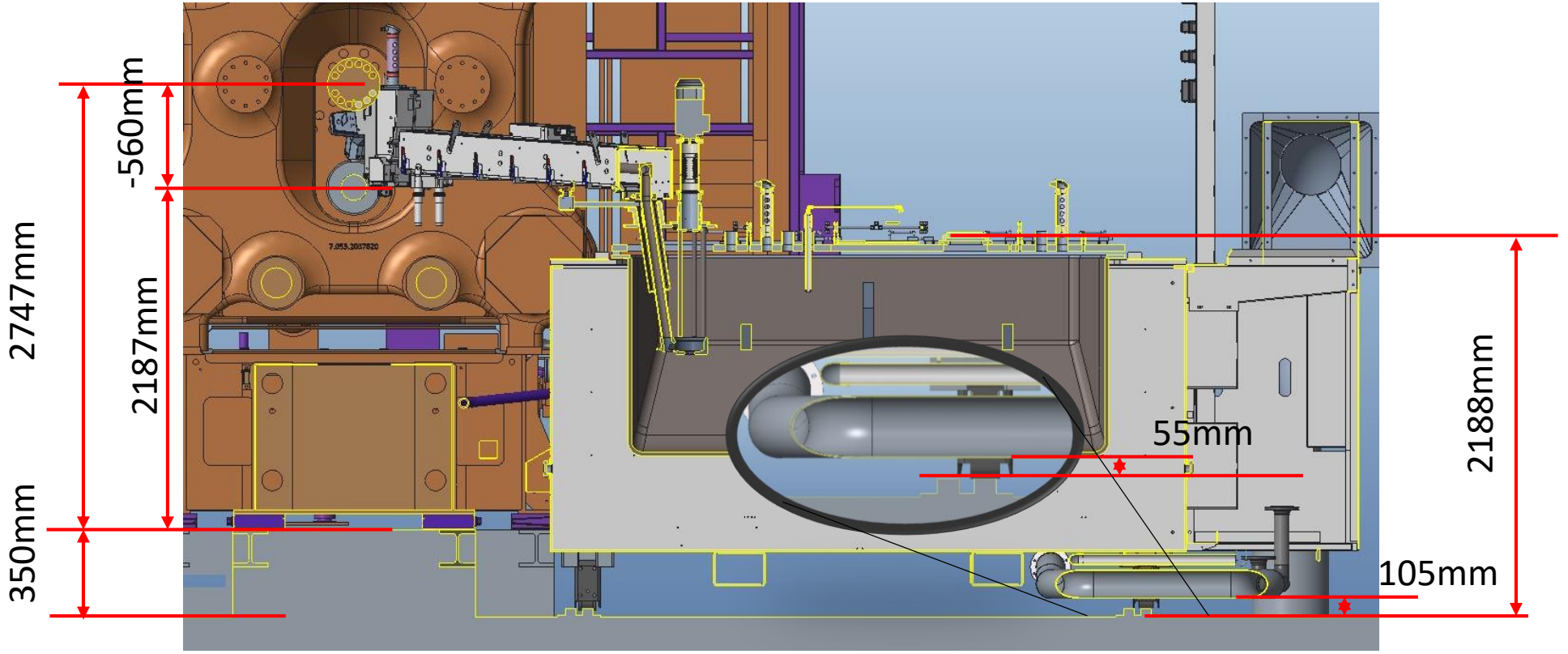


Shot sleeve length: 500mm
Rails: +100 mm

5 | Side view shot sleeve situation -560mm and filling hole 312/500mm

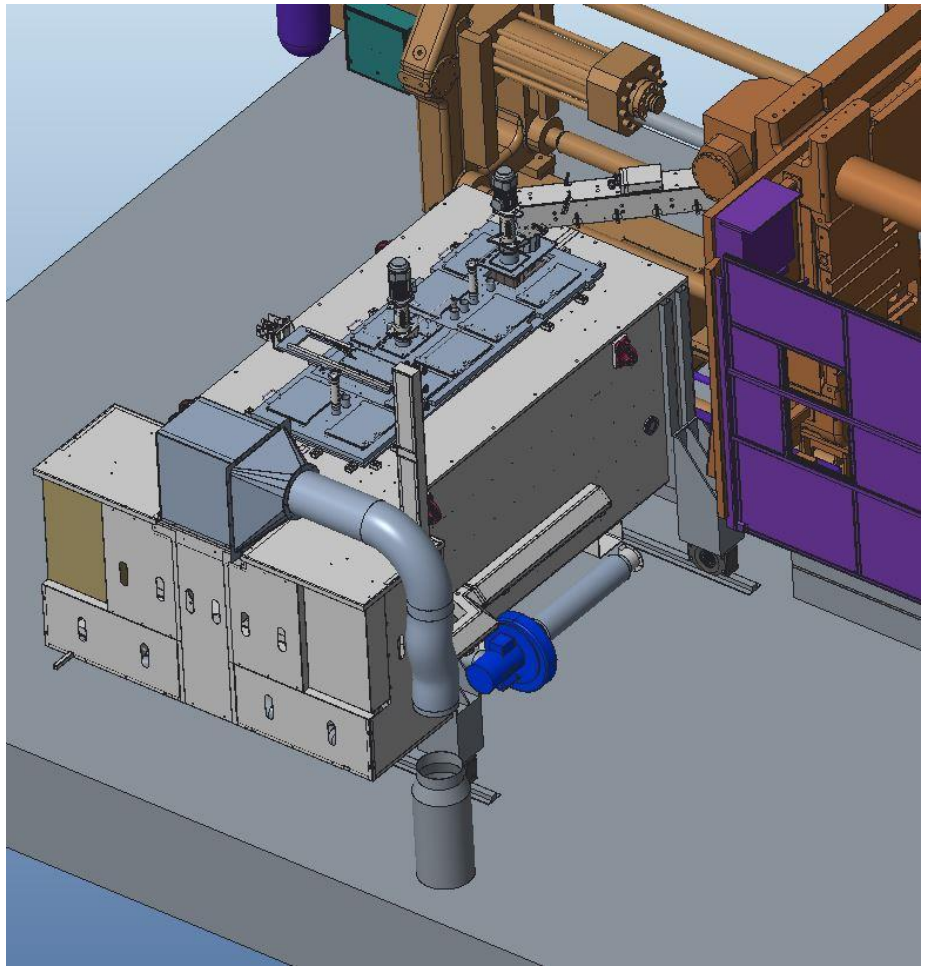
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

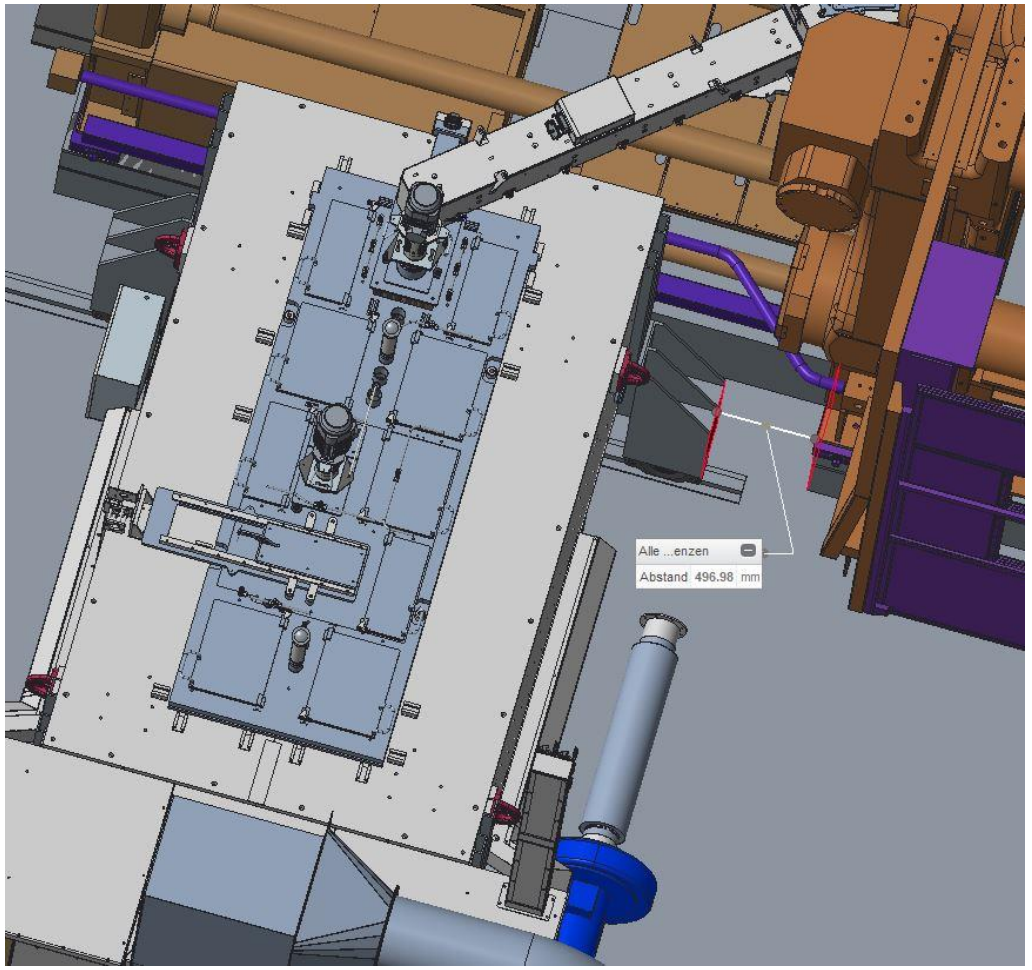
Shows the DCM on a 14” (350mm) concrete pad, which we need to reach all positions. The distance between pipe and rails will be about 55mm (~2”) at -580mm shot sleeve height:



5 | Overview -150mm

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

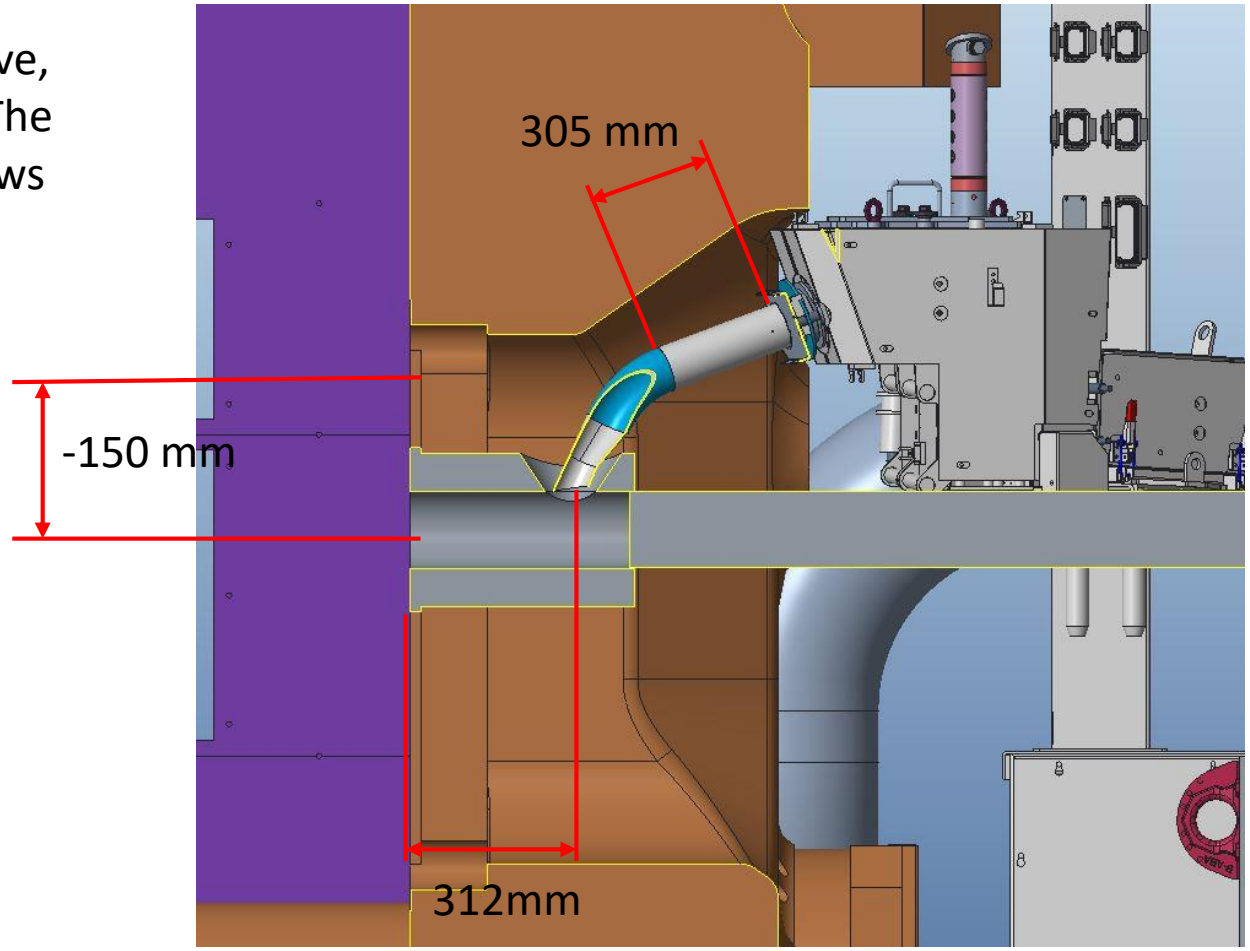




5 | Detail shot sleeve situation -150mm and filling hole 312mm (rails 0mm)

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

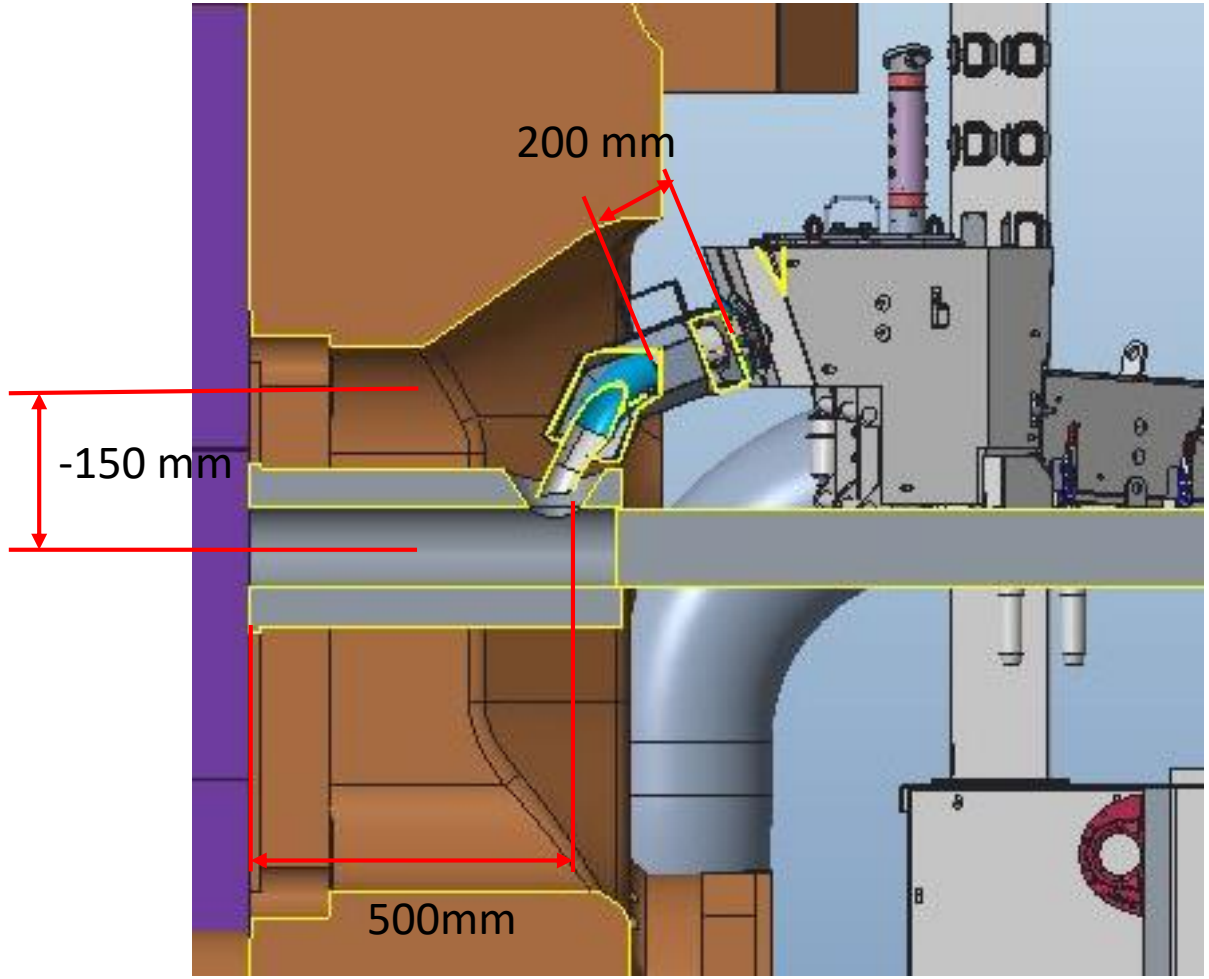
In position minus -150mm shot sleeve, the longer nozzle need to be used. The length of 312mm of shot sleeve shows only an example.



5 | Detail shot sleeve situation -150mm and filling hole 500mm (rails +100mm)

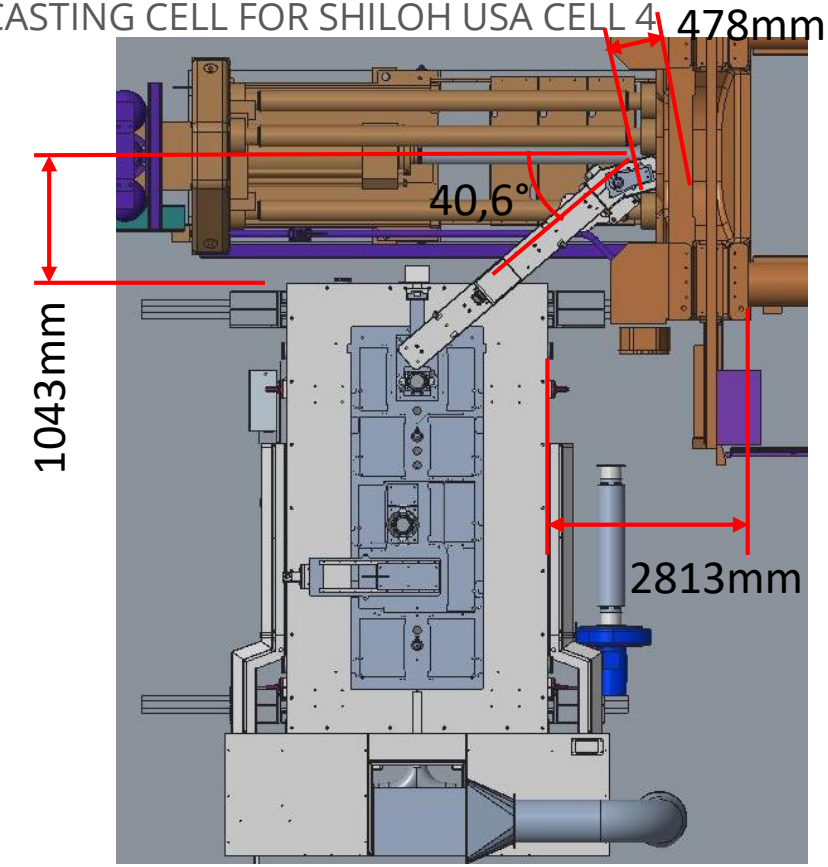
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

In position minus -150mm shot sleeve, the standard nozzle need to be used. The length of 500mm of shot sleeve shows only an example.

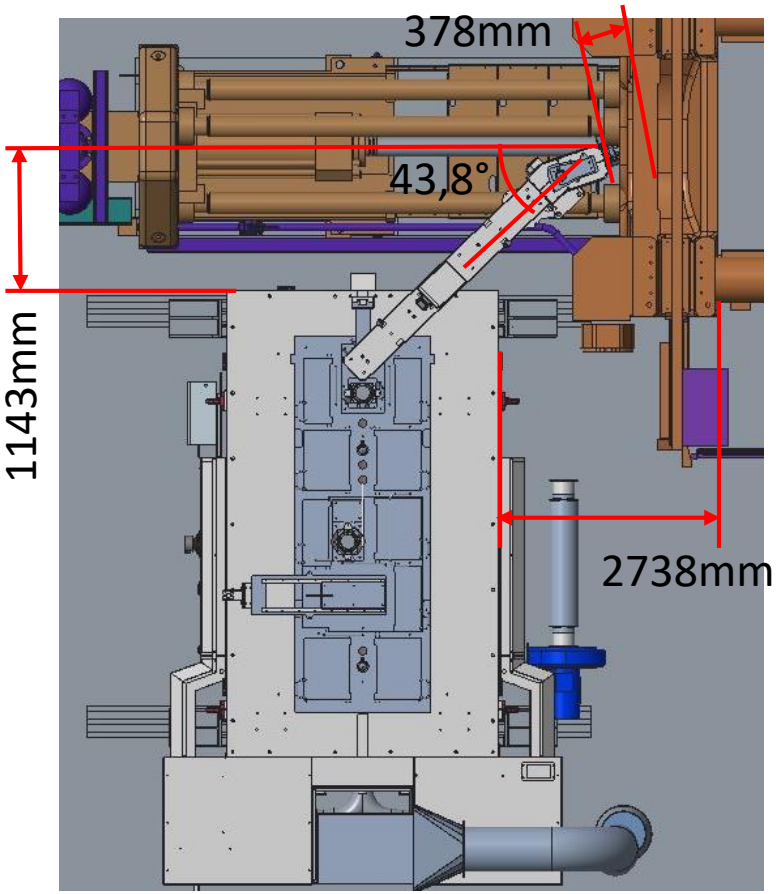


5 | Top view shot sleeve situation -150mm

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4



Shot sleeve length: 312mm
Rails: 0mm

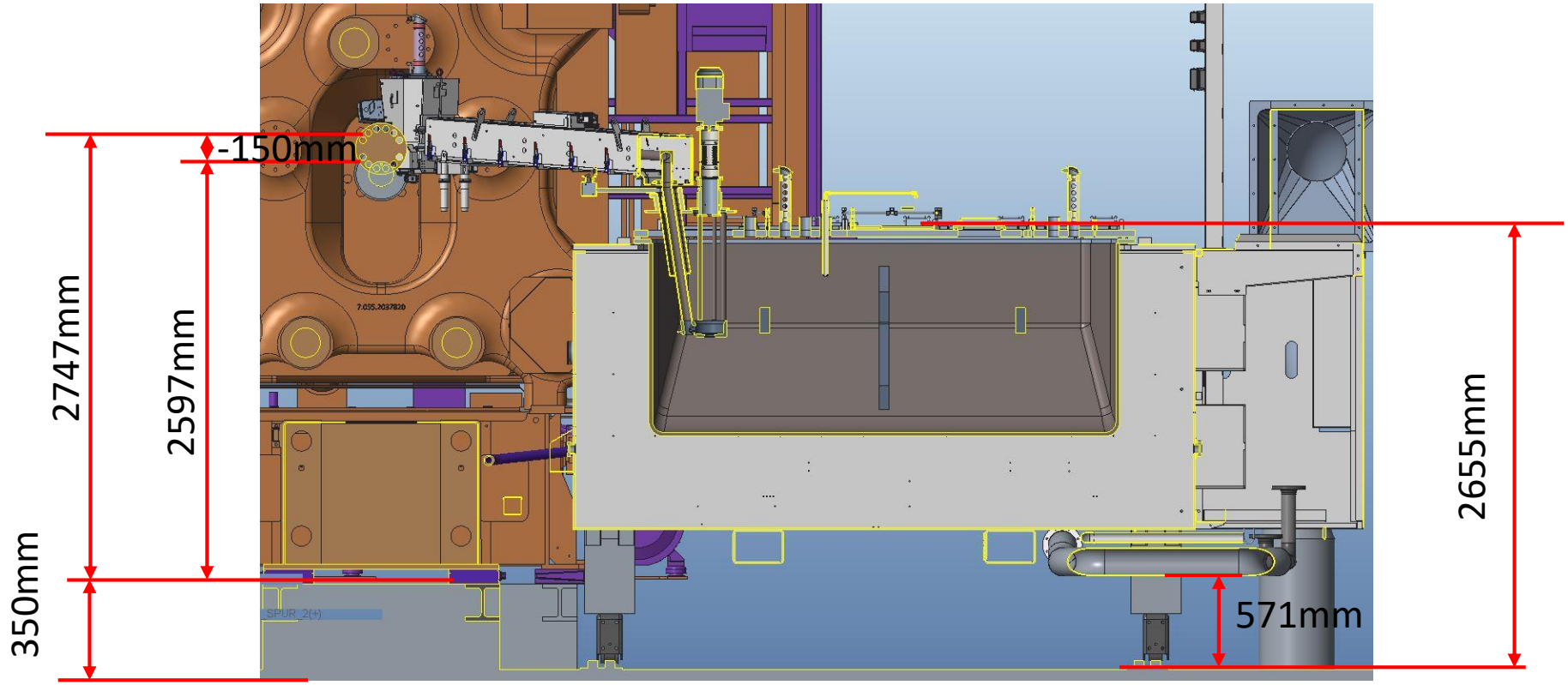


Shot sleeve length: 500mm
Rails: +100 mm

5 | Side view shot sleeve situation -150mm and filling hole 312/500mm

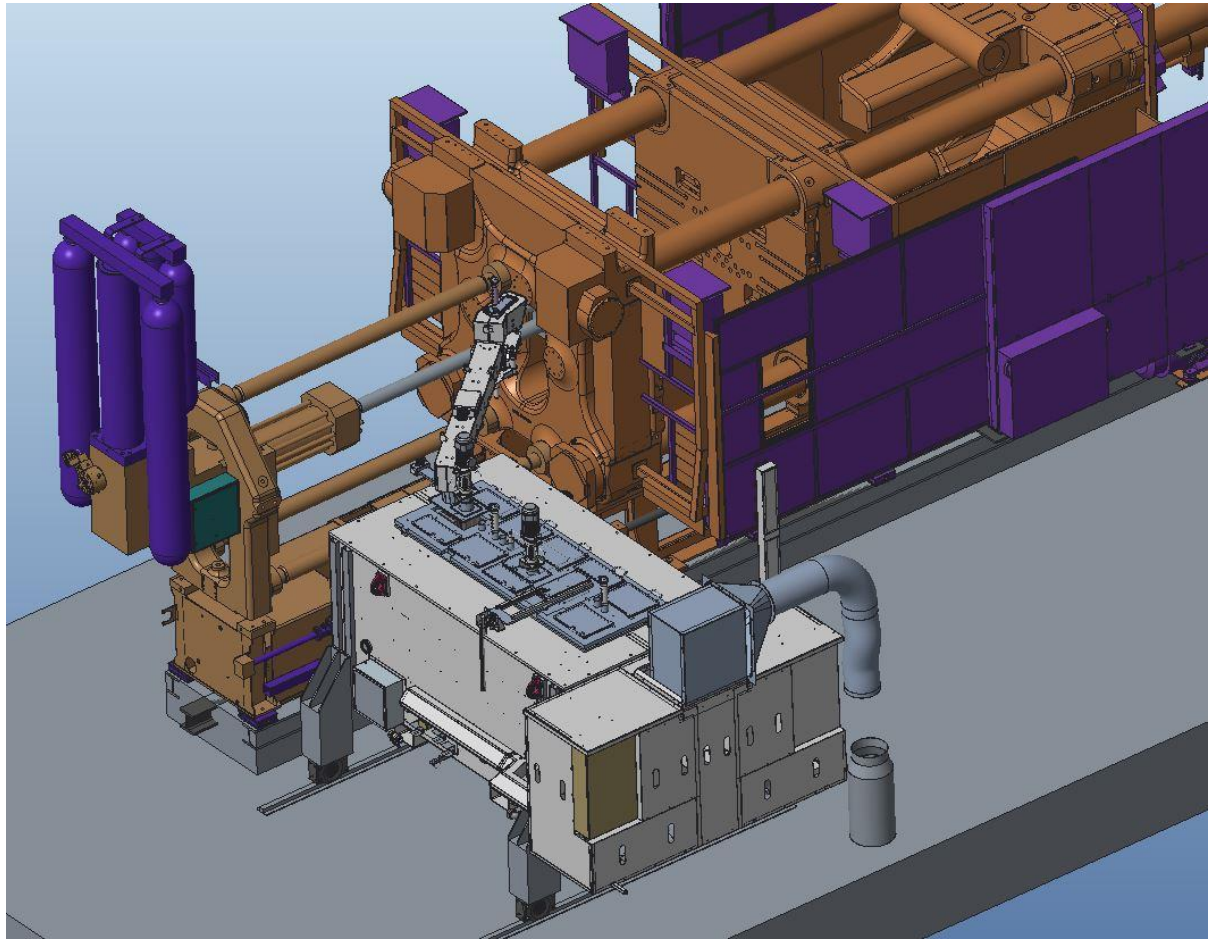
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

Shows the DCM on a 14” (350mm) concrete pad, which we need to reach all positions.



5 | Overview 0mm

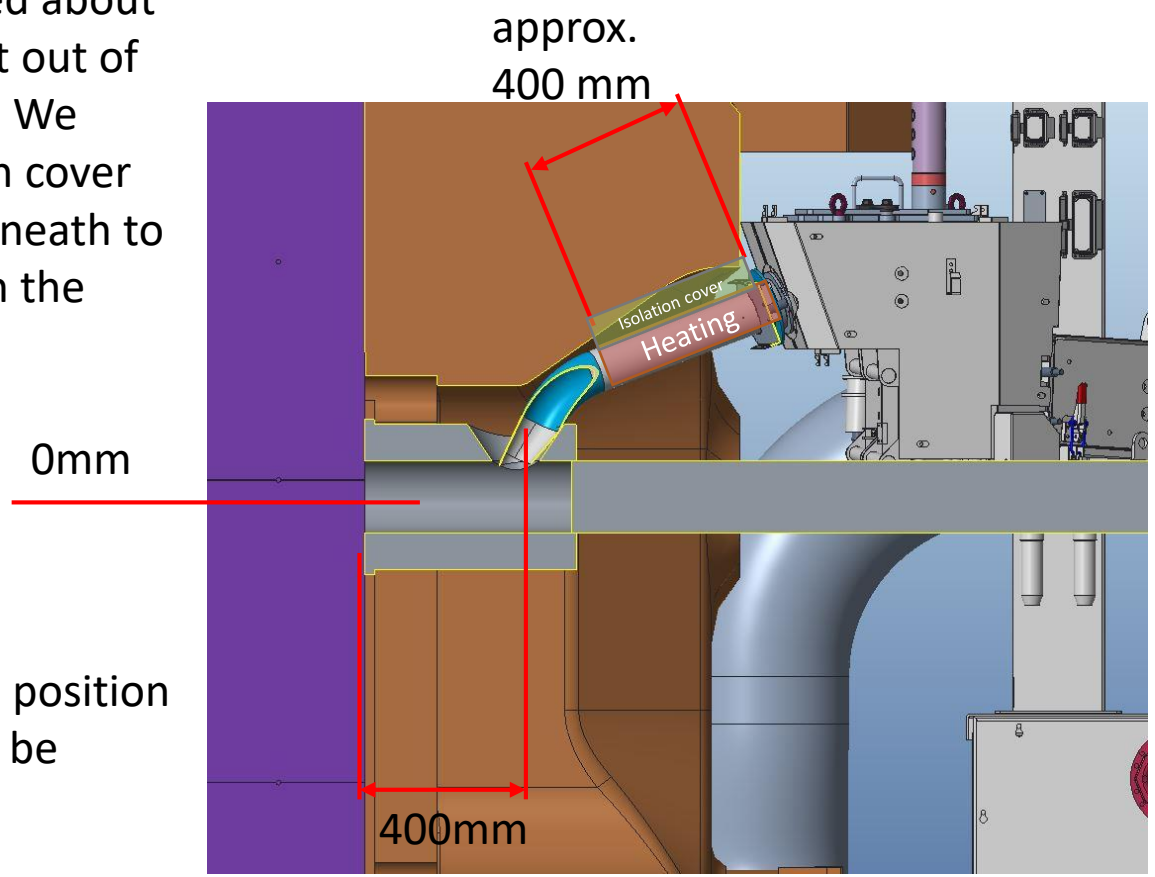
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4



5 | Detail shot sleeve situation 0mm and filling hole 400mm (rails 0mm)

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

In position 0 to -150mm shot sleeve, the nozzle needs to be extended about 212mm to move the dosing pot out of the fixed platen from the DCM. We need to use a flexible insulation cover on top and heating from underneath to avoid any sticking of material in the nozzle.



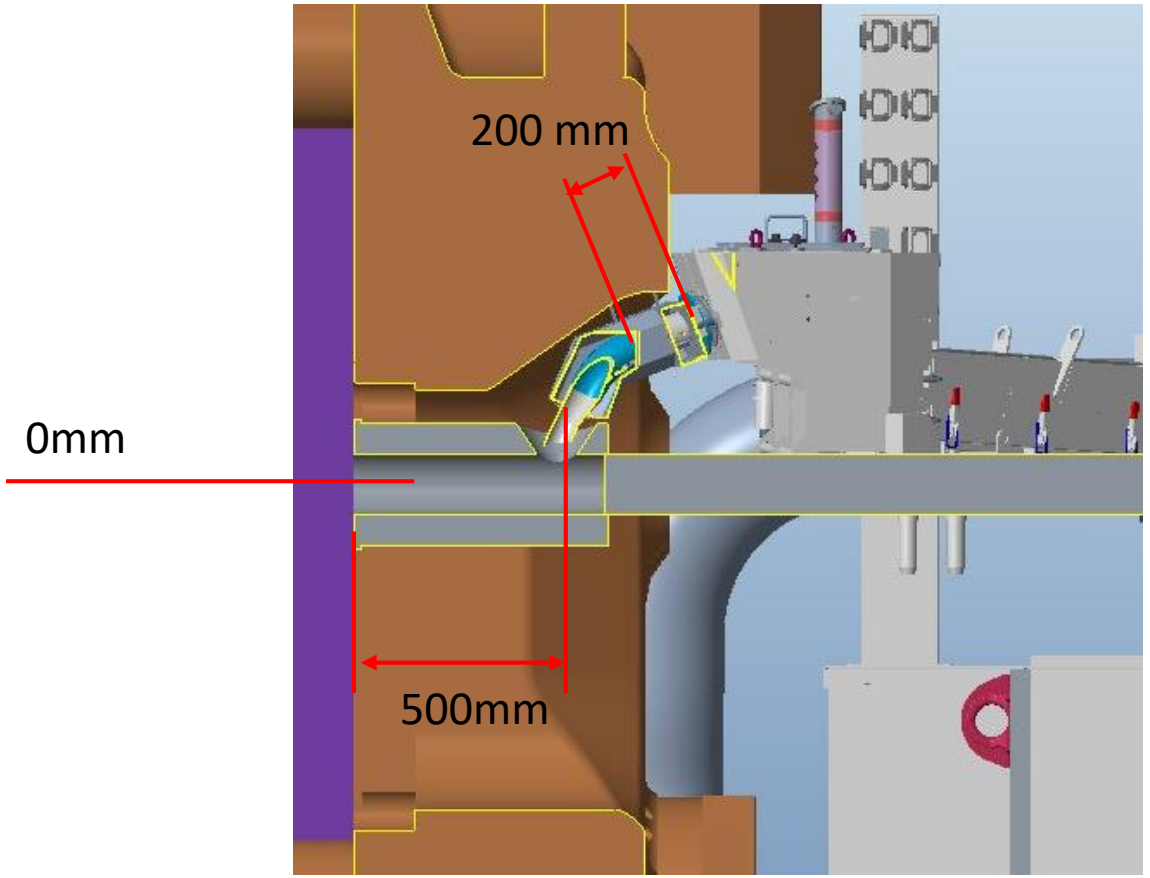
From our experience, the 0mm position is normally not used, but could be realized with this solution.

5 | Detail shot sleeve situation 0mm and filling hole 500mm (rails +100mm)

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

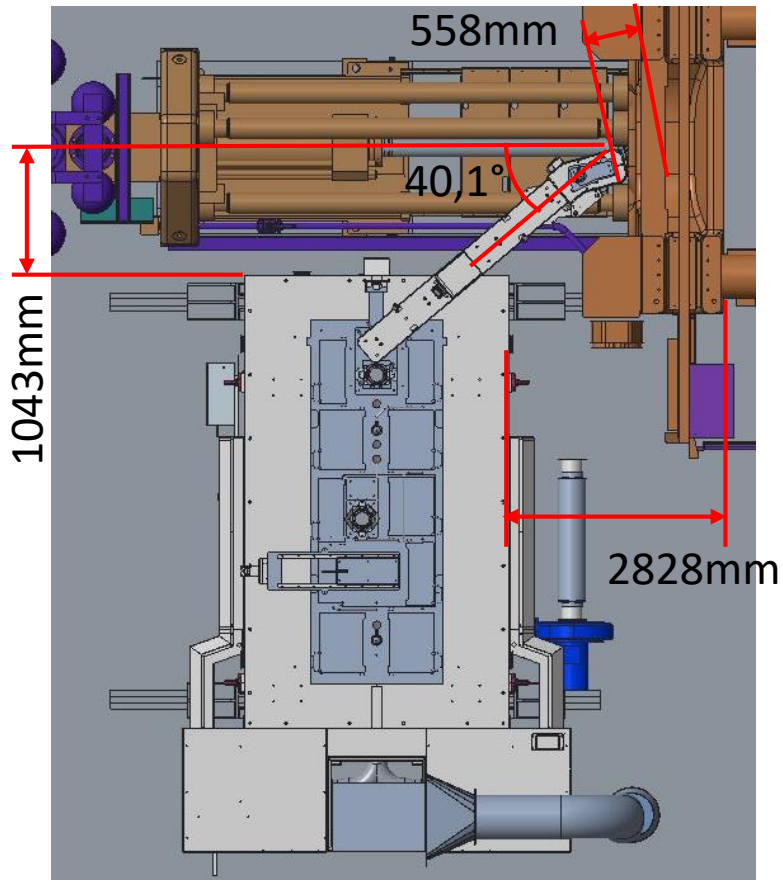
If the shot sleeve has a length of 500mm and the furnace will be placed parallel +100mm, also a standard nozzle can be used.

From our experience, the 0mm position is normally not used, but could be realized with this solution.

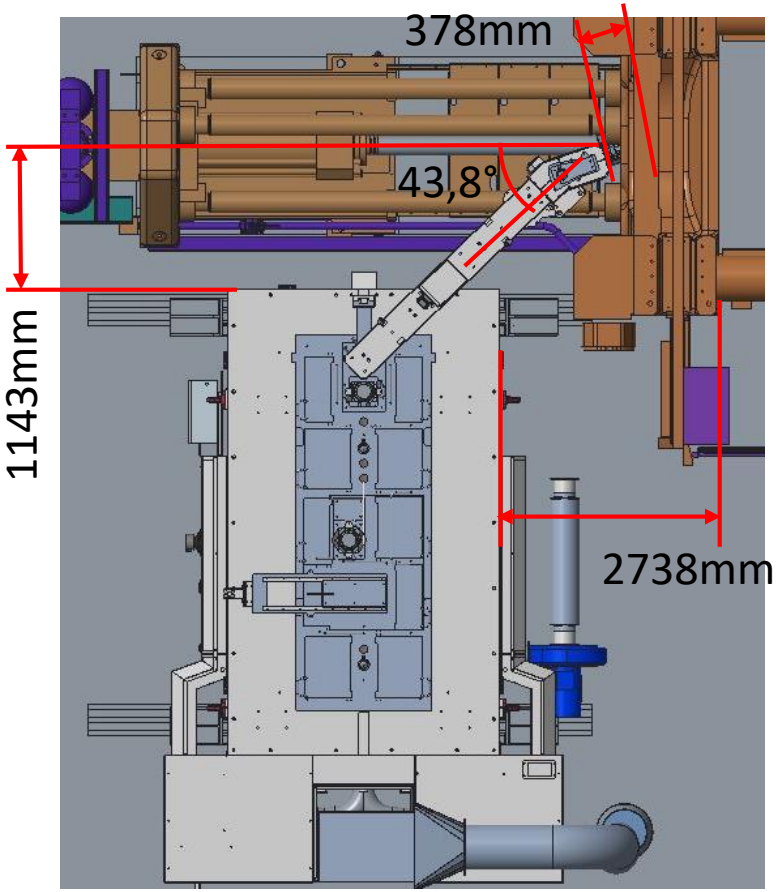


5 | Top view shot sleeve situation 0mm

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4



Shot sleeve length: 312mm
Rails: 0mm

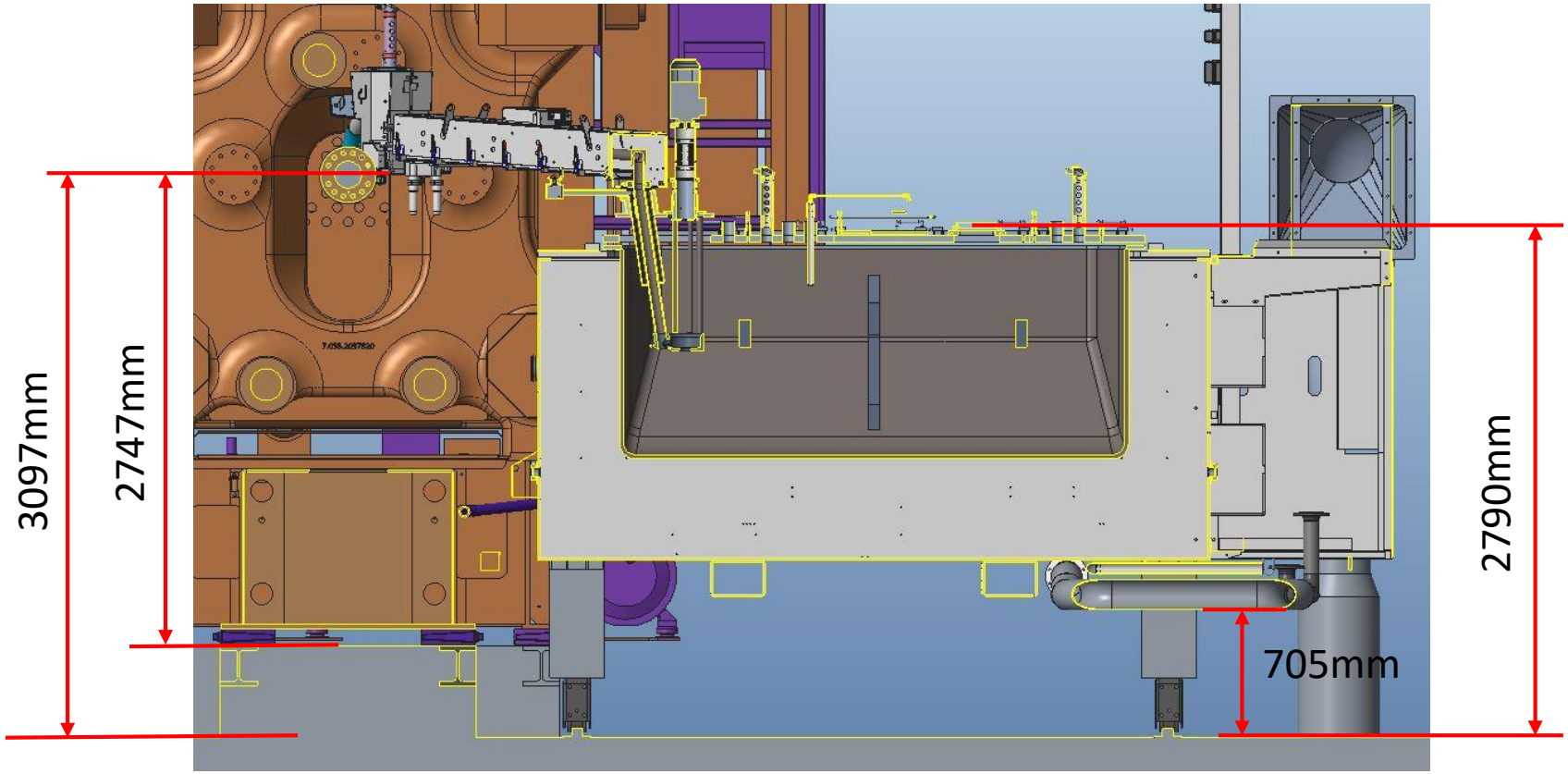


Shot sleeve length: 500mm
Rails: +100 mm

5 | Side view shot sleeve situation 0mm and filling hole 312/500mm

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

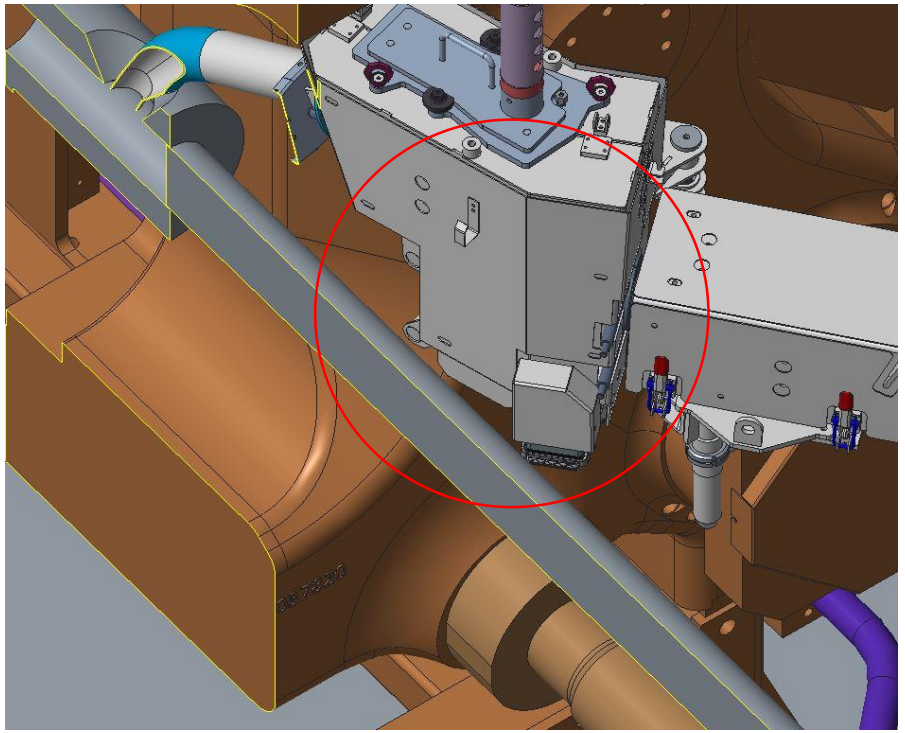
Shows the DCM on a 14” (350mm) concrete pad, which we need to reach all positions.



5 | Plunger situation / Shot sleeve dimension

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

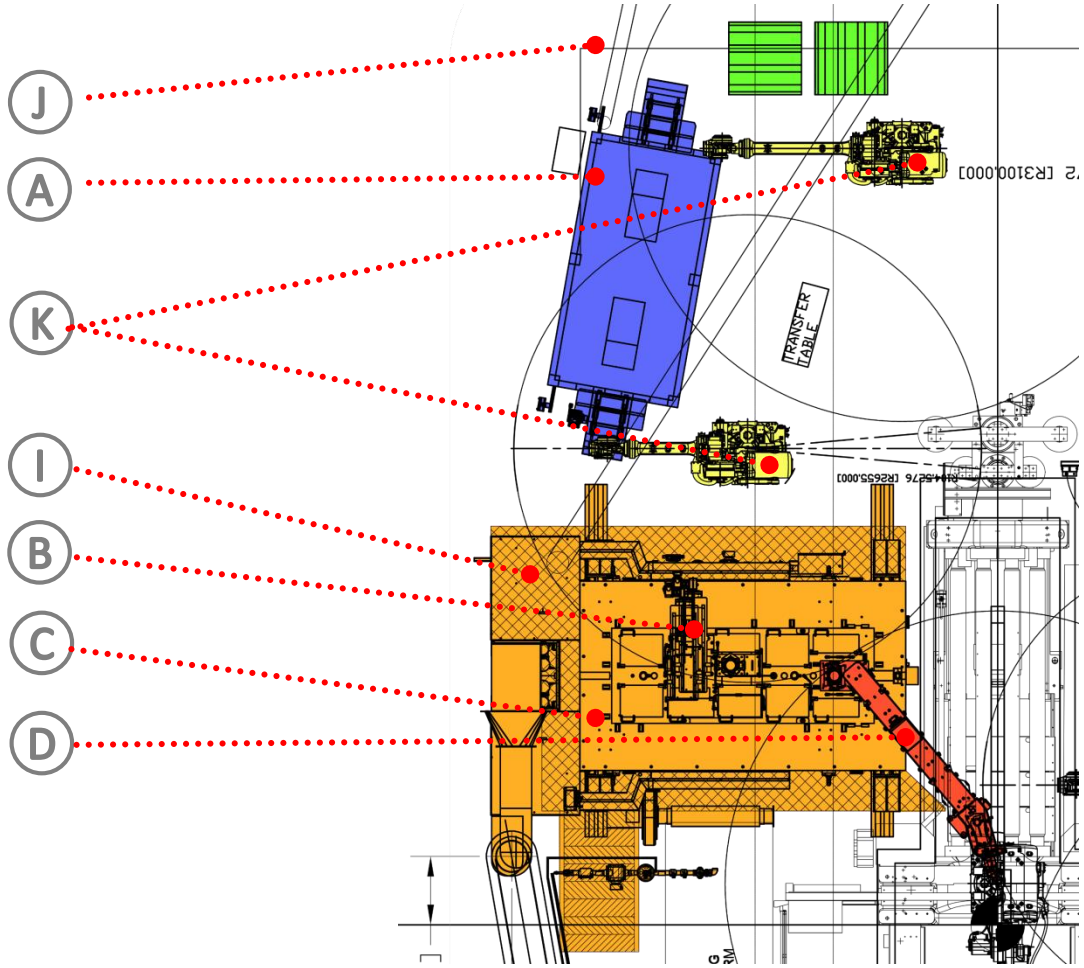
- The rail situation gives us a good position at plunger and ADSL distance. Due to the missing shot sleeve and plunger dimension, the furnace need to be adjusted in detail later on.
- Please note: For maintenance work (as example heating exchange) in the front end of the ADSL, the plunger need be removed



6 | PREPARATIONS LIST

6 | Layout Overview

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4



Pos.	Shiloh Installation
A	MVE1200E Prewarming station electrical
B	Sliding duct
C	MDO1100R Magnesium dosing furnace gas fired
D	ADSL
E	Switch cabinet MVE Position not fixed yet
F	Switch cabinet MDO Position not fixed yet
G	Gas mixing unit Position not fixed yet
H	GZE - Gas distribution panel Position not fixed yet
I	Operator platform (not in scope of supply)
J	Safety fence (not in scope of supply)
K	Robots for the ingots (not in scope of supply)

6 | Electrical supply

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

- The electric mains for the equipment via the provided transformer must be installed and should be specified according to enclosed data sheet
- Pay attention to clockwise rotating field at main supply!
- Please note that a gound fault circuit interrupter in the main supply can not be used and would occur interruptions (please use an isolated transformer in this case)
- Rauch delivery two transformer (MDO/MVE), where the wiring need to be done to the transformer and from the transformer to the switch cabinet
- The Transfomer position is not fixed yet!
- Supply of the gas mixing unit need to be from the top at the gas mixing unit. Position not fixed yet!

Supply terminal block

6 | Electrical

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

power supply connection point:

- MDO cabinet from the bottom
- MVE cabinet from the bottom

Network cable for internet connection for teleservice:

- MDO
- MVE

6 | Electrical supply

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

Supply on main switch cabinet	Electrical supply to MVE1200E	Electrical supply to MVE1200E	Electrical supply to MDO1100R	Electrical supply to MDO1100R	Electrical supply to gas mixing unit
Voltage before transformer	3 x 480 VAC / with earth, with neutral	-	3 x 480 VAC / with earth, with neutral	-	-
Voltage after transformer	3 x 400 VAC / with earth, with neutal	1 x 120VAC	3 x 400 VAC / with earth, with neutal	1 x 120VAC	1 x 120 VAC / with earth, with neutal
Voltage tolerance	± 10 %	± 10 %	± 10 %	± 10 %	± 10 %
Connection power	150kW	1,5kW	40kW	1,5kW	3kW
Pre-fuse	250A	10A	80A	10A	25A
Core cross section**	5 (4) x 250 kcmil	3x according national regulation	5 (4) x AWG 3	3x according national regulation	3x according national regulation
Frequency	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz
Control voltage	120 VAC / 24 VDC	120 VAC / 24 VDC	120 VAC / 24 VDC	120 VAC / 24 VDC	120 VAC / 24 VDC
Supply net standard after transfomer*	TN-S-Net	TN-S-Net	TN-S-Net	TN-S-Net	TN-S-Net

*Detailed information: http://en.wikipedia.org/wiki/Earthing_system

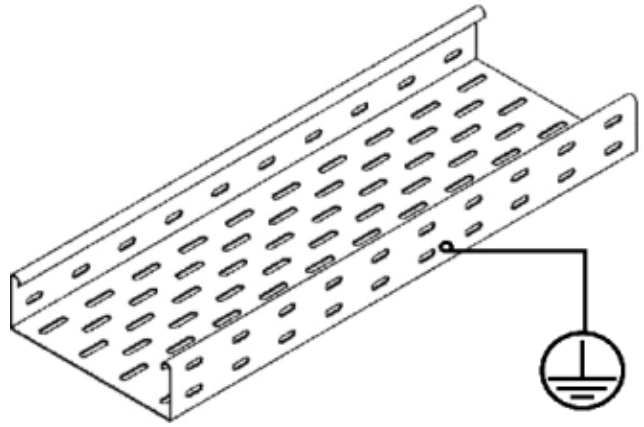
** The core cross-section of the cable should be related in accordance to the pre-fuse and the national rules

6 | Electrical supply – Cable route (not in scope of supply)

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

Cable route (not in scope of supply):

- The cable route between switch cabinet and equipment has to be prepared according to the layout.
- For longer cable connections, a sufficient tray must be prepared (e.g. through cable tray).
- Cable ways which can be in contact with splashing Mg need to be covered by non flammable material.
- The metal cable trench need to be grounded.
- The cable trench need to be splitted in control & bus cable and power load cables, by means of a separation wall.



6 | Electrical supply – Cable route

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

Cable route:

- **MDO cabinet -> furnace**
- **MDO cabinet -> Gas distribution panel**
- **MDO cabinet -> DCM cabinet**
- **MDO cabinet -> MVE cabinet**
- **MDO cabinet -> Gas mixing unit**
- **MDO cabinet -> Control panel 1**
- **MDO cabinet -> Control panel 2**
- **MDO cabinet -> cabinet from the robots**
- **MVE cabinet -> prewarming unit**

6 | Electrical supply – Cable route / cable length

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

Main cabinet MDO <-> Gas distribution panel (GZE)	? m	? ft
Main cabinet MDO <-> Main cabinet MVE (preheating unit)	? m	? ft
Main cabinet MDO <-> Junction box at back end of furnace (MDO)	? m	? ft
Main cabinet MDO <-> HMI #1 (on platform)	? m	? ft
Main cabinet MDO <-> HMI #2 (on plant floor)	? m	? ft
Main cabinet MDO <-> Combustion blower	? m	? ft
Main cabinet MDO <-> Gas mixing cabinet	? m	? ft
Main cabinet MDO <-> cabinet from the robots	? m	? ft
Main cabinet MDO <-> DCM cabinet (Interface)	? m	? ft
Main cabinet MVE <-> MVE (preheating unit)	? m	? ft

- All cable lengths including extra length inside the cabinets, distances from floor to connection points, jumps between levels (plant floor, platform level) etc.
- Lengths between connection points (junction box furnace, cabinet on preheater) are always calculated for the worst case (to the farthest point).
- On the main furnace cabinets Rauch added 2 extra meters (7ft) to the farthest end of the cabinet.
- On the gas mixing cabinet, the cables enter on top, and then extra 13ft (4 meters) inside the gas mixing cabinet.

6 | Electrical interface

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

Interface cable from MDO cabinet to:

- DCM:
  - Interface (ComTech will prepare) – Dispo 35
- Robots:
  - interface cable to switch cabinets from the robots with PROFIsafe
- Gas mixing unit
  - Hardware interface cable to MDO switch cabinet for malfunction gas mixing unit
- Switch cabinet from the MVE
  - Hardware interface cable to MDO switch cabinet and emergency stop

6 | Electrical interface – DCM

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

VDMA-Einheitsblatt **June 2014**

	DISPO 035 – Bus interface between the high pressure metal die casting machine and metal feeding device	**VDMA 24496**

ICS 25.040.40; 25.120.30

Replaces
VDMA 24496:2012-03

6 | Medium supply

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

Nitrogen N2:
- Input pressure adjustable via regulator 6–9 bar
- Input filter 5 µm
- Connection at gas cabinet with ½" tube (flexible hose recommend)
- Supply should be guaranteed permanent! (Optionally automatic switch over station to emergency supply)

Argon Ar:
- Input pressure adjustable via regulator 6–9 bar
- Input filter 5 µm
- Connection at MDO with 12mm tube
- Supply should be guaranteed permanent! (Optionally automatic switch over station to emergency supply)

Sulphurhexafluoride SF6:
- 2 SF6 bottles
- Connection of bottles
- Thread W 21,80 x 1/14 according DIN 477 No. 6
- Bottle type
- Dimensions Ø max. 230 mm, height max. 1.200 mm

CAUTION: IN CASE OF SERIAL PRODUCTION, A SUFFICIENT QUANTITY OF SF6, CO2 AND N2 HAS TO BE PROVIDED!!!

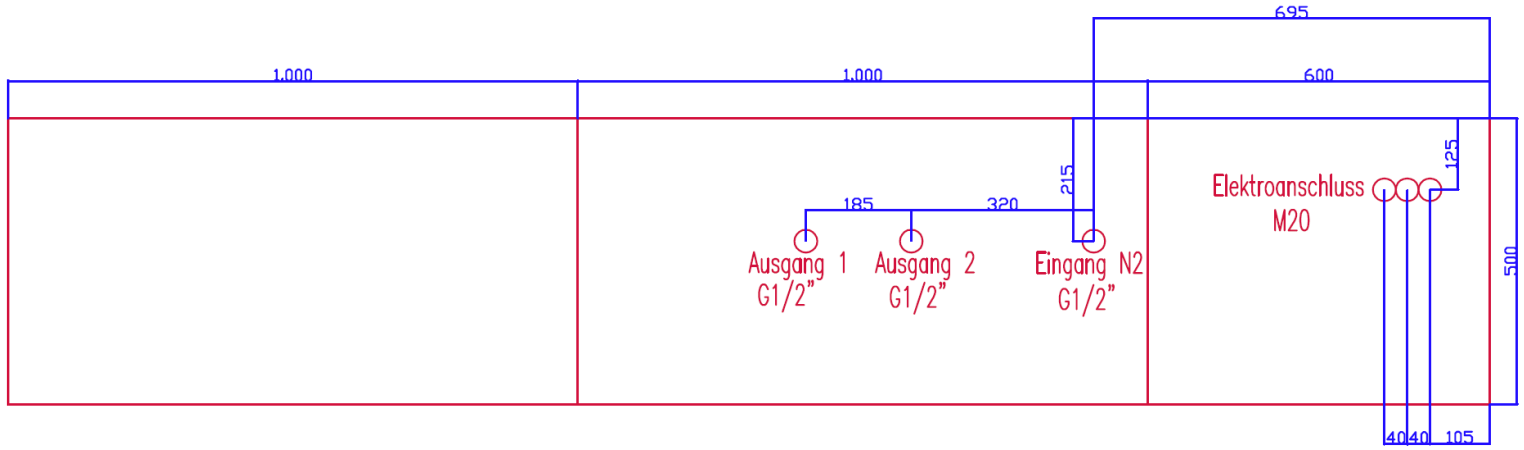
Gas Quality		
Gas	**Nitrogen N2**	**Sulphurhexafluoride SF6**
Quality	3.8	3.0
Specification	99,98 % N2	≥ 99,9 % SF6
Other gases	Max. 3 ppm O_2	Max. 500 ppm Air
	Max. 3 ppm H_2O	Max. 500 ppm CF4
	Max. 0,1 ppm CO	Max. 5 ppm H_2O
	Max. 0,1 ppm CO_2	
Notes	If above mentioned specifications are not fulfilled, excess corrosion of the crucible and forming of dross will occur! Our equipments are designed for use of gases N_2 ,SF_6 ,SO_2 in gas-phase only! Gas-bottles must be equipped with the gas-outlets for gas-phase medium – never use gases in liquid form!	

6 | gas mixing unit

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

Top connection on the gas mixing cabinet:

The height of the gas mixing cabinet is 2000mm (78,7”). To have a fast fix connection at gas mixing unit, it would be helpful to make the last 40” as flexible hose. This could work also as compensator.



6 | protective gas supply

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

protective gas line from gas mixing unit to gas distribution panel (not in scope of supply)
The protective gas pipeline should be prepared nearby, because the exact position can be fixed after the positiong of the furnace

protective gas line from gas adding station to furnace (Rauch will provide hoses)
The hoses need to be covered by customer against Mg splashes

6 | Argon supply

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

Equipment	Ar consumption
MDO	2 Nl/h @ 5bar (g) or 6bar (a)
ADSL	90 Nl/h @ 5bar (g) or 6 bar (a)

Argon connection (not in scope of supply)

The Ar pipeline should be prepared nearby , because the exact position can be fixed after the positioning of the furnace

6 | compressed air supply
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

Compressed air connection (not in scope of supply)

Gas	Compressed air
Input pressure	Min. 6 bar (a) Max. 8 bar (a)
Quality	DIN ISO 8573-1
Specification	Particulate material class I 4
	Moisture content class 4
	Oil content class 4

Equipment	Air consumption
Prewarming station	??? l/h @ 5bar (g) or 6bar (a)

ISO 8573-1:2010	Dirt				Water		Oil
	Maximum number of particles per m³			Mass concentration mg/m³	Vapor pressure dewpoint	Liquid g/m³	Total oil (aerosol liquid and vapor) mg/m³
	0.1 - 0.5 micron	0.5 - 1 micron	1 - 5 micron				
0	As specified by the equipment user or supplier and more stringent than Class 1						
1	≤ 20000	≤ 400	≤ 10	-	≤ -70°C/-94°F	-	0.01
2	≤ 400000	≤ 6000	≤ 100	-	≤ -40°C/-40°F	-	0.1
3	-	≤ 90000	≤ 1000	-	≤ -20°C/-4°F	-	1
4	-	-	≤ 10000	-	≤ +3°C/+37.4°F	-	5
5	-	-	≤ 100000	-	≤ +7°C/+44.6°F	-	-
6	-	-	-	≤ 5	≤ +10°C/+50°F	-	-
7	-	-	-	5 - 10	-	≤ 0.5	-
8	-	-	-	-	-	0.5 - 5	-
9	-	-	-	-	-	5 - 10	-
X	-	-	-	> 10	-	> 10	> 10

6 | Natural gas layout

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

Connection point natural gas (not in scope of supply)
The natural gas pipeline should be prepared nearby, because the exact position can be fixed after the positioning of the furnace.
The supply line should have a stopcock outside of the building / hall (free accesses), which can be closed in emergency situation and need to be a point in the emergency / evacuation plan.

The hoses need to be covered by customer against Mg splashes from the top.

6 | burner parameter

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

Burner parameters MDO1100R	***Naturalgas*** 10 kWh/Nm³
Max gas consumption MDO	~86 Nm³/h
Input gas pressure MDO	Min. 100 mbar (g) / Max. 450 mbar (g)
Burner performance MDO (2x250kW + 2x180kW)	860 kW

Natural gas piping (not in scope of supply):
1x Purge output line (inside thread 1”) over the hall roof for overpressure of gas line

1x Gas supply line at MDO with a diameter of G 1”1/2 inside thread mounted. A free easily accessible stopcock outside of the building should be placed in the gas supply line.
Input pressure => min. 100mbar gaseous

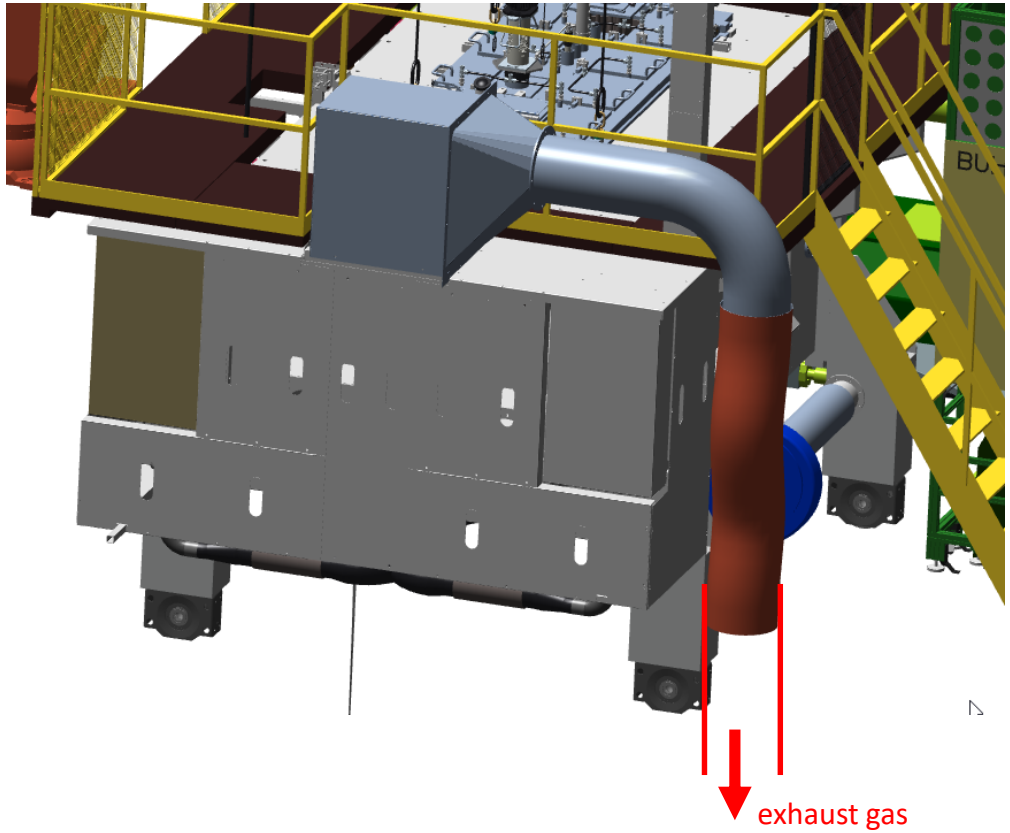
For safety regulation an overpressure control valve should be implemented in the gas supply line with a working range of 450 mbar.
All national rules for gas supply need to be observed!

6 | burner exhaust

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

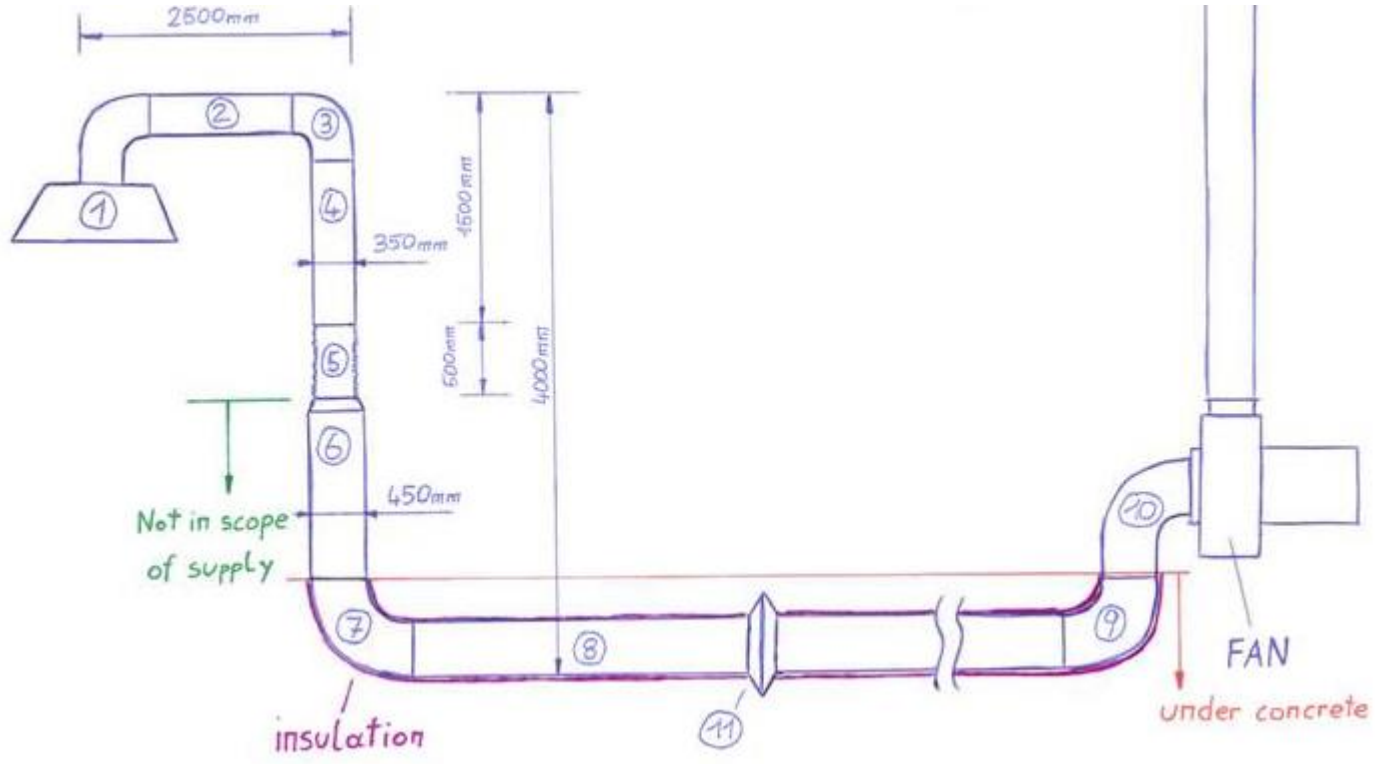
Exhaust gas	% at 200°C	*m³/h* at 200°C
CO2	1,75	154,44
H2O	5,19	458,17
N2	76,27	6733,12
O2	16,78	1481,34
∑	100	8828

- The flue gas on the end of the furnace chimney need to be transferred out of the hall. This extraction system (not in scope of supply) should consists of
  - Suction hood (to catch small movements of furnace)
  - Piping – dimension ∅450mm (∅ 18”) (not in scope of supply)
  - fan (not in scope of supply)
  - Chimney outside of the building (not in scope of supply)
- The exhaust gas would have a temperature under 200°C by reaching the exhaust system.



6 | burner exhaust

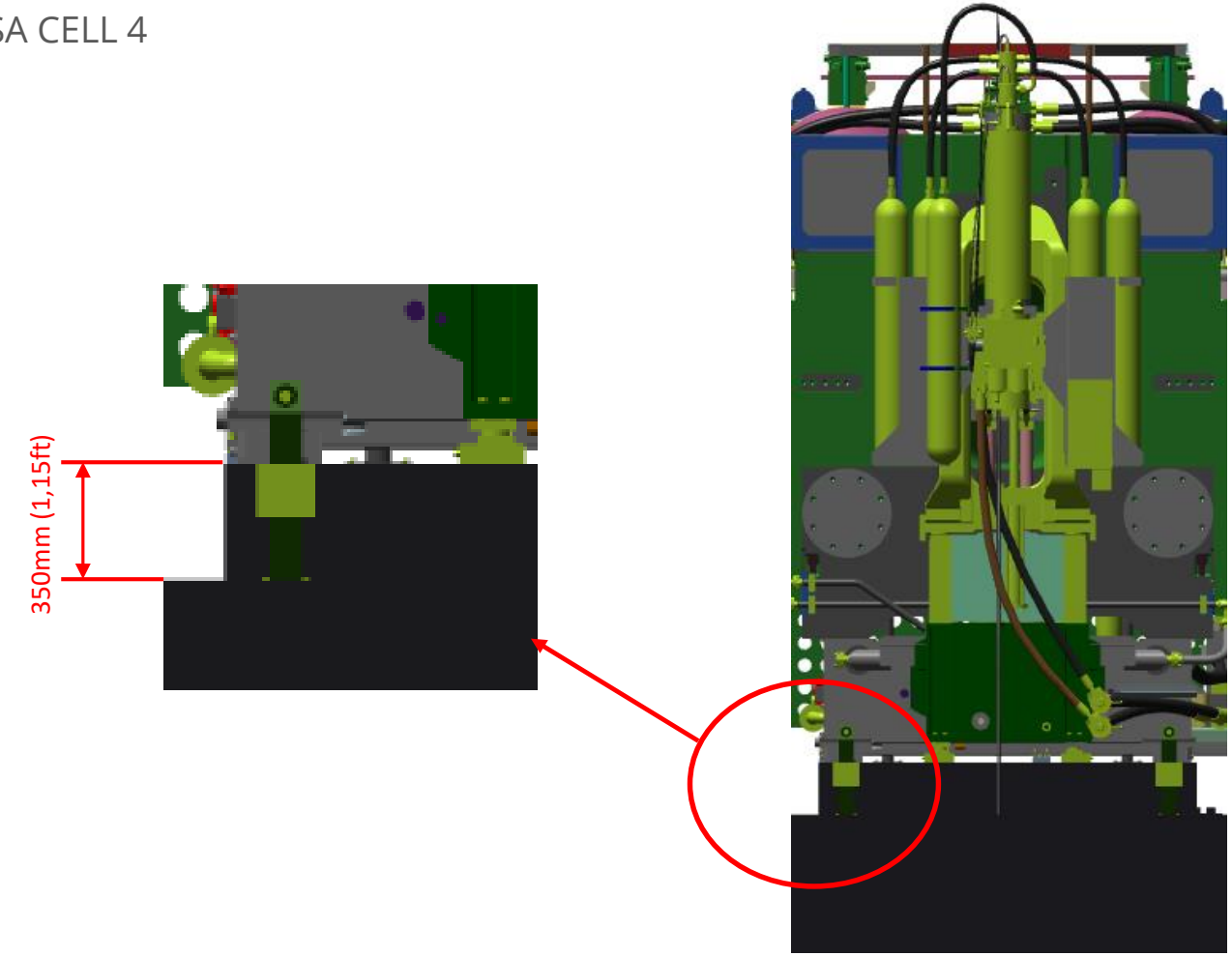
MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4



6 | sub construction DCM

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

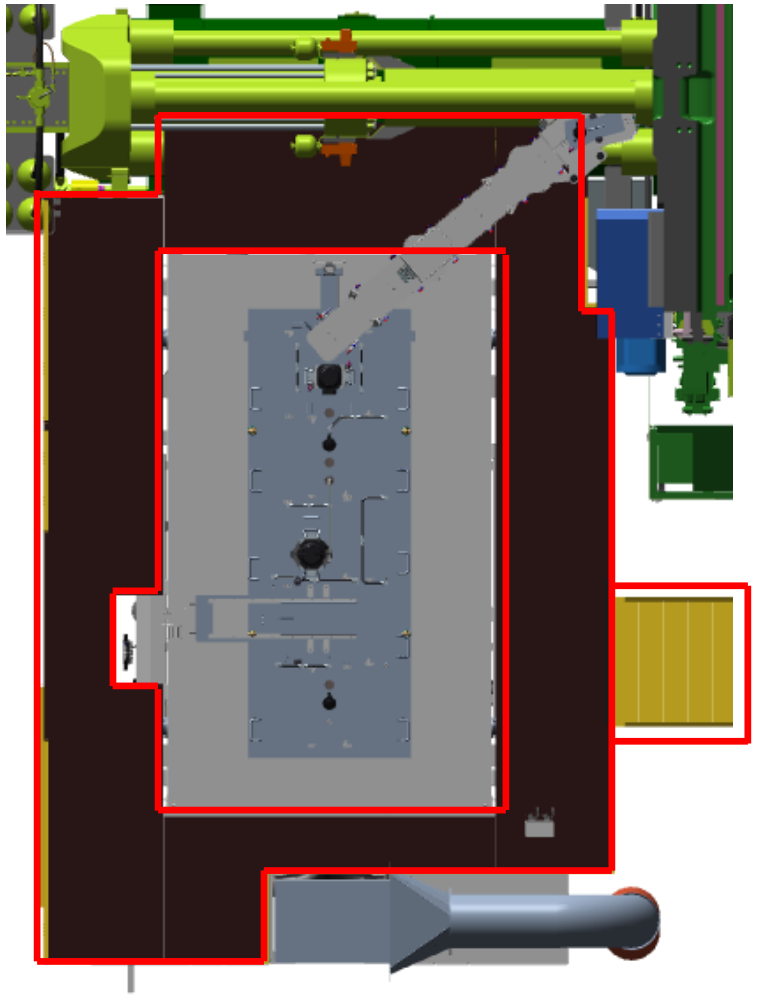
under the DCM have to be a 350mm high concrete pad, to reach all heights of the shot sleeve → as described under Point 5



6 | Operator platform

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

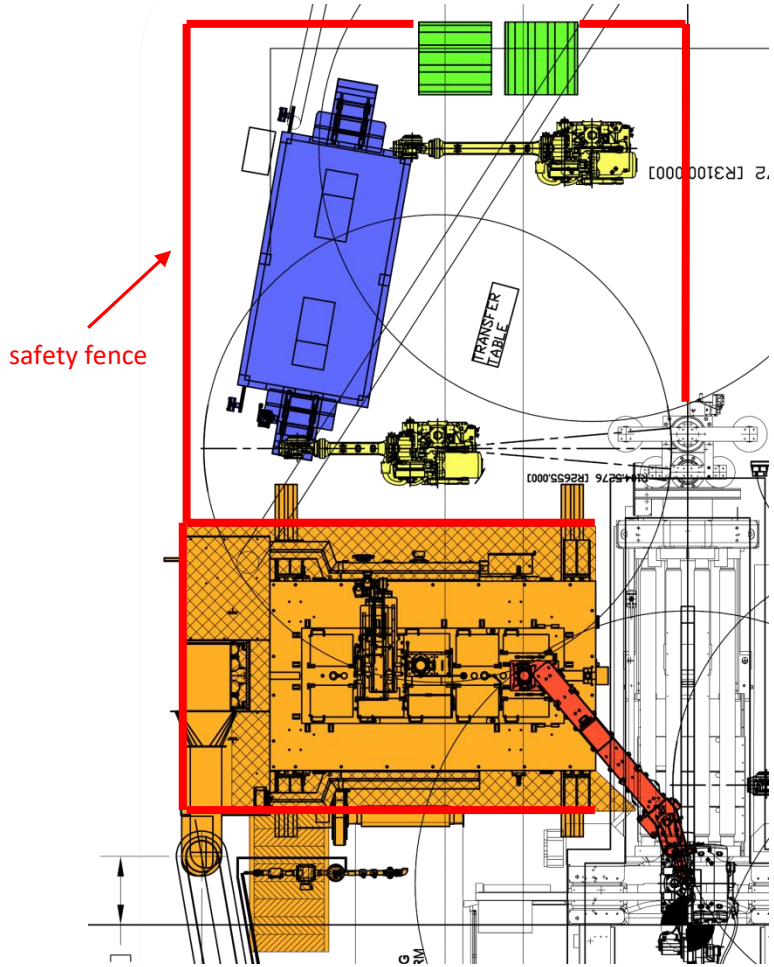
Operator platform (not in scope of supply) would be an suggestion and can vary to national rules and onsite situation.
The platform should be fixed on the furnace in order to move with the furnace. Therefore the platform doesn’t have to be rebuilt when moving to another shot sleeve position.
A drawing proposal from our side will offered to Shiloh.



6 | safety fence

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

Safety fence (not in scope of supply) need to be mounted around the MVE and the robots. The area need to be provided with a safety entrance door, which need to have an electric lock out interface to avoid any movement of the robots.



6 | required lifting points

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

for positioning and height adjusting of the furnace

(min. lifting height: 1000mm (39,37 inch)

for handling of the crucible

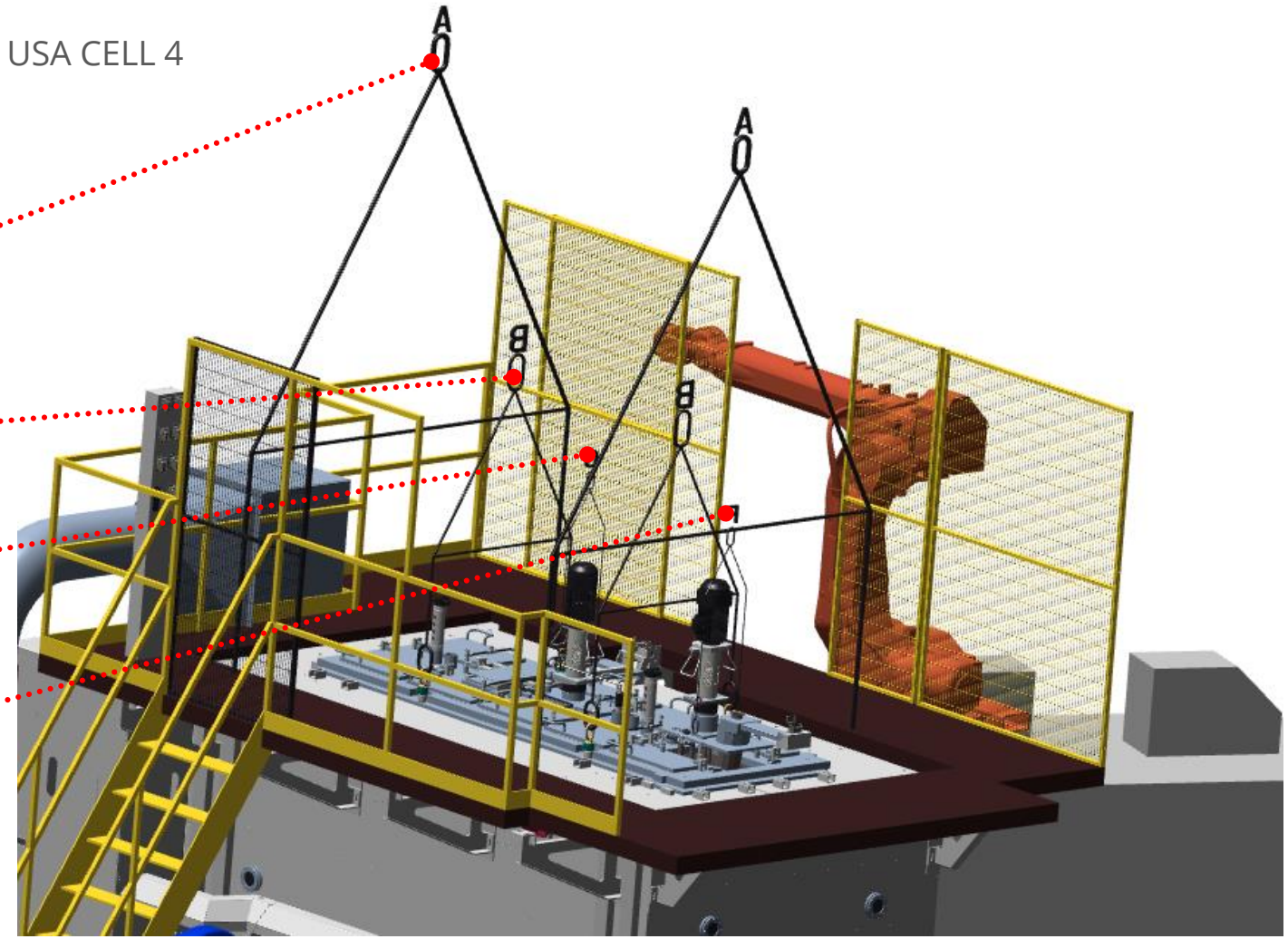
(min. lifting height: 2500mm (98,43 inch)

for exchange and maintenance of the jet pump

(min. lifting height: 2000mm (78,74 inch)

for exchange and maintenance of the ADSL pump

(min. lifting height: 2000mm (78,74 inch)



6 | required lifting points

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

for repair, maintenance and exchange work at the ADSL pot

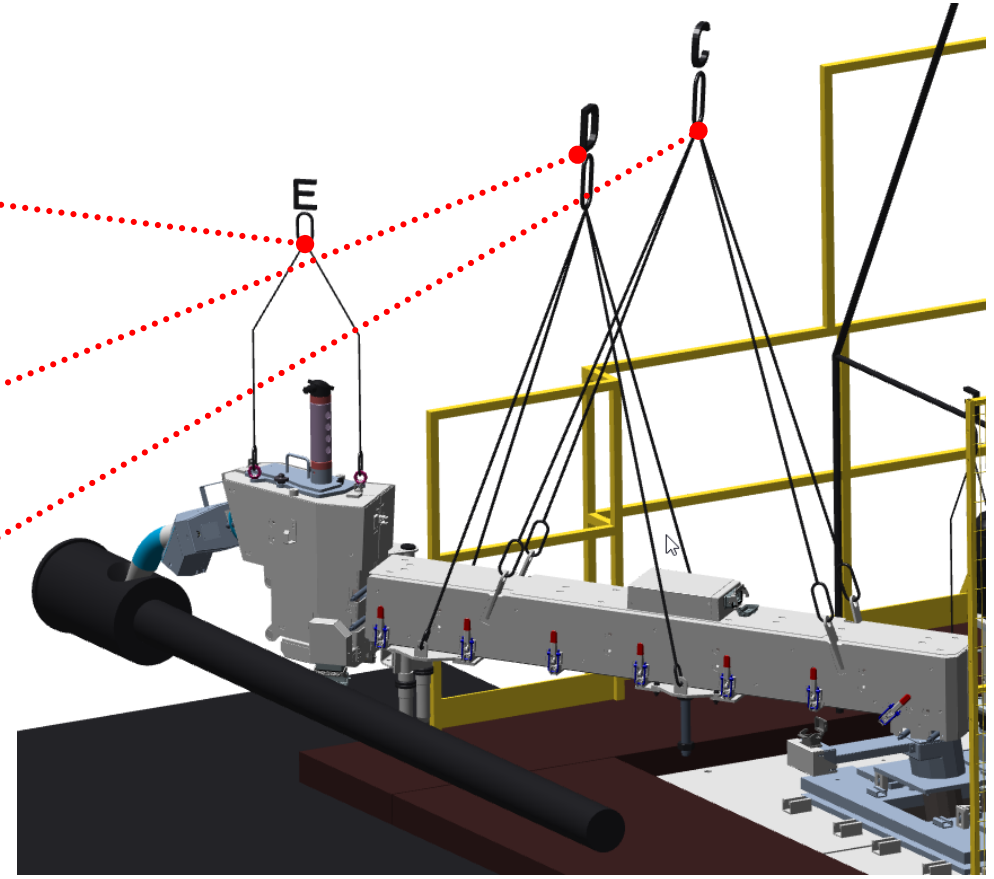
(min. lifting height: 1000mm (39,37 inch)

for repair, maintenance and exchange work at the complete ADSL

(min. lifting height: 1200mm (47,24 inch)

for maintenance and exchange work at the heating hood of the ADSL

(min. lifting height: 1100mm (43,31 inch)



6 | preparations

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

- The peripheral equipment should be ready for casting within the end of the first week of commissioning, however latest at the begin of second week.
- Staff for commissioning , operator and maintenance personal must be available – especially for the start up and purpose of training of the equipment
- Protective clothes (safety helmet equipped with complete sighting device, safety glasses, heat resistant gloves, heat resistant body protection – foundry clothes – respectively 3 sets).
- Min. four boxes for the dross with a capacity of min. 10 kg each including covers must be available
- Crane or auto crane should be available for setup and maintenance. Please pay attention to the total weight of the furnace! Corresponding elevating tools (slip, chains…)
- Min. 8x FIRE EXTINGUSIHER AND SAFTEY EQUIPMENT: Class D (appropriate for metal burns) and fire extinguisher powder for magnesium (e.g. EMGESAL FLUX 0 or ANSUL)
- Min. 2x FIRE EXTINGUISHER cars with an load of min. 200kg should be positioning nearby Mg furnaces.

24,305
Mg
12 (Magnesium)

6 | preparations

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

- concrete pad (350mm) under the DCM must be ready at commissioning of the DCM,
- Warning signs: „Attention – Magnesium!“ , „Do not extinguish with water!“ etc.
- To keep the level of Beryllium in the melt, it is necessary to add a Aluminum Beryllium masteralloy into the furnace after analyze of the Mg. For this analyze, the Spectrometer needs to be set up for Beryllium to increase Beryllium, the Aluminum Beryllium Masteralloy (5%) tabs should be onsite.
- Magnesium ingots: min. 250 pieces of 12kg ingots. More ingots necessary for production!
- Manufactured and installed operator platform and safety fence for MVE1200E/MDO1100R ready at end of first week of commissioning.
- One bottle SF6 with pressure reducer, hose 8m, manual adjustable flow meter (compressed air gun) and steel pipe.

6 | required tools for maintenance works (not in scope of supply)

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

Set of socket spanner (Proxxon 23040)

Oxyacetylene torch set with different jet

Min. 4 pcs. Steel brush

1 pcs. Hammer 300g
1 pcs. Hammer 500g

Each thread cutter 3 pcs. (M4, M5, M6, M8, M10, M12)

Flat cold chisel small size in different length

Snap ring gripper

Flat spanner metric 1x8, 1x9, 2x10, 2x13, 1x14, 1x15, 1x16, 2x17, 1x18, 2x19, 1x23, 1x24, 1x27

Cotter pin driver 3,4,5,6,7,8 mm

Electro-mechanic drilling hammer with long flat cold chisel / Big steel plate for cleaning purposes on the floor

6 | required tools for maintenance works (not in scope of supply)

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

Angle grinder with circular saw and grinding disk

Drilling machine (only during installation)

Set of socket spanners (metric) big size

Cable drum (only during installation)

Extension cable

Hammer drill machine with metric driller of 16mm and 10mm (only during installation)

Drill bit metric 3-12mm (0,5mm steps)

Crow bar min. 1m long

Electrical welding equipment

6 | required tools for maintenance works (not in scope of supply)

MAGNESIUM DIE CASTING CELL FOR SHILOH USA CELL 4

Hand saw for metals

Cutter

Four sling chain 1.5m min. 500kg

Tools to lift the equipment: Hoisting sling in different length 1 meter/3000kg, 3 meter/3000kg, 5 meter/5000kg

Digital Multimeter with temperature tester (Type K)

Shackle different sizes

Tool set for electric engineer: Screw driver 12 pcs different size and form: Philips: PH1x80, PH2x100, PH3x150, PZ1x80, PZ2x100 Slit: 2,0x60 - 2,5x75 -3,0x100 - 4,0x100 - 5,5x125 - 6,5x150 - 8,0x175; Wire stripper, pliers with cutter 180mm, side cutter 160mm, needle-nose pliers with 200mm cutting, Needle-nose pliers bent 200mm, cable cutter 170mm, water pump pliers 250mm, Wire end sleeve crimper for wire 0,5-2,5qmm,)

THANK YOU FOR YOUR ATTENTION!

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24,305
Mg
12 (Magnesium)

WE DO LIGHT METALS