CAB LINE DESIGNS TO REDUCE ENERGY COSTS

4th International Congress "Aluminium-Brazing"
May 16-18, 2006 in Düsseldorf

SECO/WARWICK Ltd
Ul. Sobieskiego 8
66-200 Świebodzin
POLAND

Piotr Skarbiński
Global Product Director
CAB Furnaces

SECO/WARWICK

GOAL:
TO PRESENT WHAT SCALE OF SAVINGS CAN BE ACHIEVED BY CAB LINE RUNNING USING THE DESIGN SOLUTIONS WHICH DECREASE ENERGY CONSUMPTION

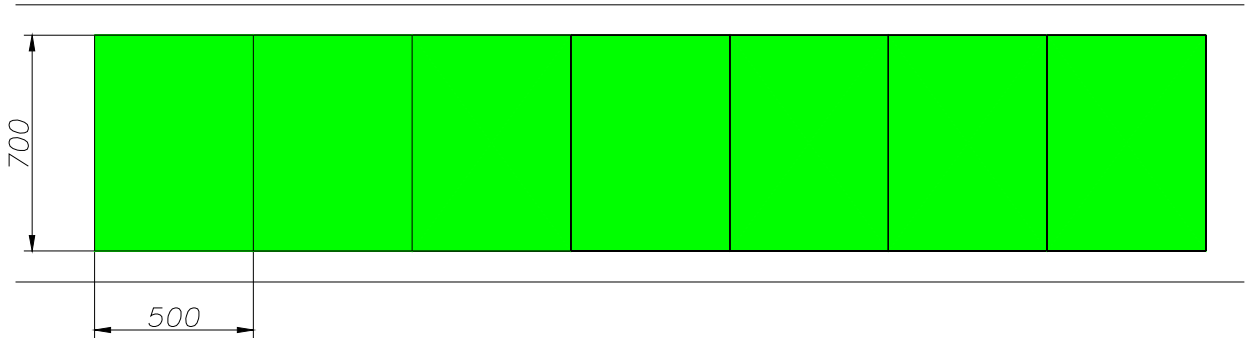
For all calculations a typical size brazing line is used as the reference example:

Load parametres:

Type – radiator
Dimensions – 500 x 700 x 50 mm
Weight – 5 kg Al, 3 kg SS fixtures
Production – 100 pieces / hour
Quantity of oil 50 g/core

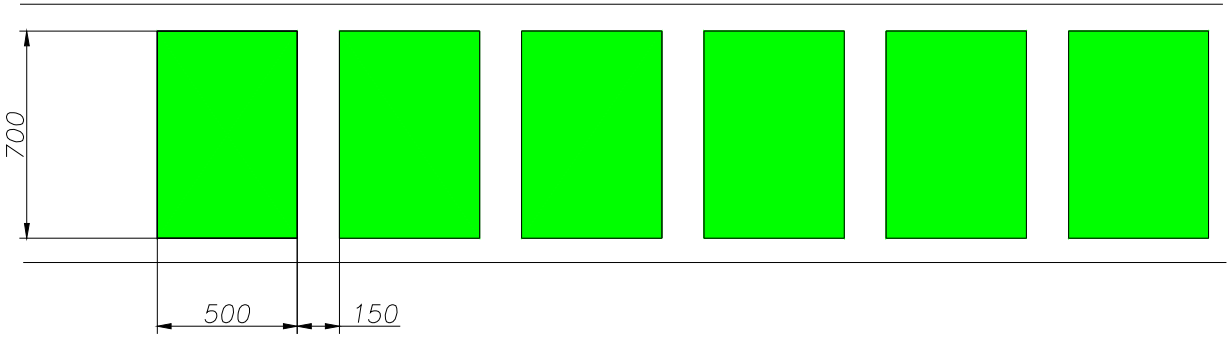
LOAD CONFIGURATION

Load configuration on degreaser's belt



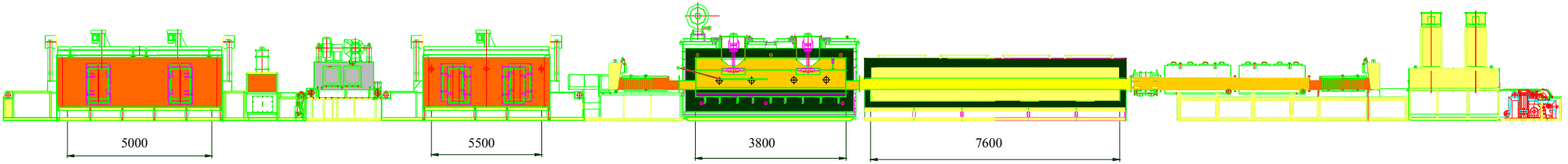
Degreaser belt speed – 833 mm/min

Load configuration on dryer/brazer's belt



Dryer/brazer belt speed – 1083 mm/min

SIZE OF REFERENCE EXAMPLE SYSTEM



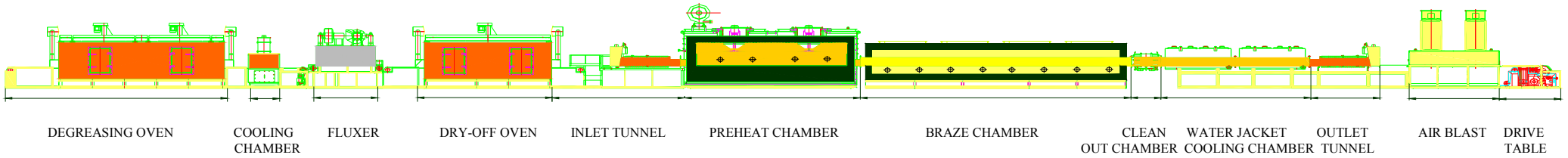
Heated lengths:

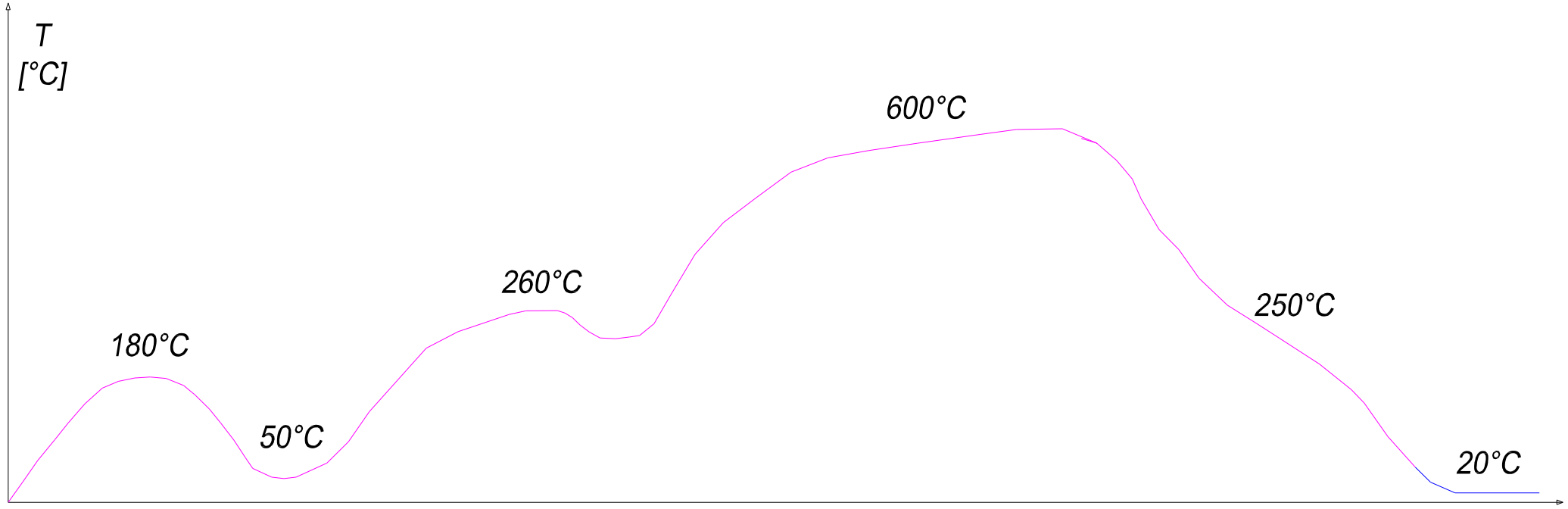
Degreasing oven – 5000 mm
Dry-off oven – 5500 mm
Preheat chamber – 3800 mm
Braze chamber – 7600 mm

Heating times:

Degreasing oven – 6 min.
Dry-off oven – 5 min.
Preheat chamber – 3,5 min.
Braze chamber – 7 min.

TEMPERATURE PROFILE

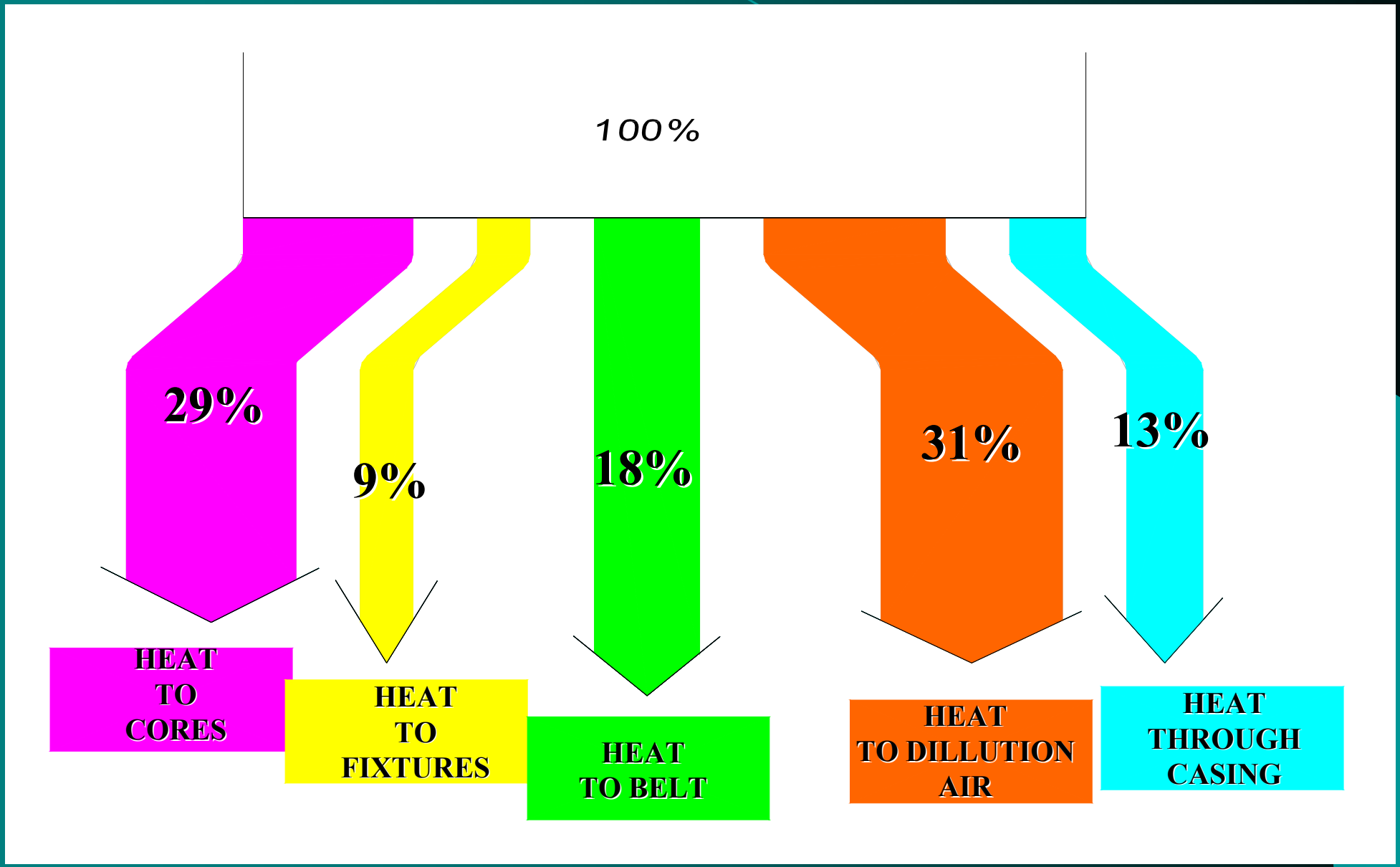




POWER CONSUMPTION SPLIT FOR EACH UNIT OF THE LINE

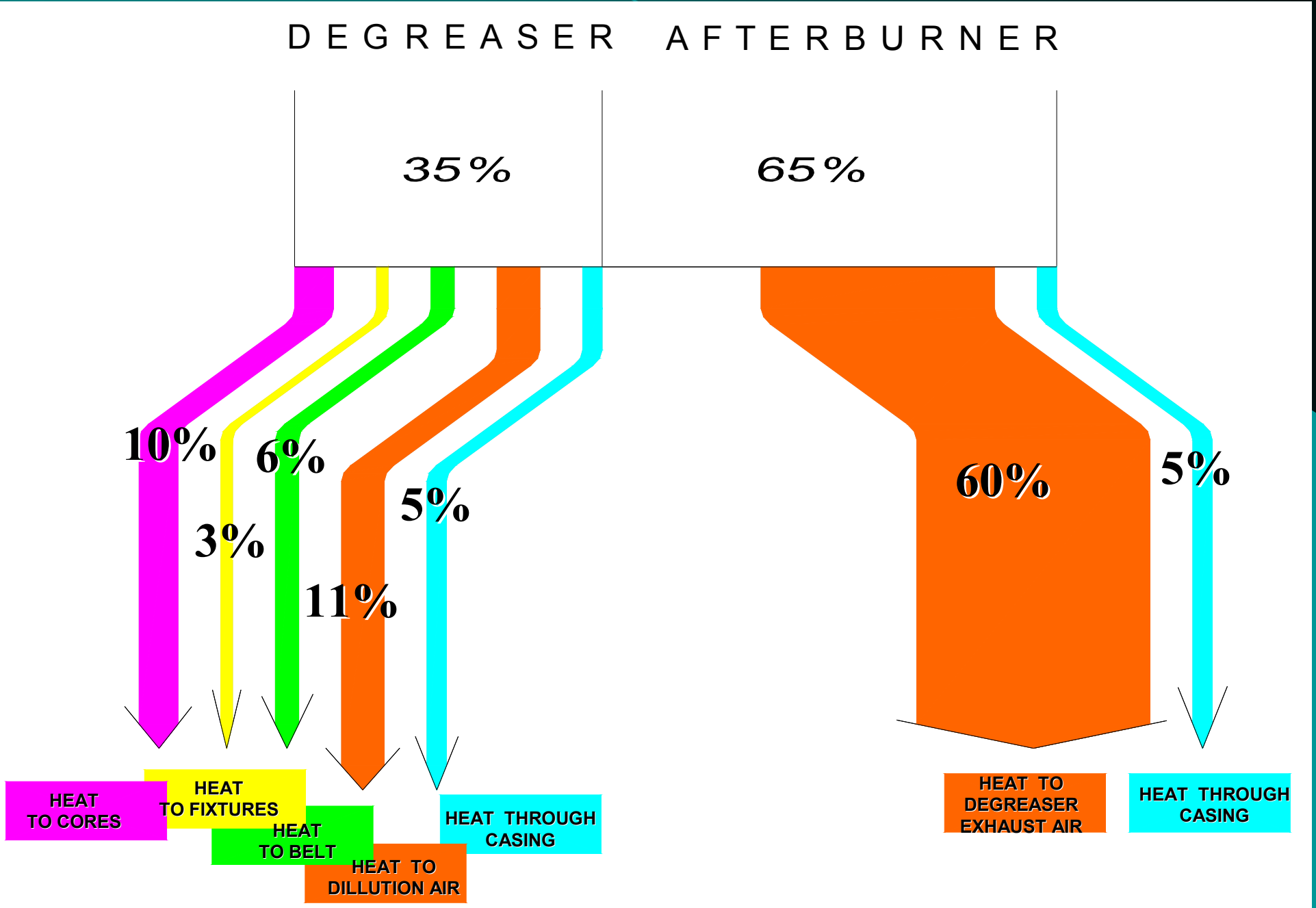
	kW (gas)	%
Degreaser	245	37
Dry-off oven	147	22
Preheat chamber	172	26
Braze chamber	101	15
Total	665	100

DEGREASER


100%
29%
9%
18%
31%
13%
HEAT TO CORES
HEAT TO FIXTURES
HEAT TO BELT
HEAT TO DILLUTION AIR
HEAT THROUGH CASING

SECO/WARWICK

DEGREASER & AFTERBURNER



DEGREASER
POSSIBLE SOLUTIONS

DEFINITIONS

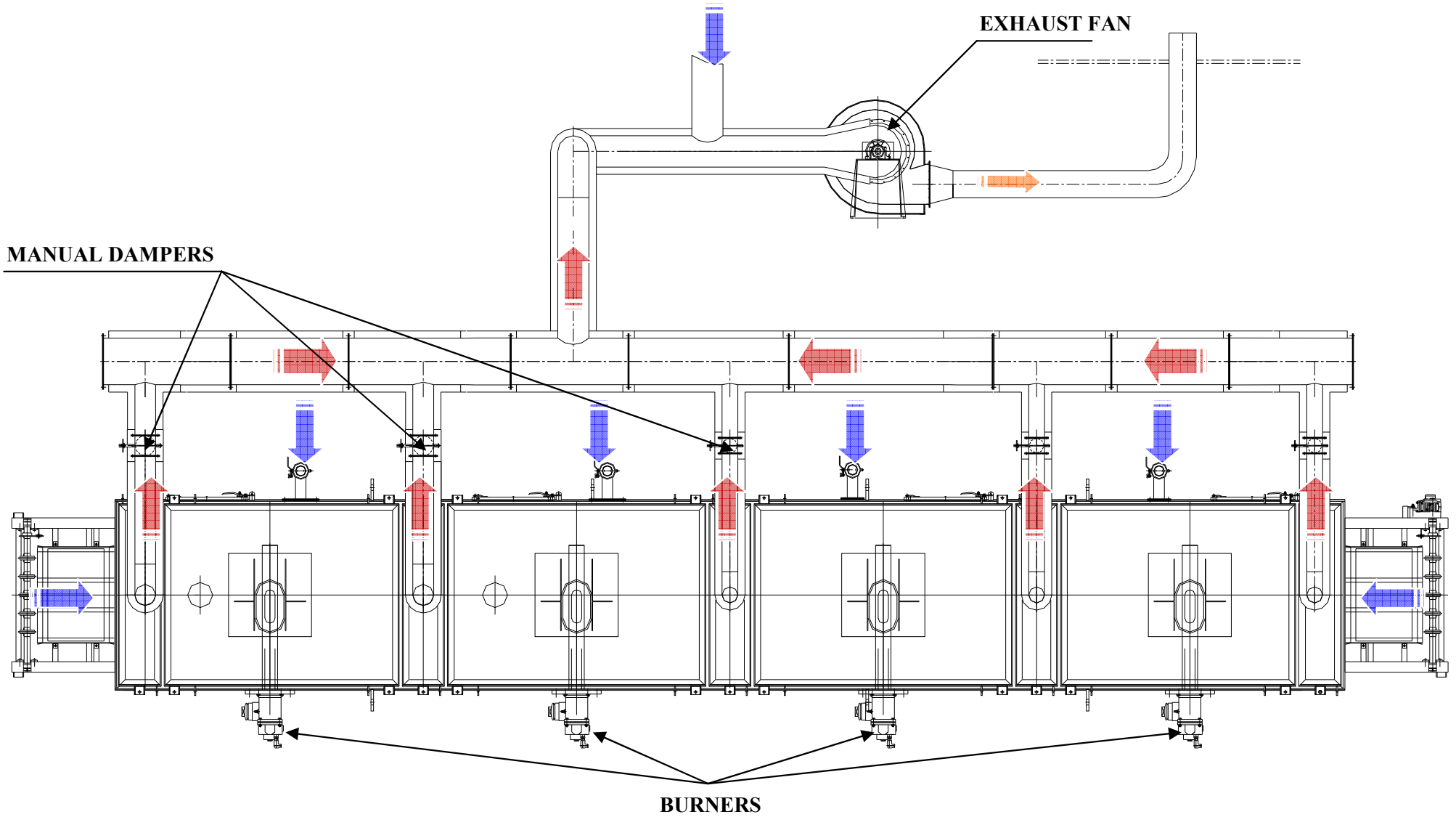
DIRECT

Burners or Electric Heaters in the oven body

INDIRECT

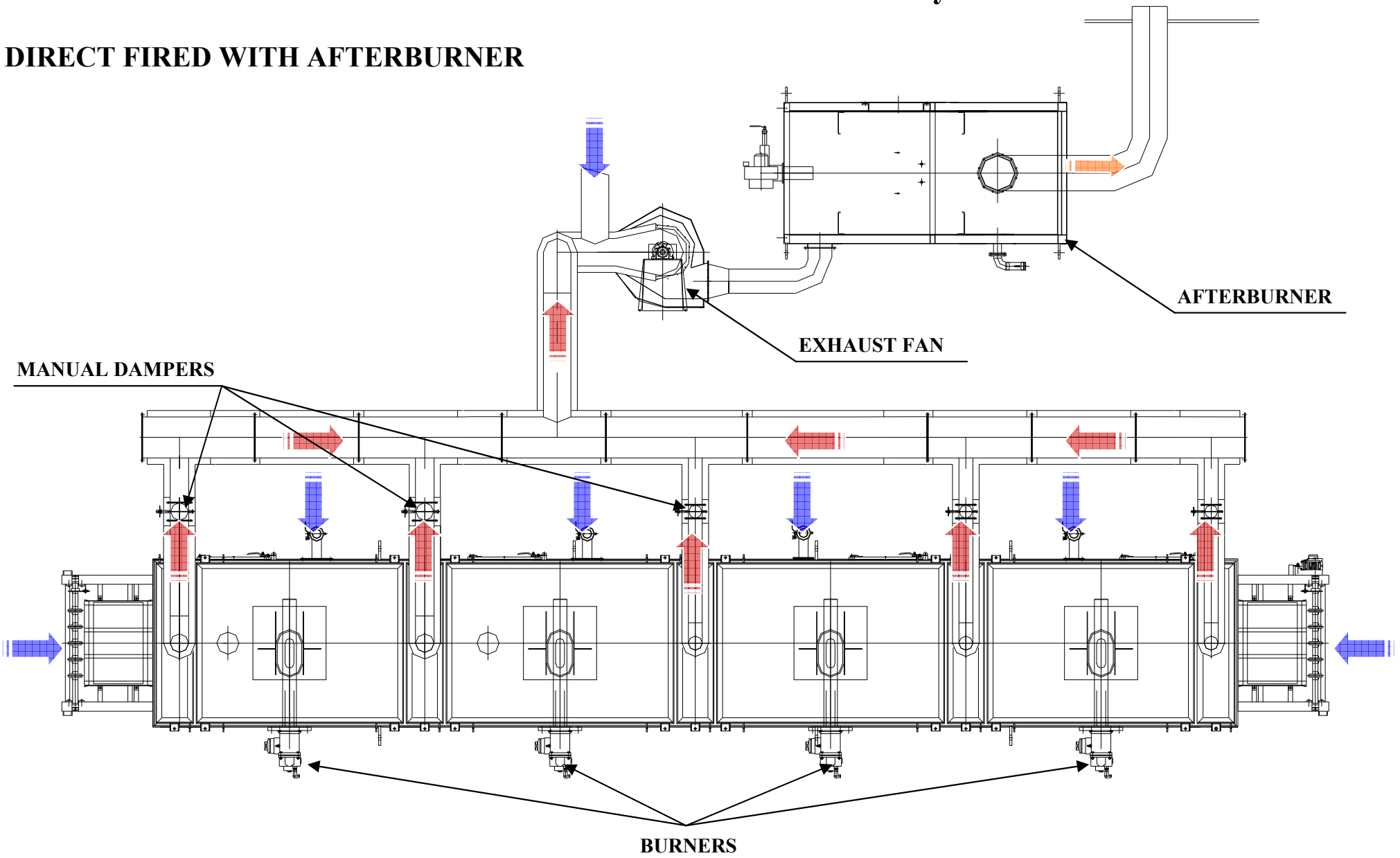
NO Burners or Electric Heaters in the oven body

DIRECT FIRED with burners or electrical heaters in the oven body



DIRECT FIRED with burners or electrical heaters in the oven body

DIRECT FIRED WITH AFTERBURNER

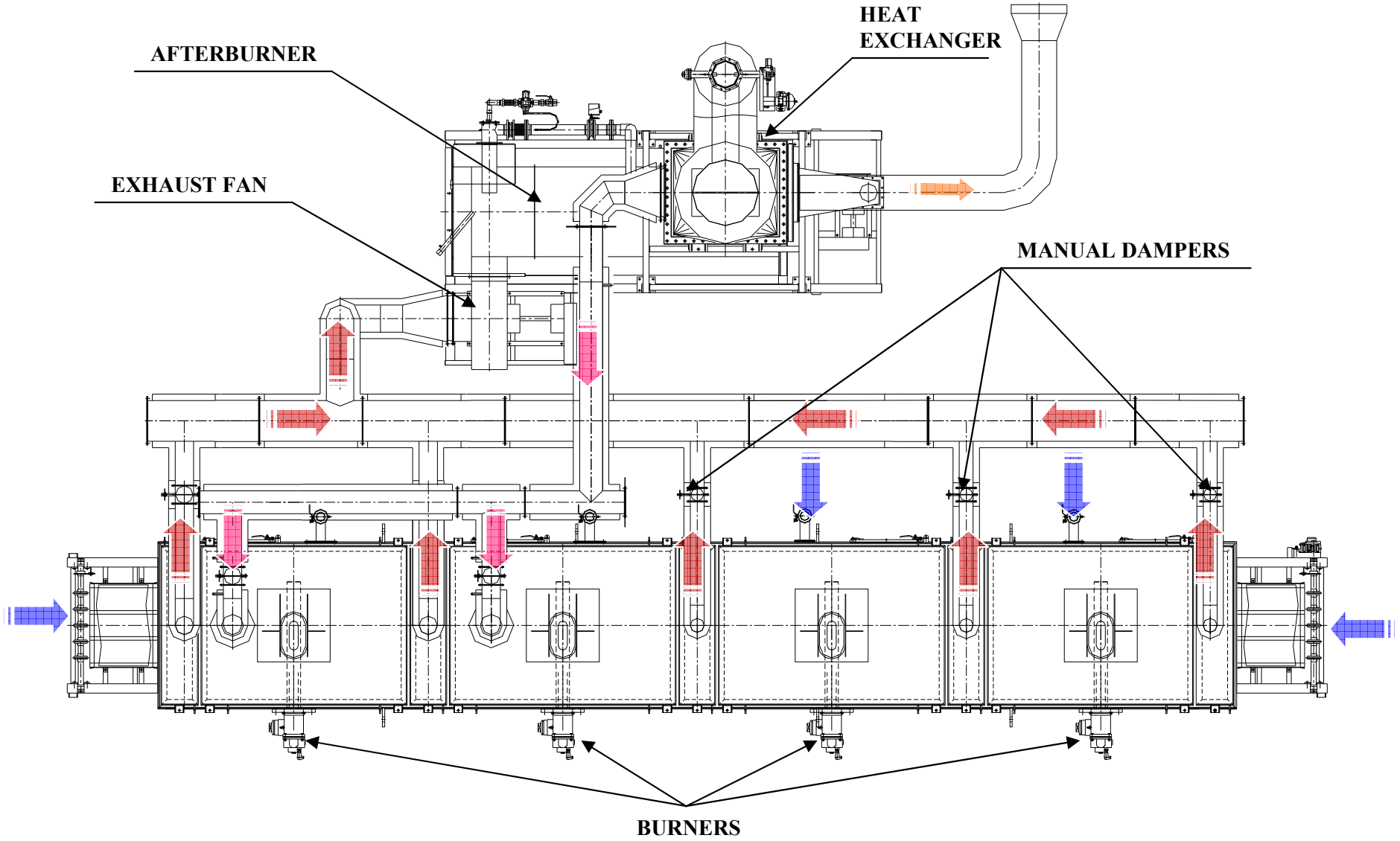


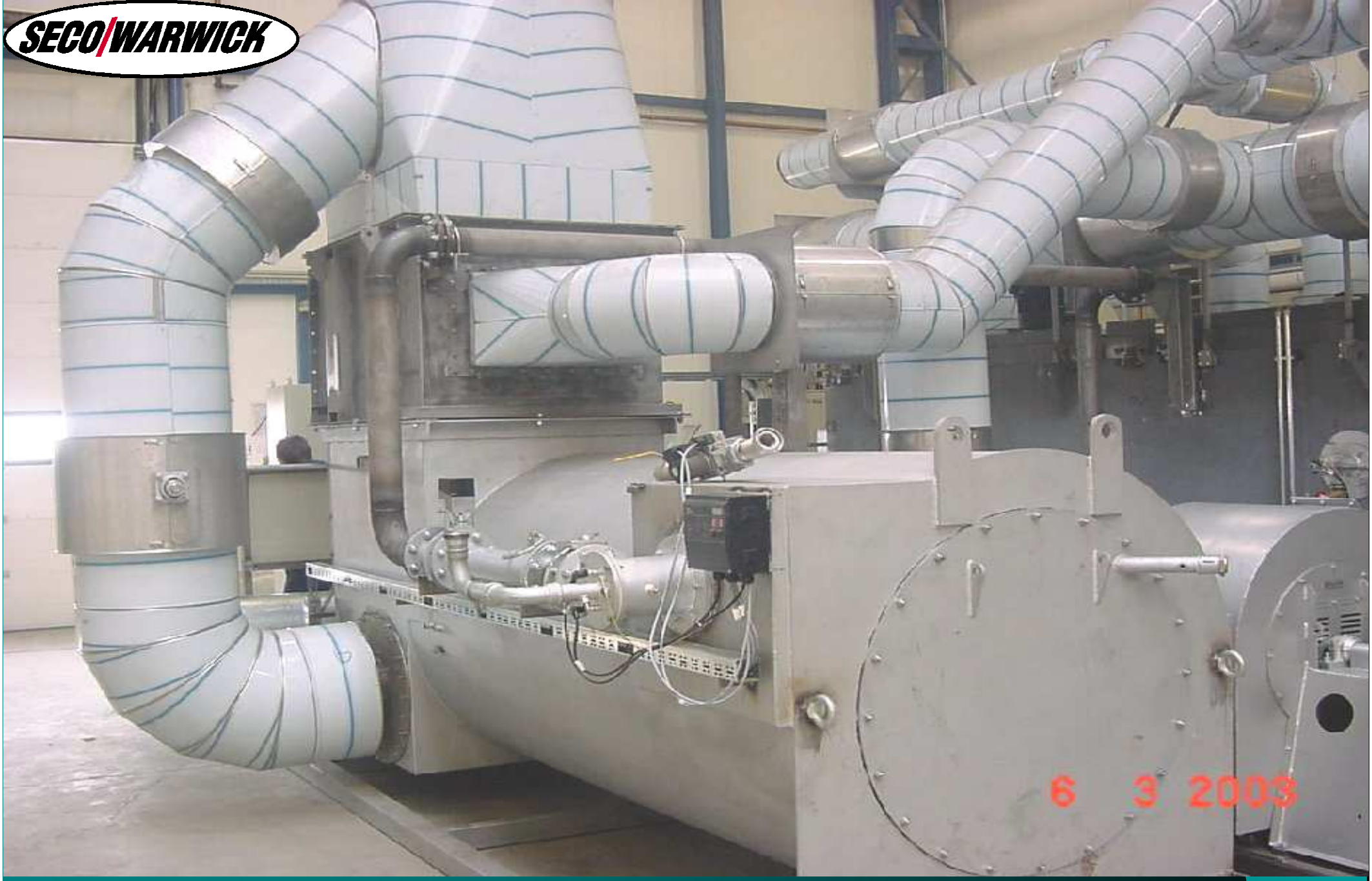
SECO/WARWICK

DIRECT FIRED DEGREASER WITH AFTERBURNER

DIRECT FIRED with burners or electrical heaters in the oven body

DIRECT FIRED WITH HEAT RECOVERY HEAT EXCHANGER

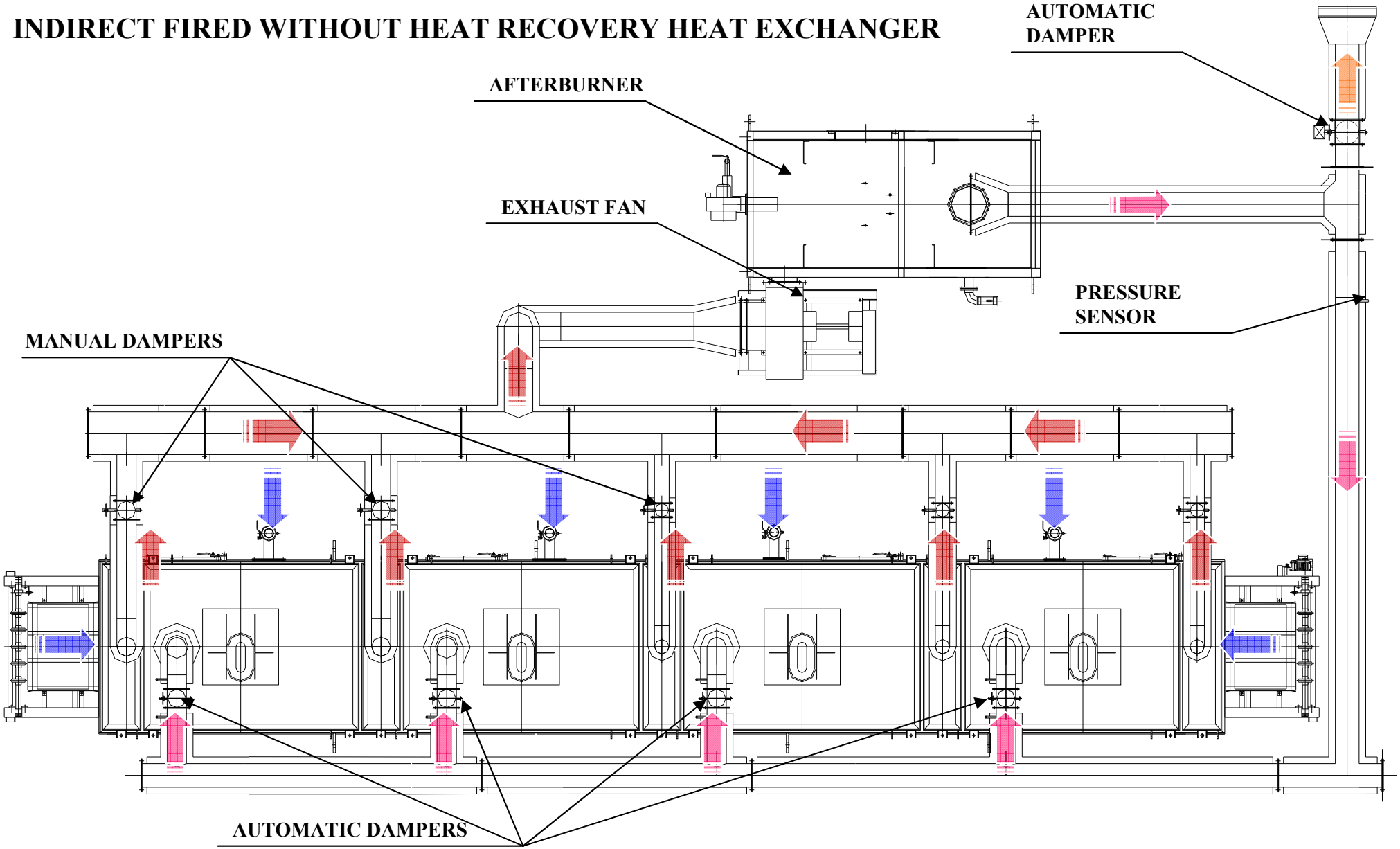


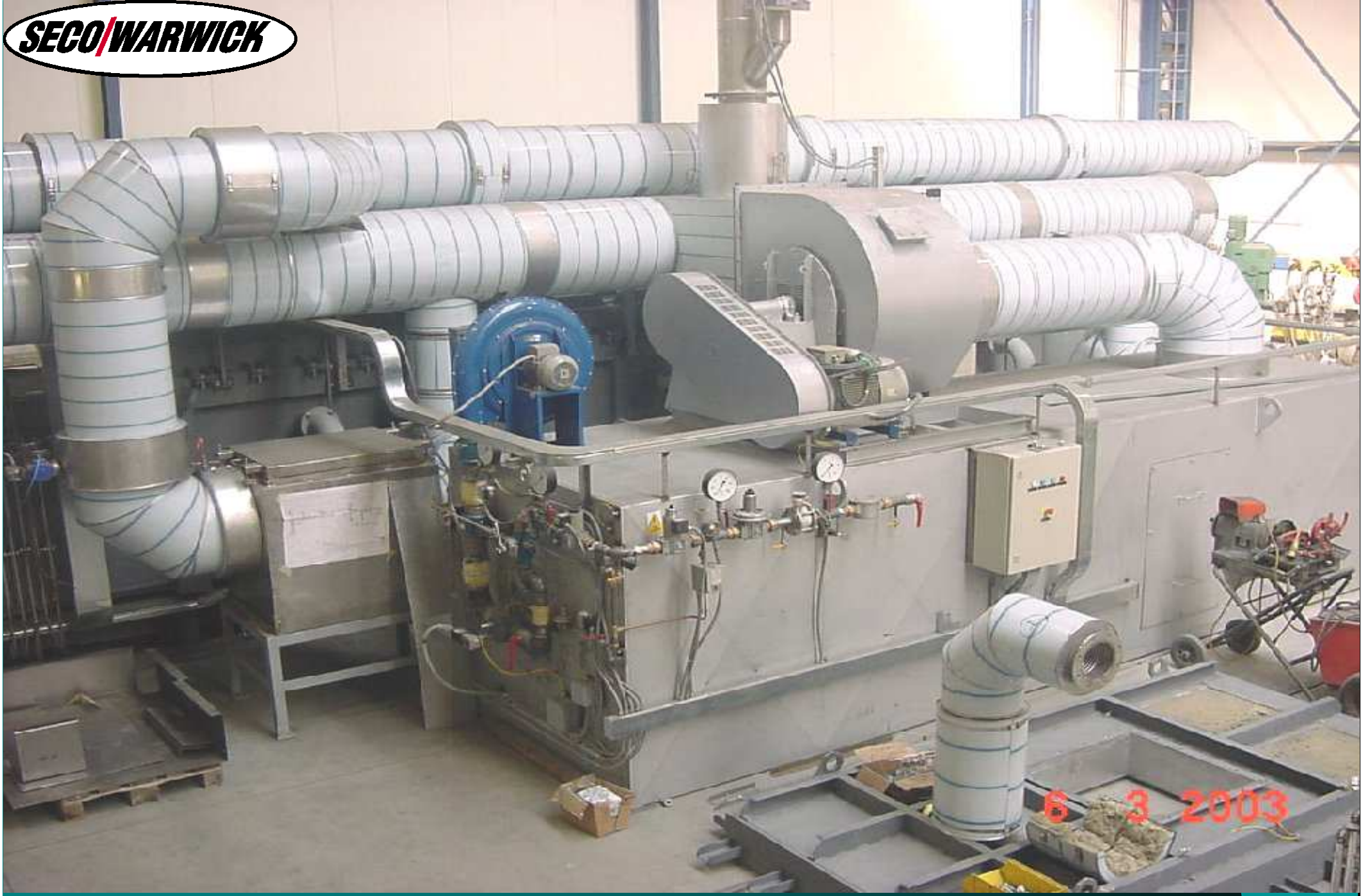


DIRECT FIRED SYSTEM WITH HEAT RECOVERY HEAT EXCHANGER

INDIRECT FIRED without burners or electrical heaters in the oven body

INDIRECT FIRED WITHOUT HEAT RECOVERY HEAT EXCHANGER

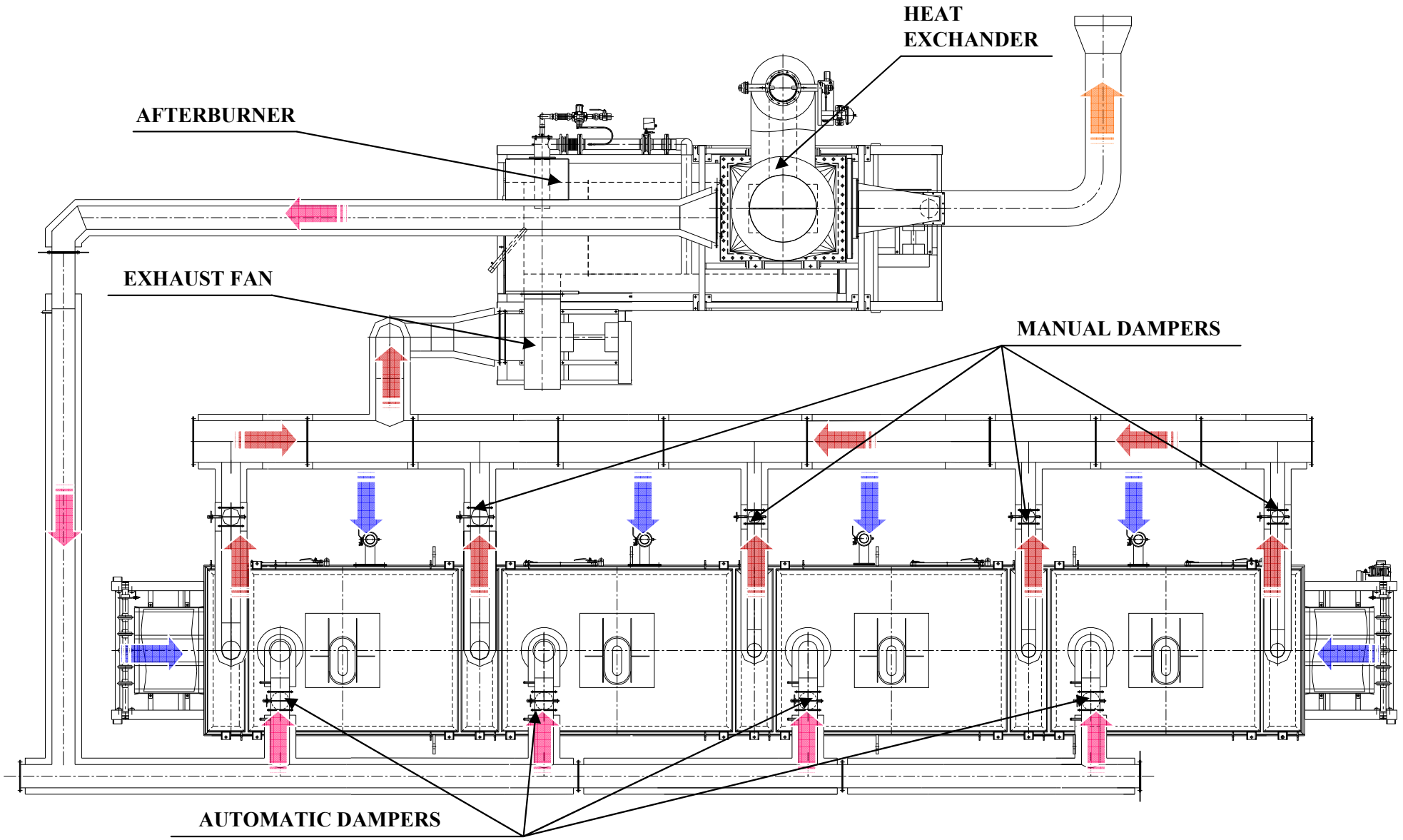




INDIRECT SYSTEM

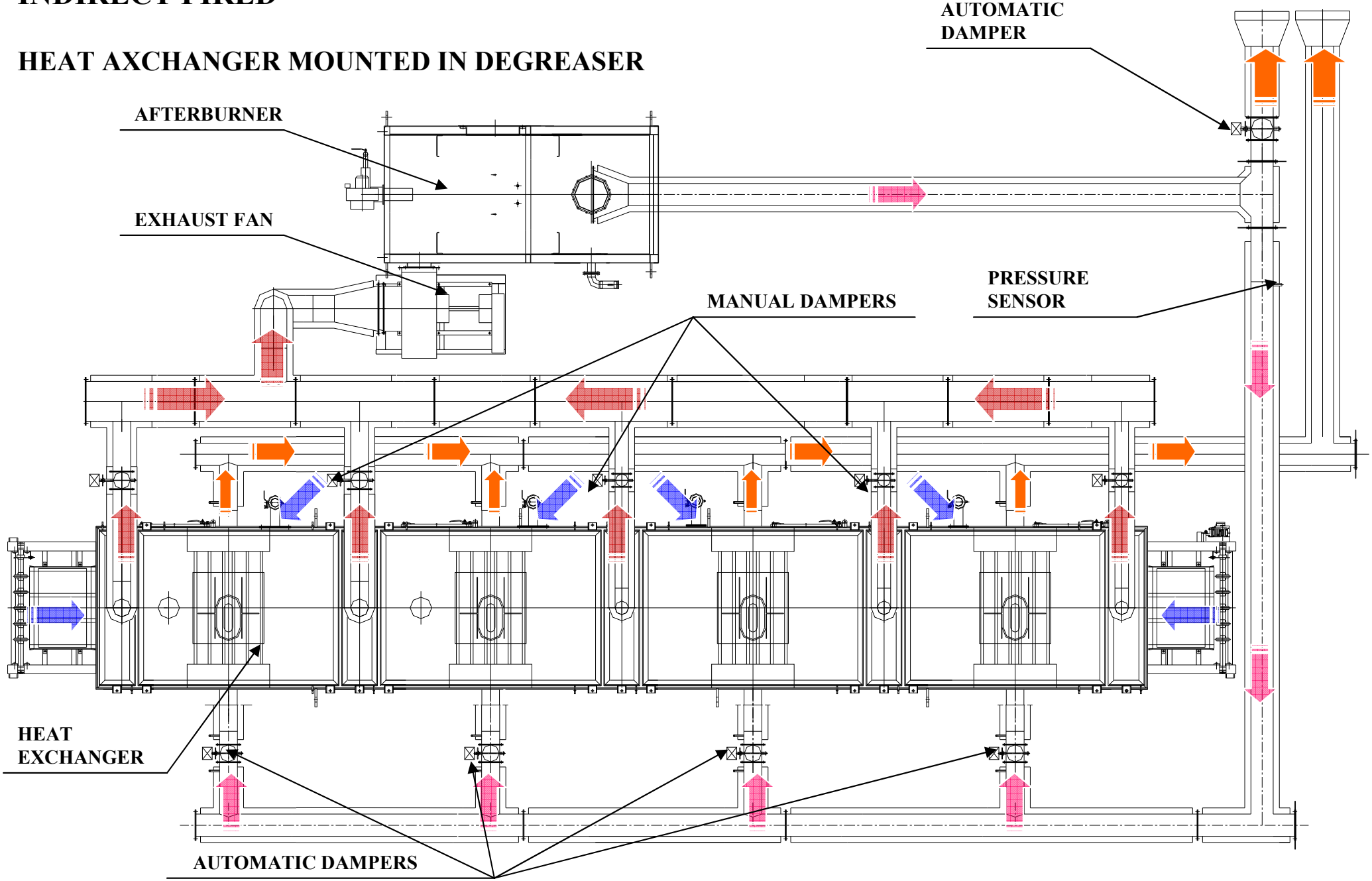
INDIRECT FIRED

INDIRECT FIRED WITH HEAT RECOVERY HEAT EXCHANGER



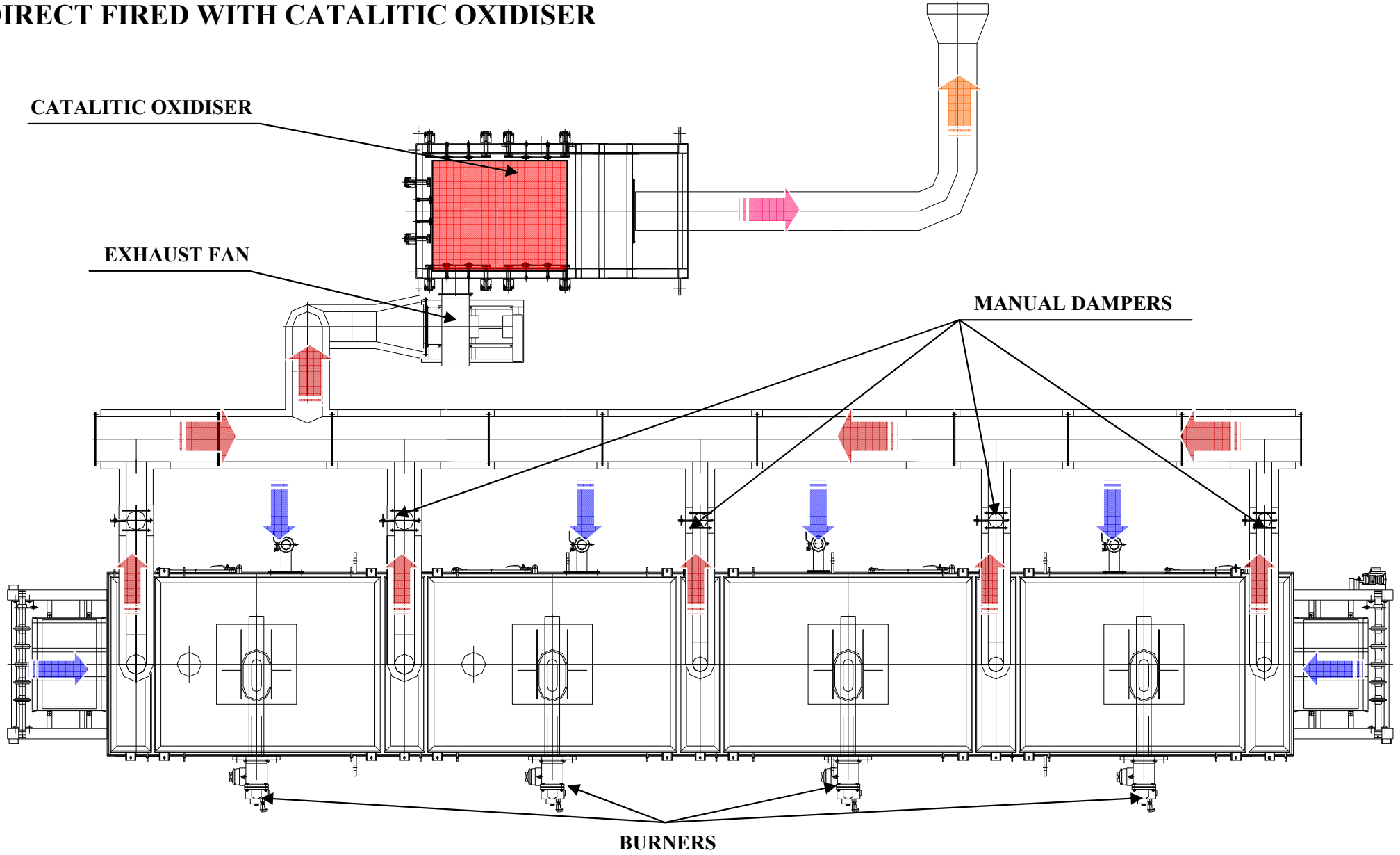
INDIRECT FIRED

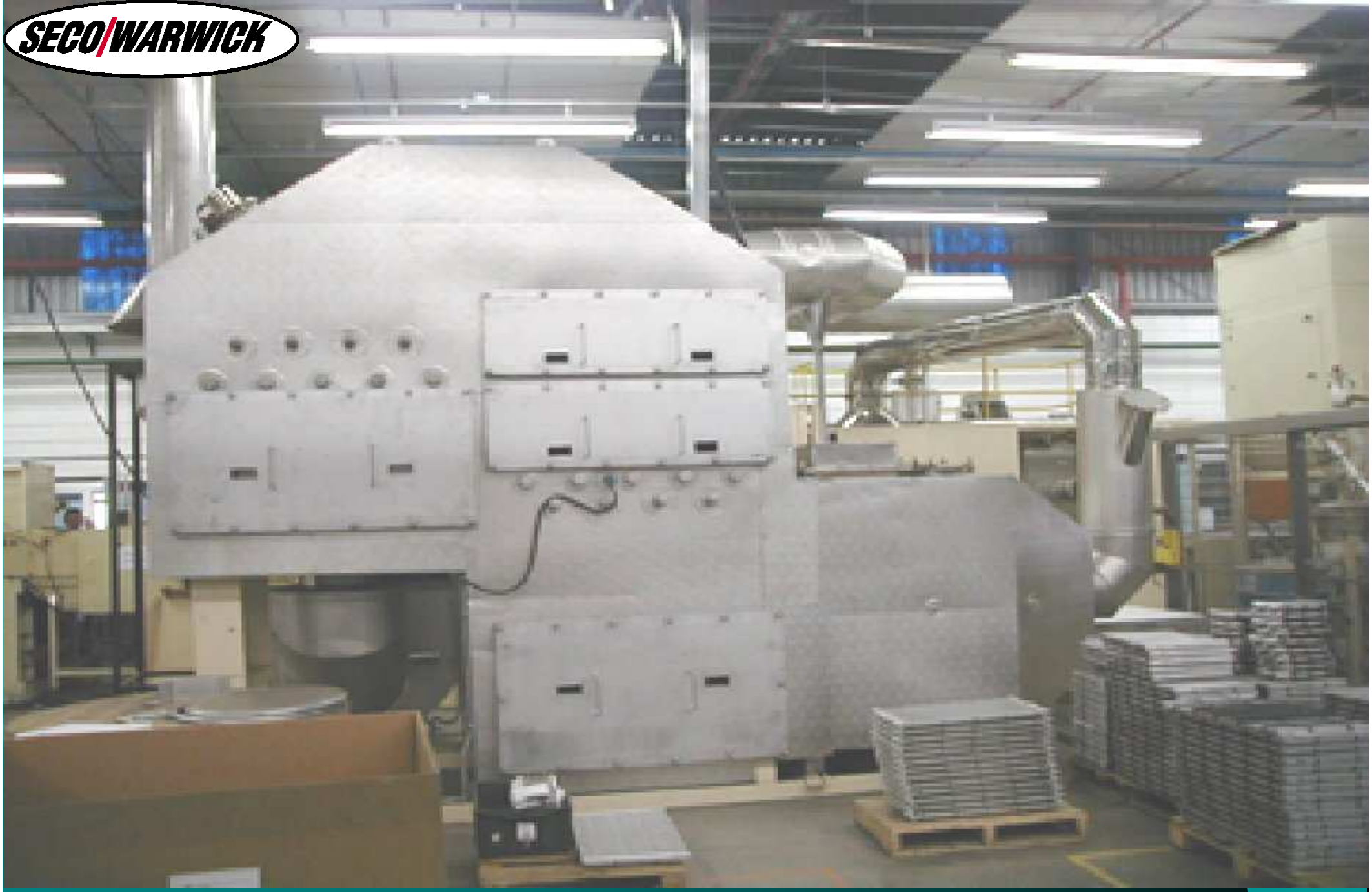
HEAT AXCHANGER MOUNTED IN DEGREASER



DIRECT FIRED

DIRECT FIRED WITH CATALITIC OXIDISER





CATALITIC OXIDISER

	INVESTMENT COST	ENERGY CONSUMPTION	NOTES
DIRECT FIRED WITHOUT HEAT EXCHANGER	VERY LOW	HIGH	THE SIMPLEST SYSTEM
DIRECT FIRED WITH HEAT EXCHANGER	MEDIUM/LOW	MEDIUM/LOW	COMPROMISE BETWEEN INVESTMENT AND RUNNING COST
INDIRECT FIRED WITHOUT HEAT EXCHANGER	LOW	HIGH	SIMPLE SYSTEM WITH ONE HEATING SOURCE
INDIRECT FIRED WITH HEAT EXCHANGER	HIGH	LOW	NO CONTACT OF PRODUCTS OF COMBUSTION WITH THE LOAD - VERY HIGH HEAT UP/SHUT DOWN TIME
DIRECT FIRED WITH CATALITIC OXIDIZER	VERY HIGH	VERY LOW	ADDITIONAL COST OF FREQUENT CATALISER EXCHANGES (EACH 2 YEARS)
INDIRECT FIRED WITH HEAT EXCHANGER MOUNTED IN THE DEGREASER	HIGH/MEDIUM	LOW	NO CONTACT OF PRODUCTS OF COMBUSTION WITH THE LOAD

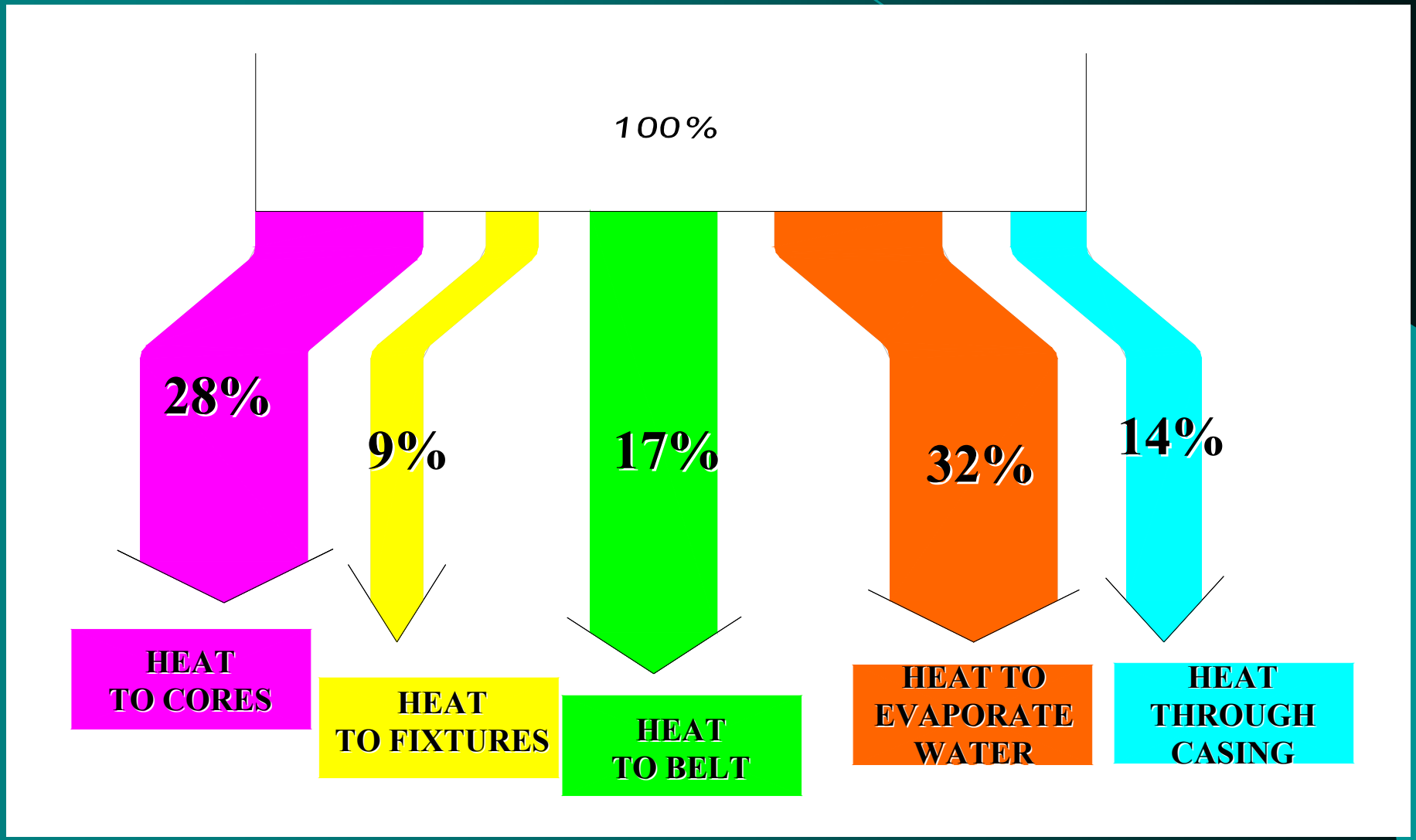
APPROXIMATE POWER CONSUMPTION FOR DIFFERENT SOLUTIONS OF DEGREASER/AFTERBURNER HEAT RECOVERY

	POWER CONSUMPTION (kW gas)
DIRECT FIRED WITHOUT HEAT EXCHANGER	245
DIRECT FIRED WITH HEAT EXCHANGER	204
INDIRECT FIRED WITHOUT HEAT EXCHANGER	205
INDIRECT FIRED WITH HEAT EXCHANGER	177
DIRECT FIRED WITH CATALITIC OXIDIZER	171
INDIRECT FIRED WITH HEAT EXCHANGER MOUNTED IN DEGREASER	185

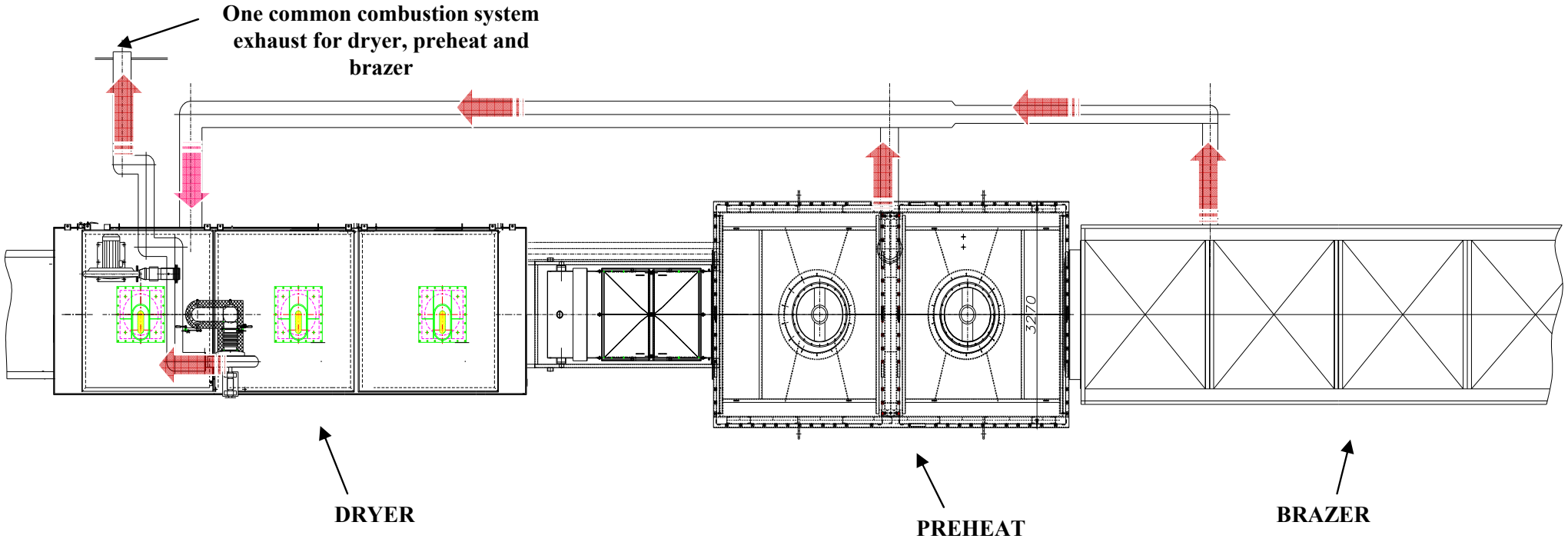
OTHER DESIGNING SOLUTIONS TO REDUCE ENERGY CONSUMPTION

- Heat recovery from furnace to dryer
- hood between dry-off oven and braze chamber
- common belt through dry-off oven and braze chamber
- increased insulation thickness
- enlarging of system size
- heat recovery from air blast cooling chamber.

DRYER


100%
28%
9%
17%
32%
14%
HEAT TO CORES
HEAT TO FIXTURES
HEAT TO BELT
HEAT TO EVAPORATE WATER
HEAT THROUGH CASING

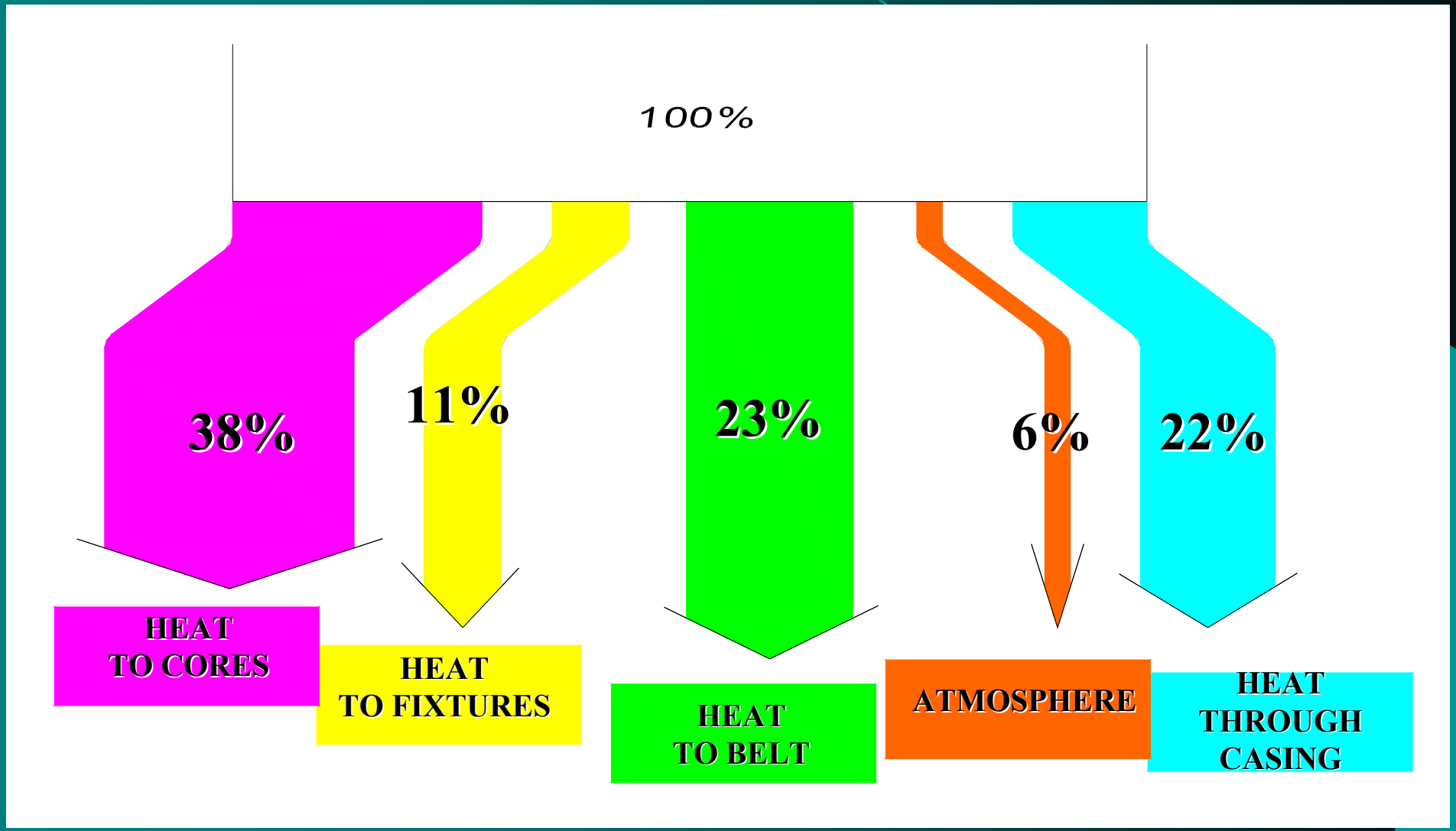
DRYER – HEAT RECOVERY SYSTEM
HOT FLUES FROM BRAZER DELIVERED TO DRYER



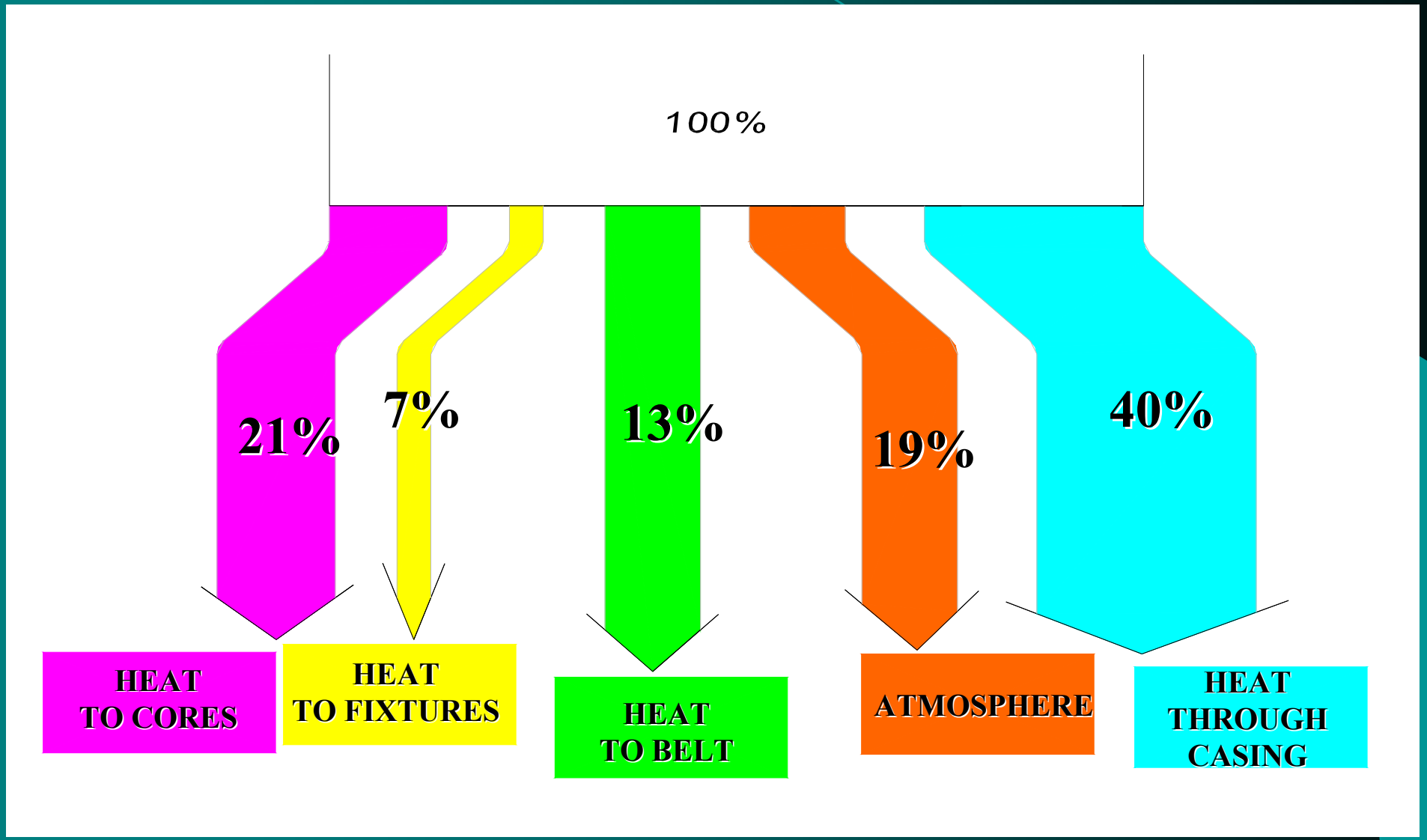
- Savings for reference example: consumption of 147 by basic dryer reduced to 102 kW (45 kW (gas) savings).

DRYER – HEAT RECOVERY SYSTEM
HOT FLUES FROM BRAZER DELIVERED TO DRYER

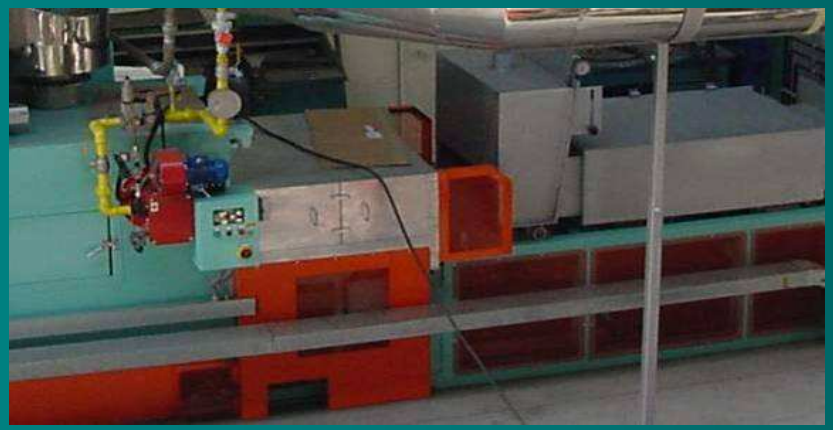
PREHEAT

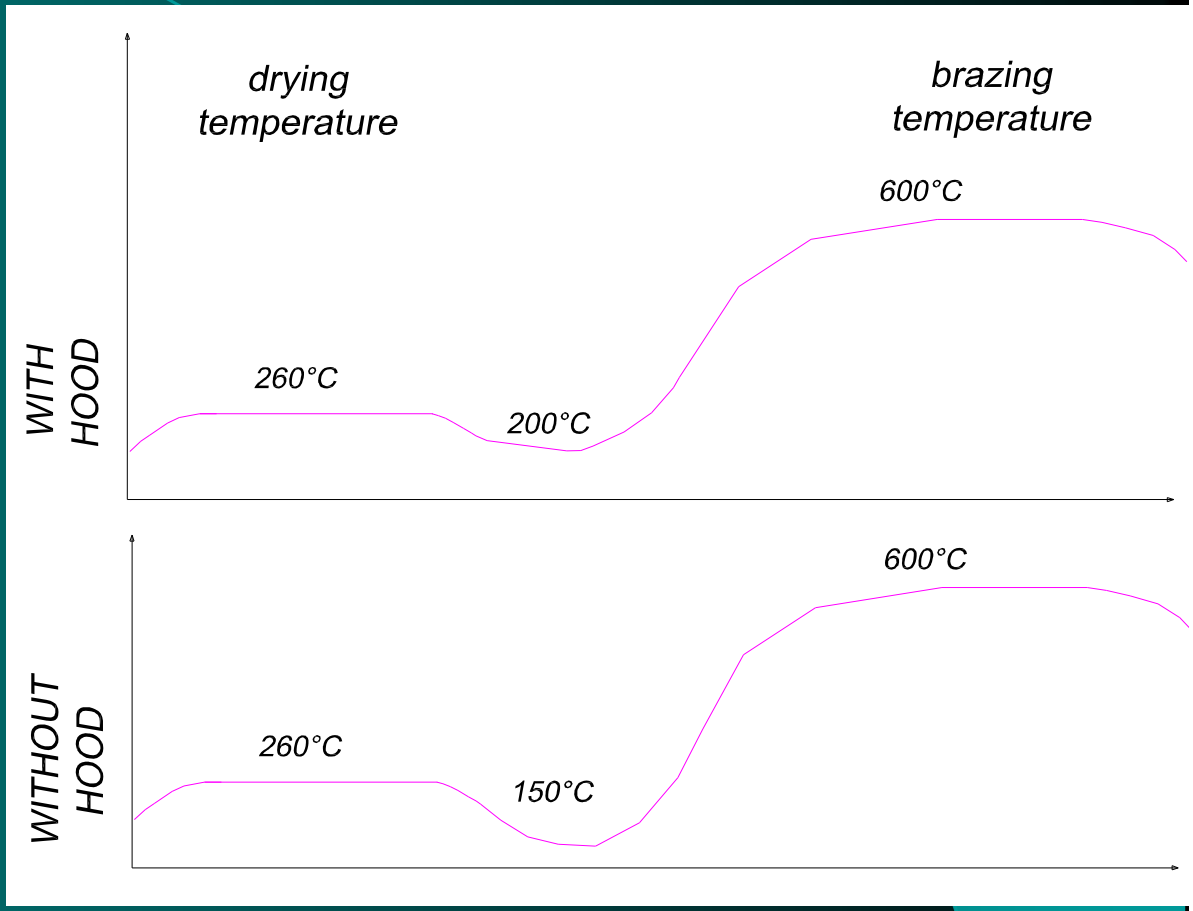

100%
38%
11%
23%
6%
22%
HEAT TO CORES
HEAT TO FIXTURES
HEAT TO BELT
ATMOSPHERE
HEAT THROUGH CASING

BRAZER


100%
21%
7%
13%
19%
40%
HEAT TO CORES
HEAT TO FIXTURES
HEAT TO BELT
ATMOSPHERE
HEAT THROUGH CASING

HOOD BETWEEN DRYER AND BRAZER

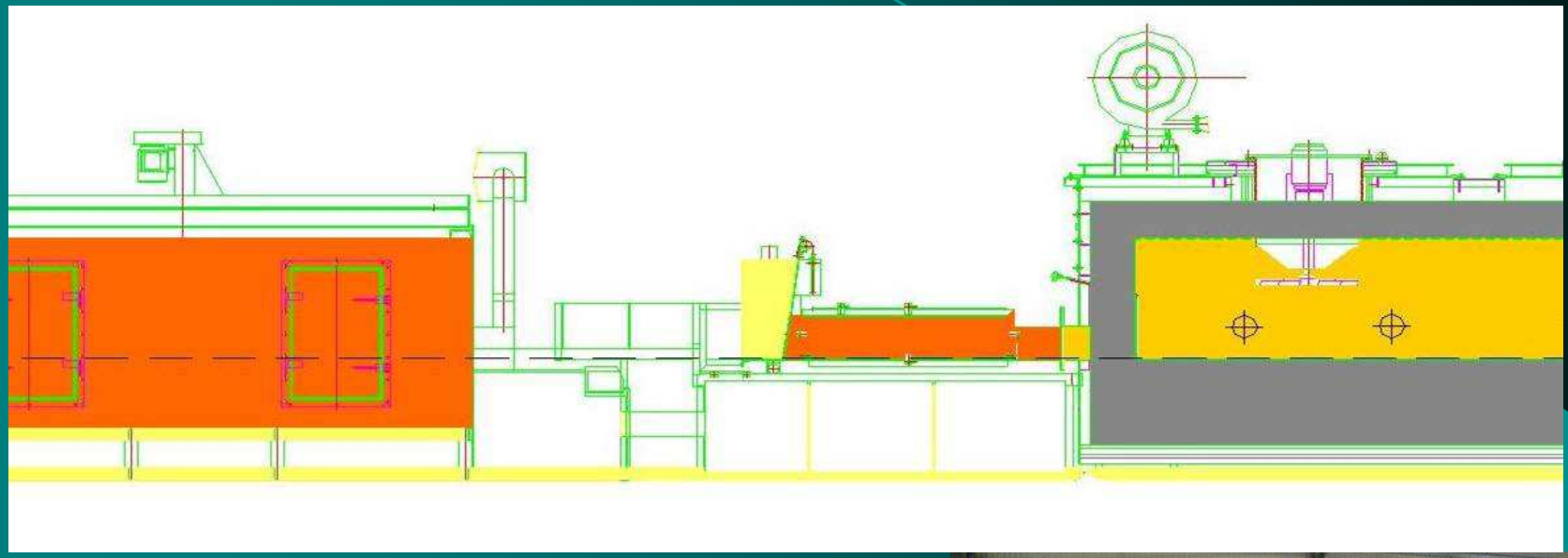




- energy saving for the reference example line is 20 kW (gas)

- additional advantage – increased brazing productivity

Common belt for dryer and brazer



- Energy saving for the reference example line is 27 kW (gas)

- additional advantage – increased brazing productivity

Increased insulation thickness - ovens

- for currently used mineral wool insulating materials (thickness 150 mm) heat losses are 0,08 kW/m^2 (15 kW for the reference example)

- further increasing of insulation can give only minor effect of energy saving.

Increased insulation thickness – preheat and brazer

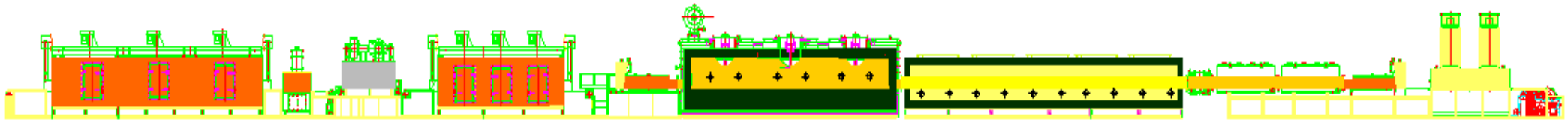
- for currently used insulating materials and thickness of 250 mm heat losses are 0,22 kW/m^2

- by increasing the insulation thickness to 300 mm heat losses will be reduced to 0,18 kW/m2

- the energy saving for the reference example line is 12 kW (gas).

Savings achieved by increasing system size

2 x 665 kW = 1330 kW



Doubled length: 1 x 1150 kW = 1150 kW

Redesigned configuration (2 loads on belt width): 1 x 1120 kW = 1120 kW

Heat recovery from cooling chamber

In the air blast cooling chamber load, fixtures, belt is cooled down from about 250ºC to ambient temperature.

For the reference example line the energy transferred to cooling air is appoximatelly 50 kW.

This energy can be recovered by using the air for i.e. plant heating.

Comparision of energy cost in aspect of natural gas and electrical energy prices

Lands/ /continents	Natural gas price [EUR/Nm3]	Elec. energy price [EUR/kWh]	Hourly natural gas consumption cost for reference system [EUR]	Hourly electrical energy consumption cost for reference system [EUR]
Europe	0,3	0,06	20	27
USA	0,28	0,045	19	20

CONCLUSIONS

Designing solutions	Saving of energy for reference example line [kW gas]	Yearly cost saving based on 8000 working hours and natural gas price: 0,3 EUR/scm [EUR]	Savings on 1 piece of heat exchanger for the reference example line [EUR]
Heat recovery on degreaser	40 - 70	9.600 – 16.800	0,012 – 0,021
Heat recovery on brazer-dryer	45	10.800	0,013
Hood	20	4.800	0,006
Common belt	27	6.500	0,008
Thermal wall losses	12	2.900	0,004
Heat recovery from air blast cooling chamber	50	12.000	0,015
Increased system size	105	25.200	0,031

CONCLUSIONS

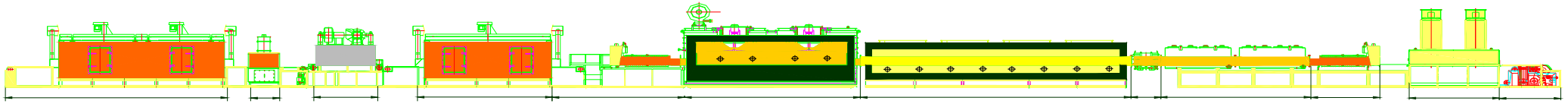
TOTAL SAVING AVAILABLE FOR REFERENCE EXAMPLE BRAZING LINE

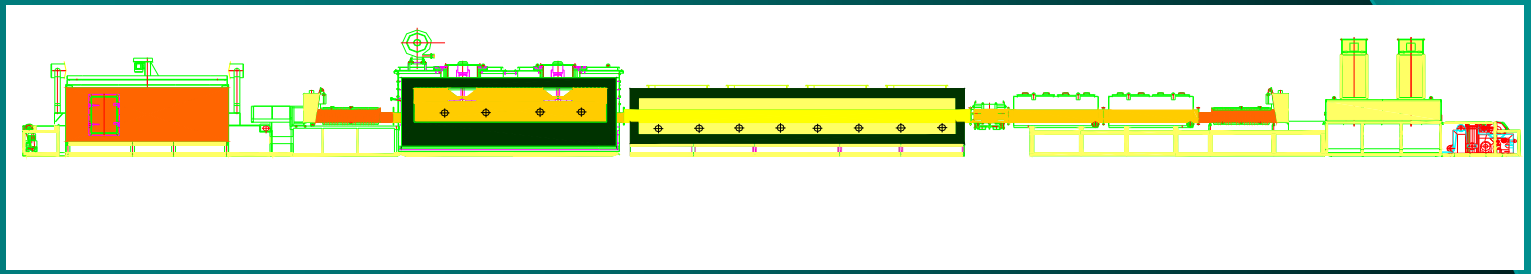
* 300 kW (gas) of savings possible to achieve on the line of ~700 kW original consumption.

* 72.000, - EUR savings per year.

* 0,09 - EUR savings per core.

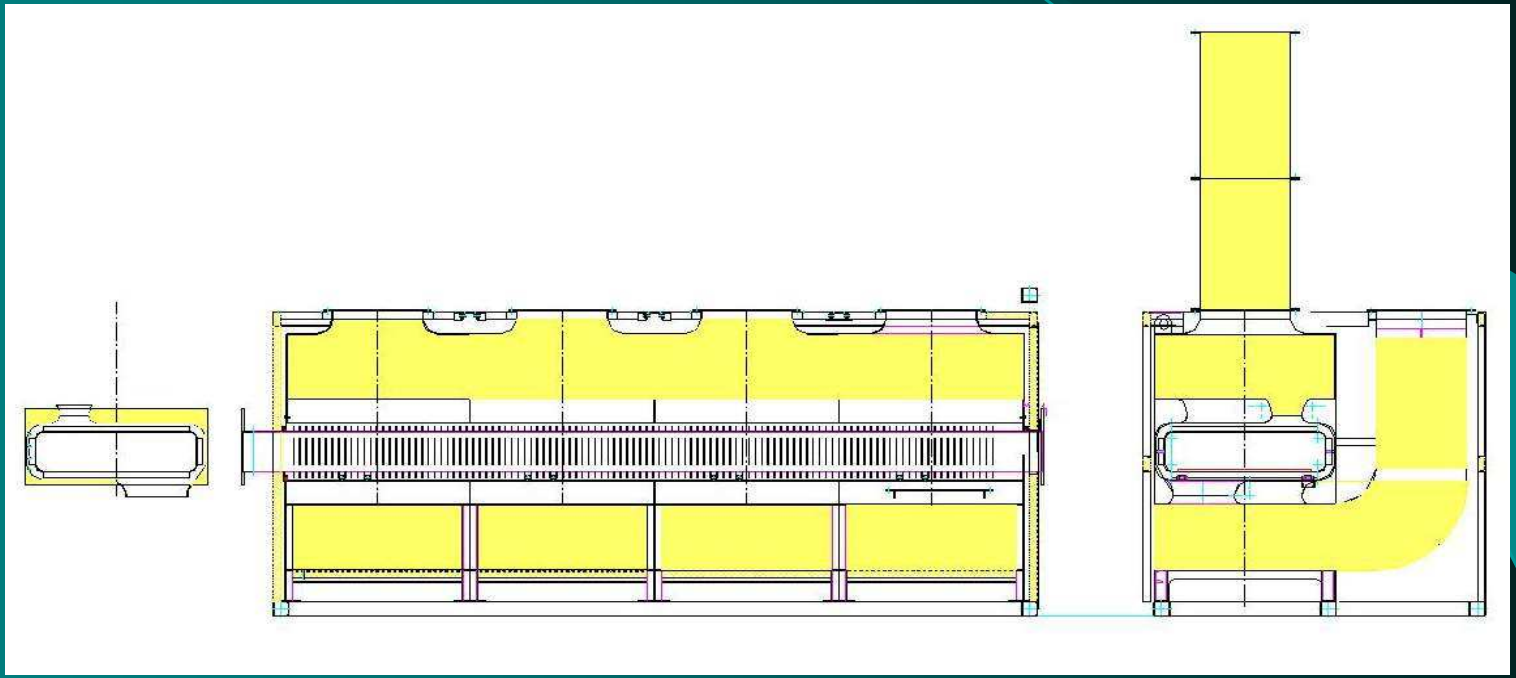
CAB line for precoated materials or paint flux technology reduces energy consumption





Power saving for reference example of CAB line is 130 kW (gas) in this case.

Forced air cooling instead of water jacketed in the atmosphere cooling section



The air cooling chamber eliminates water from the line structure but increases energy consumption (a level of 10 kW for the reference example).

Thank you for attention

SECO/WARWICK Ltd
Ul. Sobieskiego 8
66-200 Świebodzin
POLAND

Telephone: +48 68 38 21 713
Facsimile: +48 68 38 21 757

Web Site: www.secowarwick.com.pl