WITH MORE THAN 60 YEARS OF EXPERIENCE IN COMPRESSOR TECHNOLOGY AND HIGHLY DEDICATED EMPLOYEES, OUR FOCUS IS ON DEVELOPING AND APPLYING ADVANCED COMPRESSOR TECHNOLOGIES TO ACHIEVE STANDARD SETTING PERFORMANCE FOR LEADING PRODUCTS AND BUSINESSES AROUND THE WORLD.

HIGH EFFICIENT COMPRESSORS DLX-KK.1 AND NLU-KK.1/KTK.1

WHITEPAPER

www.secop.com

SETTING THE STANDARD
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1. OBJECTIVES

Introduce DLX-KK.1 and NLU-KK.1 platforms.

Reflect on the value to end users of high efficiency and low noise.

Provide inspiration for thinking “outside-the-box” with regards to value optimization of cabinets.

Contents

- General perspectives on the value of energy efficiency, cabinet volume
- Introduction of two new platforms
- DLX-KK.1
- NLU-KK.1/KTK.1
- Detailed results of cabinet tests for DLX-KK.1 and NLU-KK.1 compressors

Value of energy
Efficiency and
Cabinet volume

Impact of one energy class on the market price of a cabinet:

- Customer feedback: 50-100 Euro
- Sample (below): 80-180 Euro
- Average: 60-120 Euro per energy class, of which ~50% goes to the dealer/store
- → Extra turnover for OEM of A to A+ ≈ 30 Euro
- → Extra turnover for OEM of A+ to A++ ≈ 60 Euro

Estimated value of additional cabinet volume:

- +2 Euro per extra litre of volume (on market prices)
- 50% to dealer/store
- → Extra value for OEM = 1 Euro/L.

Sample prices of refrigerator/freezer cabinets

Conclusion:

1 L = 2.01 Euro
A to A+ = 80 Euro
A+ to A++ = 180 Euro

Sample: 61 cabinets from Saturn [saturnd.de]
2. BACKGROUND FOR DLX-KK.1 AND NLU-KK.1/KTK.1

- General market trends
  - Energy efficiency
  - Noise level
  - Environmental friendly refrigerants (R600a)
- Change towards ‘higher’ energy classes (new labelling + 2012 regulation)
- Natural continuation of the knowledge and success of our “UFO” (NLX-KK.2)
- Supports Secop’s overall vision of “Technology Leadership”
  - Setting new standards for efficiency and noise
Two new platforms: DLX-KK.1 & NLU-KK.1
Central European markets

2. BACKGROUND FOR DLX-KK.1 AND NLU-KK.1/KTK.1

DLX-KK.1 & NLU-KK.1 - COP values (CECOMAF)

- DLX-KK.1
- NLU-KK.1
- NLX-KK.2 (UFO)
- TLX-KK.3

COP values for different capacities (W): 40, 60, 80, 100, 120, 140, 160, 180, 200
## 2. BACKGROUND FOR DLX-KK.1 AND NLU-KK.1/KTK.1

### DLX-KK.1

<table>
<thead>
<tr>
<th>Type</th>
<th>Capacity [W]</th>
<th>COP [ePTC]</th>
<th>Capacity [W]</th>
<th>COP [ePTC]</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLX4KK.1</td>
<td>46</td>
<td>1.44</td>
<td>62</td>
<td>1.86</td>
</tr>
<tr>
<td>DLX4.8KK.1</td>
<td>60</td>
<td>1.47</td>
<td>81</td>
<td>1.90</td>
</tr>
<tr>
<td>DLX5.7KK.1</td>
<td>75</td>
<td>1.47</td>
<td>100</td>
<td>1.89</td>
</tr>
<tr>
<td>DLX7.5KK.1</td>
<td>95</td>
<td>1.48</td>
<td>127</td>
<td>1.88</td>
</tr>
<tr>
<td>DLX8.7KK.1</td>
<td>113</td>
<td>1.48</td>
<td>151</td>
<td>1.88</td>
</tr>
<tr>
<td>DLX9.4KK.1</td>
<td>126</td>
<td>1.47</td>
<td>168</td>
<td>1.86</td>
</tr>
</tbody>
</table>

### NLU-KK.1 & NLU-KTK.1

<table>
<thead>
<tr>
<th>Type</th>
<th>Capacity [W]</th>
<th>COP [ePTC]</th>
<th>Capacity [W]</th>
<th>COP [ePTC]</th>
</tr>
</thead>
<tbody>
<tr>
<td>NLU8.0KK</td>
<td>95</td>
<td>1.52</td>
<td>127</td>
<td>1.93</td>
</tr>
<tr>
<td>NLU8.8KK.1</td>
<td>107</td>
<td>1.54</td>
<td>144</td>
<td>1.97</td>
</tr>
<tr>
<td>NLU10KK.1</td>
<td>130</td>
<td>1.55</td>
<td>175</td>
<td>1.98</td>
</tr>
<tr>
<td>NLU11KK.1</td>
<td>148</td>
<td>1.55</td>
<td>199</td>
<td>1.98</td>
</tr>
<tr>
<td>NLU13KK.1</td>
<td>172</td>
<td>1.55</td>
<td>223</td>
<td>1.95</td>
</tr>
<tr>
<td>NLU15KK.1</td>
<td>194</td>
<td>1.54</td>
<td>259</td>
<td>1.95</td>
</tr>
<tr>
<td>NLU11KTK.1</td>
<td>153</td>
<td>1.45</td>
<td>193</td>
<td>1.84</td>
</tr>
<tr>
<td>NLU13KTK.1</td>
<td>172</td>
<td>1.46</td>
<td>230</td>
<td>1.87</td>
</tr>
<tr>
<td>NLU15KTK.1</td>
<td>194</td>
<td>1.45</td>
<td>259</td>
<td>1.84</td>
</tr>
</tbody>
</table>
TURN DOWN THE NOISE
BOOST EFFICIENCY

R_\text{600a}_

DLX-KX.1 compressors

50\% MORE SILENT THAN COMPARABLE COMPRESSORS AS A RESULT OF A NEW PLATFORM THAT COMBINES LOW NOISE AND HIGH EFFICIENCY

20\% HIGHER COP EXCEPTIONAL IN THE LOW CAPACITY RANGE

WITH MORE THAN 60 YEARS OF EXPERIENCE IN COMPRESSOR TECHNOLOGY AND HIGHLY DEDICATED EMPLOYEES, OUR FOCUS IS ON DEVELOPING AND APPLYING ADVANCED COMPRESSOR TECHNOLOGIES TO ACHIEVE STANDARD SETTING PERFORMANCE FOR LEADING PRODUCTS AND BUSINESSES AROUND THE WORLD.
3. **DLX-KK.1: 50 % MORE SILENT**

Average noise level of high-efficient compressors, panel measurements

---

**Comparison of average noise level at LBP CECOMAF**

- **DLX-KK.1:** 4-5 dBA lower than competitors
- **Secop DLX-KK.1**
- **Secop NLU-KK.1**
- **Competitor**
- **Competitor**
- **Competitor**

3 dBA lower noise → 50 % more silent!
3. **DLX-KK.1:**

50% MORE SILENT

Lower noise confirmed in cabinet tests

Tested by Secop

**DLX4KK.1:** 37.1 dBA → 50% more silent

Competitor: 40.1 dBA

Tested by Secop

**DLX5.7KK.1:** 39.2 dBA

“Compressor is calm and quiet”

Competitor: 41.2 dBA

“Compressor is easy to hear”

Tested by Customer

**DLX7.5KK.1:** 38.8 dBA → 50% more silent

Competitor: 40.9 dBA

Tested by Secop

Value of noise level

Question: Which refrigerator would you choose?

**Option 1: Standard**

- Price: 595,- Euro

**Option 2: 50% more silent**

- Price: 615,- Euro
4. DLX-KK.1: PERSPECTIVE ON NOISE LEVEL

Our perspective on noise level

Low noise is becoming increasingly important
- ‘Open’ kitchen environment
- Comfort of living
- Visible on future energy labels

Example of value analysis:
An end-user would be willing to pay 15 Euro extra for 50 % less noise ~ 5 Euro per 1 dBA reduction
- 50 % goes to the store/dealer
- Added turnover for OEM: 7.50 Euro per cabinet
- Minus price premium for low noise compressor [DLX-KK.1]: 3.00 Euro
- Added profit for OEM: 4.50 Euro per cabinet

Conclusion: value of noise level

Average noise level of high-efficient compressors, panel measurements

Comparison of average noise level at LBP CECOMAF

DLX-KK.1: 4-5 dBA lower than competitors
Added profit to OEM = 6-8 Euro

DLX-KK.1: 3-4 dBA lower than competitors
*Added profit to OEM = 4-6 Euro

*) Panel measurement
**) Catalogue values
High efficiency compressor
- Brand new platform and design, which will replace existing TL models
- COP values of 1.44-1.49*
- Exceptional efficiency in low capacity range
- Extended capacity range: 4-10 cm³ (48-135W*)

*) CECOMAF conditions

5.
DLX-KK.1: HIGH EFFICIENCY COMPRESSOR

![Graph showing COP values for DLX-KK.1 and competitors. The graph includes data points for capacity (W) and COP values, with different markers for each competitor.]
Energy savings in cabinets

DLX-KK.1 shows significant savings in cabinet tests – compared to existing TL-platform as well as compared to competitors.

Cabinet measurements:

Energy consumption (kWh/d) in %

DLX-KK.1 vs. TLX-KK.3

Energy consumption (kWh/d) in %

DLX-KK.1 vs. competitors (top-range)

DLX-KK.1 shows significant savings in cabinet tests – compared to existing TL-platform as well as compared to competitors.
6. DLX-KK.1: WHAT TO DO WITH...

What to do with additional COP/efficiency?

Assumption: Increasing the COP of compressor by ~25 percent can improve the Energy Class of a cabinet

Relationship between COP and energy class

COP-level

A

A+

A++

A+++ +25% +25% +25%

+30 Euro

+60 Euro

+?? Euro

Cooling capacity (W)

40 50 60 70 80 90 100 110 120 130 140

COP (W/W)

0.9 0.95 1.0 1.05 1.1 1.15 1.2 1.25 1.3 1.35 1.4 1.45 1.5 1.55 1.6

Compressor market overview – 40-140 W (CECOMAF)

Scenario 1)
Jump one energy class by utilizing DLX-KK.1

Scenario 2)
"First you add a superior compressor..."
Scenario 1)
Jump one energy class with DLX-KK.1
- Replace current compressor (COP < 1.15) with DLX-KK.1
- Improving the energy class will instantly increase the market value of a cabinet
- No other investments required
- Plug-and-play ("Plug-and-get-paid")

Example:

<table>
<thead>
<tr>
<th>Change</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>A ---&gt; A+</td>
<td>37.5</td>
</tr>
<tr>
<td>Increase sales price of cabinet (30 Euro for efficiency + 7.50 Euro for low noise)</td>
<td>37.5</td>
</tr>
<tr>
<td>Extra price for DLX-KK.1 compressor with 25% higher COP and 50% less noise</td>
<td>15.0</td>
</tr>
<tr>
<td>Other costs/investments</td>
<td>0.0</td>
</tr>
<tr>
<td>Added profit for OEM</td>
<td>22.5</td>
</tr>
</tbody>
</table>

Sample prices of refrigerator/freezer cabinets

Conclusion:

1 L = 2.01 Euro
A to A+ = 80 Euro
A+ to A++ = 180 Euro
Upgrading a compressor from e.g. COP 1.25 to 1.49 (+19 %) can be the first ingredient in a combined effort to improve the energy class of a cabinet.

### Supporting technologies:

<table>
<thead>
<tr>
<th>Technology</th>
<th>Vacuum Insulation Panels</th>
<th>PU Foam optimization</th>
<th>Heat exchanger optimization</th>
<th>No frost optimization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency gain</td>
<td>10-15 %</td>
<td>3 -10 %</td>
<td>0 to 5 %</td>
<td>&lt;10 %</td>
</tr>
<tr>
<td>Effort / others</td>
<td>0.6 – 1.5 m²</td>
<td>5 % on special machinery – large investment</td>
<td>5 % pure refrigerators HX optimization + electronics</td>
<td>Use ECM fan motors</td>
</tr>
<tr>
<td>Cost</td>
<td>30 – 50 Euro/m²</td>
<td>3-5 Euro/appl. for special</td>
<td>1-3 Euro/appl.</td>
<td>3-4 Euro/fan</td>
</tr>
</tbody>
</table>

Example of value analysis:
- Current compressor with COP of 1.25 in an A cabinet
- Compressor is replaced by a DLX-KK.1 with COP of 1.49 (+19 %)
- Insulation optimization is introduced to gain additional efficiency (~5 %)

#### Example:

- Increased sales price of cabinet (30 Euro for efficiency + 7.50 Euro for low noise)  
  - Price premium for Secop compressor with additional 20 COP points  
  - Total cost for PU foam optimization  
  - Added profit for OEM

<table>
<thead>
<tr>
<th></th>
<th>A → A+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased sales price of cabinet</td>
<td>37.5 Euro</td>
</tr>
<tr>
<td>Price premium for DLX-KK.1</td>
<td>15.0 Euro</td>
</tr>
<tr>
<td>PU foam optimization</td>
<td>5.0 Euro</td>
</tr>
<tr>
<td>Value surplus</td>
<td>17.5 Euro</td>
</tr>
</tbody>
</table>
7. DLX-KK.1: SUMMARY OF BENEFITS

Summary of benefits
- Exceptionally low noise level
- High efficiency demonstrated in cabinets
- Extended cooling capacity range (4-10 cm³)
- Best-in-class performance for the small capacities

Possible value analyses for a specific customer

<table>
<thead>
<tr>
<th>Performance</th>
<th>Noise</th>
<th>Logistics</th>
<th>Total value</th>
<th>Price of DLX-KK.1</th>
<th>Value surplus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>43</td>
<td>34</td>
</tr>
<tr>
<td>22</td>
<td>15</td>
<td>5</td>
<td>1</td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>
SUPERIOR PERFORMANCE FOR FUTURE ENERGY DEMANDS

R600a
NLU-KK.1 COMPRESSORS

1.98 COP

THE HIGHEST LEVEL EVER FROM A FIXED SPEED COMPRESSOR
THE HISTORICALLY HIGH EFFICIENCY BRINGS YOU ONE STEP CLOSER TO COPING WITH FUTURE ENERGY DEMANDS (1.55 BY CECOMAF)

WITH MORE THAN 60 YEARS OF EXPERIENCE IN COMPRESSOR TECHNOLOGY AND HIGHLY DEDICATED EMPLOYEES, OUR FOCUS IS ON DEVELOPING AND APPLYING ADVANCED COMPRESSOR TECHNOLOGIES TO ACHIEVE STANDARD SETTING PERFORMANCE FOR LEADING PRODUCTS AND BUSINESSES AROUND THE WORLD.
8. NLU-KK.1: HIGHEST COP ON THE MARKET

Highest COP on the market

- COP values of 1.54-1.55*
- Capacity of 99-194 W [8.0-15 cm³]*
- Available in KTK.1-version for tough market conditions

### NLU-KK.1 - COP values (CECOMAF)

<table>
<thead>
<tr>
<th>Capacity (W)</th>
<th>COP</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>1.60</td>
</tr>
<tr>
<td>110</td>
<td>1.55</td>
</tr>
<tr>
<td>130</td>
<td>1.50</td>
</tr>
<tr>
<td>150</td>
<td>1.45</td>
</tr>
<tr>
<td>170</td>
<td>1.40</td>
</tr>
<tr>
<td>190</td>
<td>1.35</td>
</tr>
<tr>
<td>210</td>
<td>1.30</td>
</tr>
</tbody>
</table>

*Capacity and COP values are approximations and may vary depending on specific conditions.
Energy savings in cabinets

NLU-KK.1: HIGH EFFICIENCY COMPRESSOR

NLU-KK.1 vs. NLX-KK.2

NLU-KK.1 vs. competitors (top-range)

NLU-KK.1 shows significant savings in cabinet tests – compared to existing NLX-platform as well as compared to competitors.
10.

NLU-KK.1: WHAT TO DO WITH...

What to do with additional COP/efficiency?

Assumption: Increasing the COP of compressor by ~25 percent can improve the Energy Class of a cabinet

![Graph showing relationship between COP and energy class]

Two scenarios...

What to do with NLU-KK.1 COP of 1.54-1.55?

![Graph showing compressor market overview - 100-200 W (CECOMAF)]

Scenario 1)
Jump one energy class by utilizing NLU-KK.1

Scenario 2)
"First you add a superior compressor..."
Scenario 1
Jump one energy class with NLU-KK.1

- Replace current compressor (COP<1.25) with NLU-KK.1
- Improving the energy class will instantly increase the market value of a cabinet
- No other investments required
- Plug-and-play ("Plug-and-get-paid")

**Compressor market overview – 100-200 W (CECOMAF)**

**Example:**

<table>
<thead>
<tr>
<th>Change</th>
<th>Cost (Euro)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A → A+</td>
<td>30.0</td>
</tr>
<tr>
<td>Extra price for Secop compressor with 25% higher COP</td>
<td>15.0</td>
</tr>
<tr>
<td>Other costs/investments</td>
<td>0.0</td>
</tr>
<tr>
<td>Added profit for OEM</td>
<td>15</td>
</tr>
</tbody>
</table>

**Sample prices of refrigerator/freezer cabinets**

**Conclusion:**

- 1 L = 2.01 Euro
- A to A+ = 80 Euro
- A+ to A++ = 180 Euro
Scenario 2) Going for the next level

Upgrading a compressor from e.g. COP 1.35 to 1.55 (+15 %) can be the first ingredient in a combined effort to improve the energy class of a cabinet.

Supporting technologies:

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<td>1-3 Euro/appl</td>
<td>3-4 Euro/fan</td>
</tr>
</tbody>
</table>

Example of value analysis

- Current compressor with COP of 1.35 in an A+ cabinet
- Compressor is replaced by a NLU-KK.1 with COP of 1.55 (+15 %)
- Vacuum panels are introduced to gain additional efficiency (~8 %)

Example:

- Increased sales price of cabinet A+ ---→ A++ 60 Euro
- Price premium for Secop compressor with additional 20 COP points 12 Euro
- Cost for vacuum panels (1.2 m² @ 35 Euro) 42 Euro
- Added profit for OEM 6 Euro
11.

NLU-KK.1: ALSO ‘EFFICIENT’ IN TERMS OF NOISE

Average noise level of high efficient compressors

Comparison of average noise level at LBP CECOMAF

<table>
<thead>
<tr>
<th>Capacity (W)</th>
<th>Noise [dBA]</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>39</td>
</tr>
<tr>
<td>60</td>
<td>39</td>
</tr>
<tr>
<td>80</td>
<td>39</td>
</tr>
<tr>
<td>100</td>
<td>39</td>
</tr>
<tr>
<td>120</td>
<td>39</td>
</tr>
<tr>
<td>140</td>
<td>39</td>
</tr>
<tr>
<td>160</td>
<td>39</td>
</tr>
<tr>
<td>180</td>
<td>39</td>
</tr>
<tr>
<td>200</td>
<td>39</td>
</tr>
</tbody>
</table>

Secop DLX-KK.1*  Secop NLU-KK.1*  Secop NLX-KK.2  Competitor*  Competitor**  Competitor*

NLU-KK.1: 1-2 dBA lower than competitors

* Panel measurement  ** Catalogue values
**12. NLU-KK.1: SUMMARY OF BENEFITS**

**Summary of benefits**
- Highest COP on the market from fixed speed compressor
- Possibility of upgrading energy class of cabinet without investments
- The first ingredient in preparing for future energy demands

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Next-best Alternative</th>
<th>Performance</th>
<th>Noise</th>
<th>Total value</th>
<th>Price of NLU-KK.1</th>
<th>Value surplus</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25</td>
<td>15</td>
<td>1</td>
<td>56</td>
<td>44</td>
<td>12</td>
</tr>
</tbody>
</table>

Possible value analyses for a specific customer
DESIGNED FOR HARD WORK UNDER TOUGH CONDITIONS

R600a
NLU-KTK.1 COMPRESSORS

20%
HIGHER PERFORMANCE THAN PREVIOUS MODELS, WITH THE ABILITY TO START UNDER LOW VOLTAGE CONDITIONS

WITH MORE THAN 60 YEARS OF EXPERIENCE IN COMPRESSOR TECHNOLOGY AND HIGHLY DEDICATED EMPLOYEES, OUR FOCUS IS ON DEVELOPING AND APPLYING ADVANCED COMPRESSOR TECHNOLOGIES TO ACHIEVE STANDARD SETTING PERFORMANCE FOR LEADING PRODUCTS AND BUSINESSES AROUND THE WORLD.
NLU-KTK.1: DESIGNED FOR HARD WORK

**Designed for hard work**
- Based on NLU-KK.1-platform
- Especially suitable for markets with
  - High ambient temperatures
  - Unstable power supply (voltage fluctuations)
- Enables OEMs to achieve wider geographical coverage
- Expected COP of 1.45-1.48 / 1.80-1.84*
- 3 sizes:
  - 11 cm³ ~145 W/193 W*
  - 13 cm³ ~175 W/233 W*
  - 15 cm³ ~190 W/253 W*

*CECOMAF/ASHRAE

**Energy savings in cabinets**
Compressor from a competitor replaced by NLU13KTK.1

Energy test:
- NLU13KTK.1: Savings > 19 %
- → Potential upgrade to next energy class
- Added value of 30-60 Euro
OUR IDENTITY
At Secop we are committed to our industry and are genuinely passionate about the difference we are able to make for our customers. We understand their business and objectives and the challenges of today’s world of refrigeration and cooling systems.
We work in a straightforward way, being open, direct and honest because we want to make things clear and easy. Our people are committed to increasing value for our customers and constantly strive for better performance, knowing that our own progression and success is dependent on theirs.

A NEWCOMER WITH 60 YEARS OF EXPERIENCE
Formerly known as Danfoss Compressors, Secop is one of the founding fathers of modern compressor technology with an experience that goes back to the beginning of the 1950s.
For more than 25 years, Secop has been setting the standard in compressor technology by developing highly efficient variable-speed compressors and by compressors working with hydrocarbons.

OUR JOURNEY SO FAR

1956  Production facility and headquarters in Flensburg, Germany founded.
1958  Start of production for PW compressors.
1972  Introduction of FR compressors.
1977  Introduction TL and BD compressors.
1979  Start of production with natural refrigerant R290 (propane).
1980  Production facility in Wuqing, China founded.
1993  Start of production with natural refrigerant R600a (isobutane).
1995  Production facility in Crnomelj, Slovenia founded.
1999  Introduction of OS compressors.
2002  Production facility in Zlate Moravce, Slovakia founded.
2005  Introduction of GS compressors.
2009  Introduction BD1.4F Micro DC compressor.
2010  Production facility in Wuqing, China founded.
2015  New generation of energy-efficient propane compressors.
2017  New variable-speed platforms for household and light commercial applications.
2018  Introduction BD Micro DC compressor.
2019  Introduction of the XV compressor opening a new chapter in refrigeration history.
2020  Secop acquires ACC Fürstenfeld, Austria.

Low High

HOUSEHOLD

Light Commercial

AC

P-Series  T-Series  DELTA  X-Series  KAPPA  D-Series  N-Series  F-Series  S-Series  G-Series

DC

BD Micro  BD P-Housing  BD T-Housing