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22457

**UNIDO Contract No.: 98 / 162**

**Project No.: MP / CPR /97 / 202**

**Activity Code: 460D31**

## **FINAL REPORT**

Subject:

**Provision and services and transfer of technology  
Related to the Conversion of Compressor Production  
For Household Refrigerators from CFC 12 to R 134a  
At the Yuhuan Refrigerator Compressor Factory in  
Kanmen Town in the  
PEOPLE'S REPUBLIC OF CHINA**

Made in Eger, Hungary, 06-th of December 2000.

This report contains the cover page, 7 pages of text and 24 pages of appendix, including 4 pages of drawings

# Final Report

## Continuation of Fourth Progress Report

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Appendix 2.	( Protocol of "0"series of Yuhuan) (5+12)=	17 pages
Appendix 3.	( Summary table of "0" tests of Yuhuan)	1 pages
Appendix 4.	( Summary table of Berva "0" samples)	1 pages
Appendix 5.	( Improving construction drawings )	4 pages
	B-Y-007-1 (Valve plate) ( size:A3 )	
	B-Y 002 (Suction valve leaf) ( size:A3 )	
	B-Y 008/1 (Fixing plate) ( size:A4 )	
	B-Y-062/1 (Suction muffler II.) ( size:A3 )	

## 1. Antecedents

In accordance with the mutual agreement, made In Yuhuan on 27. April, see 1. Appendix of the Fourth Progress Report, the Yuhuan Compressor Factory manufactured and matched the parts of 3+10+10 =23 pieces “0” series models of QD 51, 57, and 66. The original number of samples, was 3 x 15 pcs., what they couldn't produce because of unknown reason.

The suction valve leafs for the models, was produced by Berva individually.

The suction muffler was produced and welded by Branson machines, unfortunately there was not perfect welding, as it can be read in test and acceptance protocol made in Yuhuan ( Appendix 2. ).

During the November visit in Yuhuan the Washing machines have been tried and accepted by Yuhuan. The surveying lists, Appendix 2. of 4. Progress Report made in April, 2000.,has been changed, by the oil drying unit, which have been planted, the aluminium press casting machine and the mould of plastic muffler are underway to the factory.

The way of manufacturing of compressor parts was partly different from the final technological prescriptions, because of lack of some auxiliary processing material e.g. cutting compounds.

## **2. Production and tests of “0” samples in China**

The compressor samples produced by SLDQ Yuhuan was assembled and tested in the laboratory of Yuhuan factory between 13. and 24. November. The bottom compressor shells had been made with suction pipe position, differently from the original design of that. Consequently we had to change the position locally, by experimental way opposite to the suction orifice of suction muffler, the original hole of pipe has been soldered by silver soldering rod. The type of oil lubricant filled in compressor: EMKARATE RL 22H product of ICI, the prescribed quantity: 250 ccm, as it was told, but there was no oil test protocol.

In the preliminary time schedule of ‘0’ production and tests there was required the measured and mated compressor parts, but the measuring protocols were missing prior to assembly. The proceeding of activities happened basically in accordance this schedule see enclosed as Appendix 1. We couldn’t compare the surface qualities and the dimensions with the prescriptions. The exact measurement protocols will be made by Berva, and the performance and noise test comparisons as well in Hungary, because SLDQ promised to send the send 3x3 tested samples to Berva Rt. factory for request of Berva representative for analysis and comparison. The protocol of ‘0’ production, test procedures, test protocols for noise and calorimeter and precursory evaluations see enclosed in Appendix 2. The summary of calorimeter and noise tests of Yuhuan ‘0’ series is shown in Appendix 3. There are collected the assembled and tested 10 compressor samples, with the mean ( average ) values of results, the differences from the contract values ( R12 performances ) in absolute values and in percents too. The results of noise test are the same like it was measured in Berva Acoustical Laboratory, but the cooling capacities an COP-s are smaller than we measured in our factory. The differences are smaller than the allowable tolerance in statement of these according to the standard EN 12900. The reasons can be probably found in the machining, mating and settings, because there was not the final technology used in the part production. The real reasons will be found after the repeated test and analysis of the parts in Berva. The reasons must be discovered for drawing a lesson, what kind of process must be paid particular attention to, during the future mass production.

### 3. Preliminary “0” tests in Berva

There was also assembled compressor samples in Berva, according to the new design. The missing parts like suction valve leaf and suction muffler had been produced individually. The shells we used more times and we prepare individual mountable bottom and top shells, because of limited number of shell parts.

The tests has been made partly in mountable, partly in welded shells.

The calorimeter and noise test results please find in the summary table marked as Appendix 4. The noise results are very similar to the tests in Yuhuan, but the calorimeter test results are much better. The energy consumption (power input) is less than at the Yuhuan ‘0’ tests or almost similar, the difference is 2- 5 W, but the refrigerating capacity show smaller, with 7- 13 W differences. There was made more tests beyond the calorimeter and noise performances, but we want to highlight only the start ability tests, as the most important beside the previous parameters, and this was affected by the construction changes. The test was executed in accordance with the MSZ 05 Hungarian standard, in cold condition in refrigerant circle.

The condition is the following:

Winding temperature: 32 °C

Refrigerant: R134a

Suction pressure: 4.9 bar ( saturated pressure of +15 °C of refrigerant )

Discharge pressure: 4.9 bar ( saturated pressure of +15 °C of refrigerant )

Number of starts: 10 / compressor

Frequency: 50 Hz

Required voltage, where every start is successful:  $0.9 \times U_{\text{nominal}} = 198\text{V}$

The start ability QD compressor models is much better than the standard requirement.

The **found lower voltage limit** of models at the above parameters:

**QD 51: 145 V**

**QD 57: 150 V**

**QD 66: 150 V**

## 4. Further improving construction proposals

### 4.1 Proposals for improvement of thermodynamic performances

#### a.) For increment of refrigerating capacity

The results of Yuhuan '0' production tests show that the refrigerating capacity was found in principal smaller than the predicted, and the value of Berva tests. The reason of the difference will be investigated after reception of the mentioned samples in Berva, but we want to suggest for Yuhuan Compressor Factory some possible modification for consideration or choice.

- a1. Please to consider the use of thinner suction valve leaf. The reduction from 0.2mm to 0.18 or 0.16 mm is advisable. The rate of reduction can be decided after execution of accelerated life time ( 30 /2 or 27 /0.7 bar ) test for both size.
- a2. Please to try to reduce the gap between the piston and cylinder from the present reported 10- 12  $\mu$  to at least 8- 10  $\mu$ . In case of some advanced compressor producer firm it is 4- 5  $\mu$  only, but the surfaces and the shape faults of piston and cylinder must be kept in smaller range.
- a3. The dead volume of cylinder must be kept below 0.1 mm , even if the trials after the '0' tests didn't show improvement in cooling capacities.
- a4. For the diameters of discharge bore we propose a radical reduction, because these reduced sizes of bores can be enough for the actual refrigerant flow, besides the noise level will be further reduced therefore, and there are large reserves in the starting ability, as we reported in paragraph 3. The proposed sizes can be seen in drawing No.: B-Y-007-1 what is a part of Appendix 5. besides other drawings.
- a5. We propose the use of straight suction valve leaf differently from the mutual accepted drawing of bent suction valve leaf. Please find enclosed in Appendix 5. , No.: B-Y 002. The bent type of valve leaf is advantageous in case of bad starting properties of compressors, - what has no significance see in paragraph 3.  
The '0' samples in Yuhuan and the samples in Berva was also manufactured with straight suction valves.
- a6. Please to play also more attention to the deburring of valve leafs and sits.

### **b.) For increment of COP by decreasing of friction**

- b1.** Please to try to reduce the sliding surface roughness of crankshaft and the bearings in the cylinder block, and in connecting rod.  
The present prescription is Ra 0.4
- b2.** Parallel with the roughness reduction the use of oil with lower viscosity can further decrease the friction and the power consumption.
- b3.** Please to check the possibility of application of iron core made of better quality, to decrease the motor losses.

### **4.2 Drawing modifications for more reliability**

Beside the above mentioned proposed modifications there are two drawings modified enclosed in the Appendix 5.

- a.)** The fixing plate of suction muffler No.: B-Y 008/1 . The fixture of muffler is more stable by application of this version. The '0' samples was assembled also with this version in Yuhuan, (produced and taken to Yuhuan by Berva) and in Berva as well.
- b.)** Suction muffler II. No.: B-Y-062/1  
In accordance with the leakage test of PBT suction mufflers in Yuhuan, see in Protocol of '0' series ( Appendix 2. ) the ultrasonic welding of the two parts off mufflers was not perfect, because there was found some slight leakage in about one third of mufflers. The Muffler II. has been equipped with supplementary rip on the surrounding outer edge, and the plus material of that can fill the gaps during the ultrasound welding more perfectly.  
The rip size is shown on magnified detail "B" of before named drawing.  
Although the function of muffler probably wasn't seriously disturbed, this modification is necessary for the construction.  
The modification of muffler mould can not be made by Yuhuan factory, hence they would like to ask UNIDO to help them by a Branson expert, who could make this small modification in Yuhuan locally because it needs pretty accuracy.



## 5. Summary

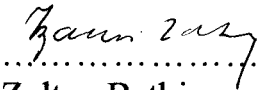
The '0' series production and tests have been executed, although in reduced number, than it was planned. The few number of samples and the non serial featured machining could a little degraded the results. The introduction of the entire new technology of production will be executed in the next year probably.

In spite of this fact, the introduced and up to now tried parts of technology, are able to work properly, like the washing and the laboratory examinations and equipment. The conversion technology delivered by Berva can function at the other productions as well eg. at isobutane compressor production what the Yuhuan factory want to introduce too, as second alternative of phase out of R 12 refrigerant. Unfortunately the troubles of purchase of machines, tools and processing materials slowed down the introduction of complete new technology, but the available parts of that seem properly operable and acceptable for the factory. The trials of compressor performances have some uncertainty, concerning the calorimeter tests in Yuhuan, seems slightly disagreeing with the tests of Berva, what was executed on similar samples. The reasons of the differences will be clarified after repeated test and analysis of the mentioned samples in Berva. Besides the improving proposals ( paragraph 4. ) will also generate further betterment in the questioned parameters.

The Berva Co. Ltd. is willing and ready to go on the co operation with the Yuhuan factory in the future, even if this project will be finished.

Our factory is waiting and hope the earliest start of all-embracing mass production with the adherent production technology.

Made in Berva Co. Ltd. Eger, December 06. 2000.

  
.....  
Zoltan Batki  
Technical Director

UNIDO Contract No.: 98 / 162  
 Project No.: MP / CRP / 97 / 202  
 Activity Code: 460D31

### Preliminary time schedule of „0” series test activity in November 2000. Yuhuan China

Item	Activities	Responsible	Number of estimated days necessary	Workdays																				
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1.	Supply of checked compressor parts, according to the new drwgs. 3 x 15 pcs.	SLDQ	0					●																
2.	6 washing machines get ready for operation	METALLUX SLDQ	5	■	■	■	■	■																
3.	Chemical test protocol of supplied water of washing machines for filling	SLDQ	0					●																
4.	Washing of parts of 3 x 15 compressors	SLDQ METALLUX BERVA	1	■	■	■	■	■																
5.	Purity test of groups of compressor parts (conditions prior to assembly)	SLDQ METALLUX BERVA	3	■	■	■	■	■																
6.	Complete oil test protocol ( oil properties prior to the filling in compressors)	SLDQ	0					●																
7.	Assembly and operation check of 3 x 15 pcs. compressors)	SLDQ BERVA	2							■	■													
8.	Test and protocol of remaining moisture test in compressors (dew point tests)	SLDQ BERVA	2							■	■													
9.	Calorimeter test of 3 x 15 compressors	SLDQ	5							■	■	■	■	■										
10.	Noise test of 3 x 15 compressors	SLDQ	5							■	■	■	■	■										
11.	Evaluation and protocol of calorimeter and noise tests	SLDQ METALLUX BERVA	2									■	■											
12.	Launch of other agreed long run tests	SLDQ BERVA	4									■	■	■	■									

Planned presence on site: METALLUX  
 BERVA :

with 4 persons  
 1 person Laszlo Kovacs  
 2 fő Istvan Homoki  
 Janos Pusztai

on 1 ÷ 5 workdays  
 1 ÷ 14 workdays  
 6 ÷ 14 workdays  
 6 ÷ 14 workdays

Made by: Janos Pusztai  
 in Eger, 2000. October 20.

**Protocol of the "0" series production and test of UNIDO conversion  
project MP/CPR/97/202  
UNIDO 转换项目 MP/CPR/97/202  
“O”系列样机生产测试备忘录**

*Made:* In official room of Yuhuan County Refrigerator Compressor Factory (SLDQ) in Yuhuan, China, on 24-th of November 2000

中国玉环, 2000.11.24

Person in charge of SLDQ: Mr. Li Shujin, Vice President

Mr. Yuan Wei, Dept. Director

玉环工厂负责人: 李书锦先生, 副总裁; 袁伟先生, 部长

Person in charge of Berva Co. Ltd.: Mr. Laszlo Kovacs, Lab Chief Eng.

Berva 公司负责人: Laszlo Kovacs 先生, 实验室主任

**Subject:** Production, test, and evaluation of "0" series of QD compressors,  
Converted to R 134a refrigerant

主题: QD "O"系列样机转换为 R134a 工质的生产、测试和评估

***Introduction 简介:***

In accordance with the last agreement dated in April 2000, SLDQ manufactured and matched the components of QD compressors but only 23 pieces is complete available in the following division:

按照 2000 年 4 月份双方达成的备忘录, 玉环工厂生产、装配了 QD 压缩机, 但只有 23 台可用于性能测试。各型号数量如下:

QD 66        10 pcs.

QD57        10 pcs.

QD 51        3 pcs.

The parts was produced according to the new drawings, supplied and given to SLDQ by Berva in April this year with mutual approval an signatures.

The preparation of new technology has not been fully presented and used, because of the lack of most machines tools and auxiliary materials.

玉环工厂按照今年 4 月份 Berva 公司提供且经双方签字认可的新图纸, 制造了工件。因大部分设备、工具和材料没能及时就位, 转换中将要采用的新技术无法得以全面实施。

The situation of the machines and tools is almost the same like in April this year, which was reported to UNIDO in the 4. Progress report, part 1., appendix 2. and 3.

设备及工具目前的状况与今年 4 月份时的几乎相同。有关设备及工具在 4 月份时的状况的报告已提交给 UNIDO, 具体为进展报告 4 第一部分、附件 2 和 3。

Consequently we could get information only about the construction of the new compressors, and partly the performances.

因此，我们仅仅只能了解有关新工质压缩机的结构和部分性能方面的情况。

### **1. Activities 工作内容:**

According to the Preliminary Time Schedule, what had been sent to SLDQ and UNIDO by Berva in October this year, the assembly, the drying and round-welding of compressors has being done since 13. November continuously for tests. The tests began in the second part of this week.

根据事先制订且于今年 10 月份提交给玉环工厂和 UNIDO 的时间表，11 月 13 日以来，先后实施完成了实验前的压缩机装配、干燥和封焊等工作。测试工作于本周开始。

In accordance with the facilities and pledge of SLDQ laboratory personals, 3 pcs of compressors pro type (total 9) can be tested by calorimeter, but all of 23 pcs. (10+10+3) for noise, until the planned deadline of the above time schedule. The capacity of calorimeter is only 2 pcs/ day, because the laboratory spend 4 hours for one machine.

根据玉环工厂的设施和实验室人员的保证，截止预定日期，用量热计可测试各型号 3 个共 9 台，噪声测试共 23 台（10+10+3）。因一台量热计测试一台压缩机需 4 小时，故一天只能测试 2 台。

The representative of Berva has a doubt, because of the low number of calorimeter test, and propose to go on the tests on all of samples.

因用量热计测试的压缩机的数量过少，Berva 对样机测试结果不太确定，因此建议玉环工厂继续对所有样机均进行测试。

Besides Berva asks SLDQ to send at least the tested minimum 3x3 compressor samples to Berva factory in Hungary, because they want to execute both the noise and calorimeter tests on them, as comparison.

此外，Berva 要求玉环工厂将已测试的样机，每个型号至少 3 台（共 3×3 台）送往 Berva 公司，因 Berva 打算在其工厂进行噪声和量热计测试，以进行比较。

### **2. Evaluation 评估**

The results of tests show, that the noise parameters meet the requirements of UNIDO contract. The found noise levels ( in dBA) are generally lower, than the target values of agreement.

测试结果表明，噪声参数符合 UNIDO 合同的规定值。测试出的噪声，与合同值相比，总体偏低。

The undertaken values in contract are the followings:

合同规定的噪声值如下：

QD 51      40 dBA

QD 57 41 dBA

QD 66 41 dBA

The thermodynamic parameters show not an uniform pictures.

测试出的热力参数, 不同样机, 差异较大。

The efficiencies ( COP ) of QD 51 and QD56 is lower than the contract value, and is a little higher at QD 66 models. The detailed values are indicated in attached test reports.

QD 51 和 QD57 的 COP 值低于目标值; QD 66 的则略高于合同值。具体见随附的测试报告。

The undertaken values are 1 for QD 51, 57, and 66 equally.

合同规定的 QD 51, 57 和 66 COP 值均相同, 为 1。

The refrigerating capacities are lower than the target values, although the values are dispersed and the number of tested samples is few, for doubtless judgement about this fact.

与目标值相比, 制冷量较低。虽然测得的结果与合同规定不一致, 但考虑到测试的样机的数量少, 就此判定样机制冷量不够高还存在一定疑问。

The possible reasons can be found probably in the quality of parts (surfaces, tolerances, shaping faults) and/ or maybe in the assembly, like to big dead volumes or gap between the piston and cylinder and so on.

造成制冷量达不到合同要求的可能因素有: 工件质量不合格(粗糙度、公差和形状等故障)和/或装配尺寸有问题, 如气缸余隙和活塞与缸孔见公差过大等。

The measuring protocols of each part have not been presented. The real reason or reasons smaller refrigerating capacity can be investigated after the disassembly of compressors and check of every parts of them.

玉环工厂没能提交各工件的检验记录单。只有拆开样机, 分别检测工件精度和配合公差后, 才能调查出制冷量偏小的真正原因。

The Euronorm EN 12900 also allows - 10% tolerance in refrigerating capacity in case refrigerator compressors like this.

像此类压缩机, 在制冷量参数上, Euronorm EN 12900 标准(欧洲标准)也允许-10%的偏差。

The detailed test protocols of noise and calorimeter is appended to this protocol. 噪声及量热计测试结果见测试报告。

### ***3. Proposals of Berva for start of long time tests***

Berva 公司关于其它测试的建议

a.) Blocked rotor test 转子堵转试验

-Duration 持续时间: 15 days 天

-Concerning norm 相关标准:

IEC 335 -2- 34 paragraph 19.1 第 19.1 段

( Berva handed over to SLDQ Berva 公司已提交给玉环工厂 )

b.) Accelerated life time test in R 134a refrigerant circle

在 R134a 制冷剂回路中进行加速寿命试验

- Discharge pressure 排气压力: 30 bar

- Suction pressure 吸气压力: 2 bar

- duration 持续时间: 3000 hours 小时

or similar what SLDQ used to apply 或采用玉环类似的测试系统

c.) Purity test on 1 compressor

单台压缩机的清洁度试验

-Soluble residual 可溶杂质: maximum 最大 100 mg /one compressor 单台压机

-Solid residual 固体杂质: maximum 最大 30 mg/one compressor 单台压机

d.) Capillary tube test:毛细管试验

- duration 持续时间: 2000 hours 小时

Remark: The result of purity and capillary tube test can be used as

备注: information only.

清洁度试验和毛细管试验结果仅供参考。

The competent result can be got at the compressors after sampling from the mass production, when every technological facility and condition will be available.

只有在完全使用转换所需的各项设备及技术进行批量生产，从中取样进行测试时，才能取得有效的测试结果。

**4. Yuhuan's comments 玉环工厂意见**

1.) The COP for QD51 and QD57 is much lower compared to the requirement of contract. Berva is responsible to do some modification to enhance this efficiency.

与合同要求相比，QD 51 和 QD57 的 COP 值偏低。为此，Berva 有责任做相关改进工作，以提高 COP 值。

2.) As indicated in the attached test reports, the cooling capacities for all three models (QD51, QD57, QD66) are much lower compared to the contracted values. Berva has the liability to carry out modification to increase this performance of converted R134a compressors according to the contract.

如测试报告所示，QD51, QD57 和 QD66 三个型号的样机的制冷量均过低。Berva 有义务实施有关改进措施以提高工质转换后的 R134a 压缩机的制冷量使其符合合同规定要求。

3.) According to the test result done by Yuhuan under the guidance of Berva's engineer, the samples of PBT mufflers supplied by Branson have

the faults of leakage, for which, the representative of Berva will inform UNIDO and offer the modification resolution to urge the supplier of the molds to do modification for quality mufflers.

根据 Berva 指导下玉环工厂所做的试验结果, Branson 提供的 PBT 消声器样件绝大部分漏气。因此, Berva 将通知 UNIDO 并提供改进方案以敦促模具供应商做相关改进工作以便玉环工厂生产出合格的消声器。

### 5. Summary 小结

The planned "O" series of R 134a compressors has been assembled though in reduced number.

设计的“O”系列 R 134a 样机, 在数量减少的情况下, 进行了安装。

The calorimeter and noise tests have been completed as above mentioned.

如上所述, 已进行了量热计和噪声测试。

Unfortunately the complete conversion technology could not be tried thoroughly.

According to all of trials and tests, we have been made until now, Berva asks

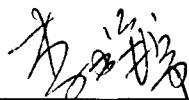
SLDQ for acceptance of the converted construction and technology.

不幸的是, 整个转换技术无法得以全盘测试考察。根据截止目前已完成的试装和测试情况, Berva 公司提请玉环工厂验收该项目的转换技术。



Berva Co. Ltd. as supplier

Berva 有限公司, 技术服务供应方



SLDQ as acceptor and user

玉环冰箱压缩机厂, 技术服务接受方和用户

**Appendix 附: Noise and Calorimeter Test Reports 噪声及量热计测试报告**  
**(3 for QD51, 3 for QD57 and 4 for QD66**  
**QD 51 和 QD57 各 3, QD66 4 台)**

浙江双龙电气集团  
玉环县冰箱压缩机厂  
电冰箱压缩机性能试验报告

编号: ZC0402B  
部门编号: D0046

委托部门	技术科	测试日期	2000-11-15
检验类别	试验样机	型号	QD57
测试依据	GB/T9098-1996	数量	1台

试验条件:

制冷剂	R-134a	冷凝温度 (℃)	54.4
环境温度 (℃)	32.2	蒸发温度 (℃)	-23.3
吸气温度 (℃)	32.2	阀前制冷剂温度 (℃)	32.2
电 容 (uf)	/	额定电压 (v)	220

试验结果:

试验项目	技术要求	样 机 编 号	
		1#	
电 流 A		0.86	
功 率 W		130.2	
制 冷 量 W		128.4	
C O P W/W		0.99	
绕组温度 ℃		105.6	
低压端壳温 ℃		78.2	
泄漏电流 mA		0.033	
绝缘电阻 MΩ		500	
冷态电气强度		通过	

结论:

--

备注:

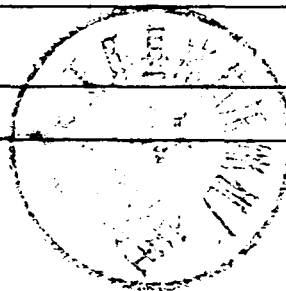
<p>八部生产R134a压缩机。(UNDO项目)</p> <p>噪声: 57.2 dB(A) 振动: 0.27 m/s<sup>2</sup></p>
---

主检: 丁丽丹

审核: 陈俊波

批准: 林建平

日期: 2000.11.15





浙江双龙电气集团  
玉环县冰箱压缩机厂  
电冰箱压缩机性能试验报告

编号: ZC0402B  
部门编号: D0047

委托部门	技术科	测试日期	2000-11-16
检验类别	试验样机	型号	QD66
测试依据	GB/T9098-1996	数量	2台

试验条件:

制冷剂	R-134a	冷凝温度 (℃)	54.4
环境温度 (℃)	32.2	蒸发温度 (℃)	-23.3
吸气温度 (℃)	32.2	阀前制冷剂温度 (℃)	32.2
电 容 (uf)	/	额定电压 (v)	220

试验结果:

试验项目	技术要求	样 机 编 号	
		1#	2#
电 流 A		0.93	0.92
功 率 W		139.4	139.3
制 冷 量 W		149.1	150.2
C O P W/W		1.07	1.08
绕组温度 ℃		105.9	99.8
低压端壳温 ℃		79.9	75.4
泄漏电流 mA		0.033	0.034
绝缘电阻 MΩ		500	500
冷态电气强度		通过	通过

结论:

备注:

八部生产R134a压缩机. (UNDO项目)

噪声: 1#: 39.2 dBA)    2#: 39.6 dBA)

振动: 1#: 0.40 m/s<sup>2</sup>    2#: 0.34 m/s<sup>2</sup>

主检: 丁丽丹    审核: 陈敏    批准: 林建平    日期: 2000.11.16

浙江双龙电气集团  
玉环县冰箱压缩机厂  
电冰箱压缩机性能试验报告

编号: ZC0402B  
部门编号: D0049

委托部门	技术科	测试日期	2000-11-17
检验类别	试验样机	型号	QD51
测试依据	GB/T9098-1996	数量	2台

试验条件:

制冷剂	R-134a	冷凝温度 (℃)	54.4
环境温度 (℃)	32.2	蒸发温度 (℃)	-23.3
吸气温度 (℃)	32.2	阀前制冷剂温度(℃)	32.2
电 容 (uf)	/	额定电压 (v)	220

试验结果:

试验项目	技术要求	样 机 编 号	
		1#	2#
电 流 A		0.83	0.86
功 率 W		114.4	116.1
制 冷 量 W		111.0	106.0
C O P W/W		0.97	0.91
绕组温度 ℃		99.0	101.5
低压端壳温 ℃		76.9	77.7
泄漏电流 mA		0.032	0.031
绝缘电阻 MΩ		500	500
冷态电气强度		通过	通过

结论:

--

备注:

八部生产R134a压缩机. (UNDO项目) 噪声: 1# 28.3 dB(A)    2#: 37.1 dB(A) 振动: 1# 0.28 m/s <sup>2</sup> 2#: 0.34 m/s <sup>2</sup>
---

主检: 丁丽丹    审核: 陈敏敏    批准: 林建平    日期: 2000.11.17

浙江双龙电气集团  
玉环县冰箱压缩机厂  
电冰箱压缩机性能试验报告

编号: ZC0402B  
部门编号: D0052

委托部门	玉环县冰箱压缩机厂(8)部	测试日期	2000-11-20
检验类别	试验样机	型号	QD68
测试依据	GB/T9098-1996	数量	2台

试验条件:

制冷剂	R-134a	冷凝温度 (℃)	54.4
环境温度 (℃)	32.2	蒸发温度 (℃)	-23.3
吸气温度 (℃)	32.2	阀前制冷剂温度(℃)	32.2
电 容 (uf)	/	额定电压 (v)	220

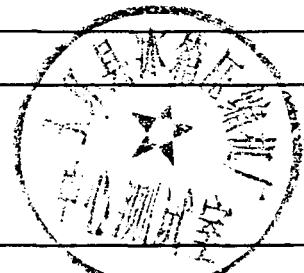
试验结果:

试验项目	技术要求	样 机 编 号	
		3#	4#
电 流 A		0.92	0.94
功 率 W		137.9	146.2
制 冷 量 W		146.8	142.1
C O P W/W		1.06	0.97
绕组温度 ℃		102.9	121.4
低压端壳温 ℃		83.6	83.4
泄漏电流 mA		0.037	0.034
绝缘电阻 MΩ		500	500
冷态电气强度		通过	通过

结论:

备注:

八部生产R134a压缩机(UNDO项目).



主检: 张锋      审核: 陈爱斌      批准: 林建平      日期: 2000.11.20

浙江双龙电气集团  
玉环县冰箱压缩机厂  
电冰箱压缩机性能试验报告

编号: ZC0402B  
部门编号: D0055

委托部门	玉环县冰箱压缩机厂(8)部	测试日期	2000-11-21
检验类别	试验样机	型号	QD57
测试依据	GB/T9098-1998	数量	2台

试验条件:

制冷剂	R-134a	冷凝温度 (℃)	54.4
环境温度 (℃)	32.2	蒸发温度 (℃)	-23.3
吸气温度 (℃)	32.2	阀前制冷剂温度(℃)	32.2
电 容 (uf)	/	额定电压 (v)	220

试验结果:

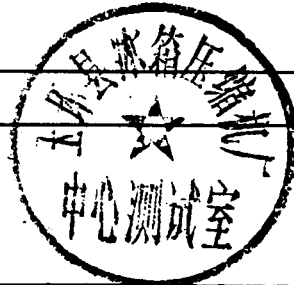
试验项目	技术要求	样 机 编 号	
		3#	4#
电 流 A		0.86	0.89
功 率 W		130.3	133.4
制 冷 量 W		127.7	122.4
C O P W/W		0.98	0.92
绕组温度 ℃		100.6	105.7
低压端壳温 ℃		81.7	84.2
泄漏电流 mA		0.032	0.033
绝缘电阻 MΩ		500	500
冷态电气强度		通过	通过

结论:

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备注:

八部生产R134a压缩机(UNDO项目).
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主检: 丁丽丹    审核: 陈淑敏    批准: 林建平    日期: 2000.11.21

浙江双龙电气集团  
玉环县冰箱压缩机厂  
电冰箱压缩机性能试验报告

编号: ZC0402B  
部门编号: D0056

委托部门	玉环县冰箱压缩机厂(8)部	测试日期	2000-11-22
检验类别	试验样机	型号	QD51
测试依据	GB/T9098-1996	数量	1台

试验条件:

制冷剂	R-134a	冷凝温度 (℃)	54.4
环境温度 (℃)	32.2	蒸发温度 (℃)	-23.3
吸气温度 (℃)	32.2	阀前制冷剂温度(℃)	32.2
电 容 (uf)	/	额定电压 (v)	220

试验结果:

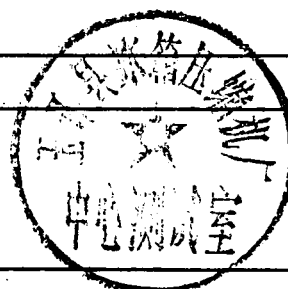
试验项目	技术要求	样 机 编 号	
		3#	
电 流 A		0.84	
功 率 W		114.4	
制 冷 量 W		106.9	
C O P W/W		0.93	
绕组温度 ℃		101.2	
低压端壳温 ℃		77.2	
泄漏电流 mA		0.031	
绝缘电阻 MΩ		500	
冷态电气强度		通过	

结论:

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备注:

八都生产R134a压缩机(UNDO项目).
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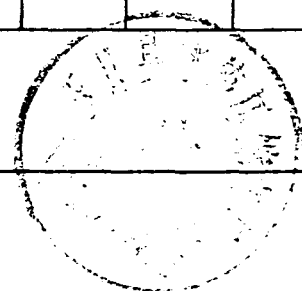


主检: 丁丽丹      审核: 陈峻毅      批准: 林建平      日期: 2000.11.22

浙江双龙电气集团  
玉环县冰箱压缩机厂  
压缩机噪声试验报告单

编号: ZC0403.1A  
部门编号: D0039

型号规格	QD51	试验日期	2000.11.15	测试数量	2台							
测试标准	GB/T9098-1996《电冰箱用全封闭型电动机—压缩机》 GB4214-1984《家用电器噪声声功率级的测定》											
一. 测试环境条件												
环境温度	20	℃	本底噪声	16	dB(A)							
二. 测试仪器及布点												
声级计	校准仪			包络面半径 r:m								
B.K 2610 精密声级计	B.K 4231 校对仪			1.0								
三. 测试结果: 声功率级 $L_{wA} = \overline{L_{pA}} + 10 \lg(6.28r^2)$												
样机编号	声 压 级										声功率级 dB(A)	振动 (m/s <sup>2</sup> )
	1	2	3	4	5	6	7	8	9	10		
1#	33.2	29.3	29.0	27.9	30.9	30.5	31.5	30.5	30.0	29.8	38.3	0.28
2#	30.5	27.0	28.0	28.2	28.0	30.5	29.5	29.0	28.8	31.0	37.1	0.34
四. 结论:												
五. 备注:												
R134a工质. (UNDO项目)												

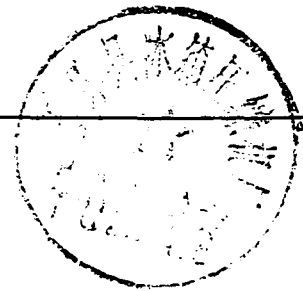


主检: 邱爱云    审核: 陈敏    批准: 林建平    日期: 2000.11.15

浙江双龙电气集团  
玉环县冰箱压缩机厂  
压缩机噪声试验报告单

编号: ZC0403.1A  
部门编号: D0040

型号规格	QD66	试验日期	2000.11.15	测试数量	2台							
测试标准	GB/T9098-1996《电冰箱用全封闭型电动机—压缩机》 GB4214-1984《家用电器噪声声功率级的测定》											
一. 测试环境条件												
环境温度	20℃	本底噪声	16 dB(A)									
二. 测试仪器及布点												
声级计	校准仪		包络面半径 r:m									
B.K 2610 精密声级计	B.K 4231 校对仪		1.0									
三. 测试结果: 声功率级 $L_{wA} = \overline{L_{pA}} + 10\lg(6.28r^2)$												
样机编号	声 压 级										声功率级 dB(A)	振动 (m/s <sup>2</sup> )
	1	2	3	4	5	6	7	8	9	10		
1#	33.5	29.2	30.3	31.0	32.3	32.3	31.5	31.8	31.2	28.5	39.2	0.40
2#	32.4	30.0	32.0	29.5	31.2	32.5	33.0	32.0	31.8	31.5	39.6	0.34
四. 结论:												
五. 备注:												
R134a工质. (UNDO2R13)												

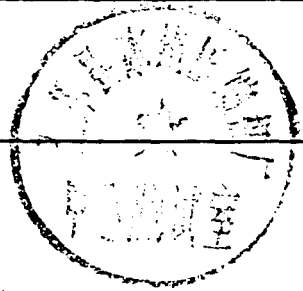


主检: 邵爱云    审核: 陈爱敏    批准: 林建平    日期: 2000.11.15

浙江双龙电气集团  
玉环县冰箱压缩机厂  
压缩机噪声试验报告单

编号: ZC0403.1A  
部门编号: D0041

型号规格	QD57	试验日期	2000.11.15	测试数量	2台							
测试标准	GB/T9098-1996《电冰箱用全封闭型电动机—压缩机》 GB4214-1984《家用电器噪声声功率级的测定》											
一. 测试环境条件												
环境温度	20	℃	本底噪声	16	dB(A)							
二. 测试仪器及布点												
声级计	校准仪			包络面半径 r:m								
B.K 2810 精密声级计	B.K 4231 校对仪			1.0								
三. 测试结果: 声功率级 $L_{WA} = \overline{L_{pA}} + 10\lg(6.28r^2)$												
样机编号	声 压 级										声功 率级 dB(A)	振动 ( $m/s^2$ )
	1	2	3	4	5	6	7	8	9	10		
1#	33.6	26.0	30.0	27.8	29.0	30.0	29.5	29.5	28.0	28.5	37.2	0.27
2#												
四. 结论:												
五. 备注: 2#机不能启动. R134a工质. (UNDO项目)												



主检: 邵爱云    审核: 陈敏    批准: 林建平    日期: 2000.11.15



浙江双龙电气集团  
玉环县冰箱压缩机厂  
压缩机噪声试验报告单

编号: ZC0403.1A  
部门编号: D0047

型号规格	QD66	试验日期	2000.11.18	测试数量	2 台							
测试标准	GB/T9098-1996 《电冰箱用全封闭型电动机—压缩机》 GB4214-1984 《家用电器噪声声功率级的测定》											
一. 测试环境条件												
环境温度	21	℃	本底噪声	16	dB(A)							
二. 测试仪器及布点												
声级计	校准仪			包络面半径 r:m								
B.K 2610 精密声级计	B.K 4231 校对仪			1.0								
三. 测试结果: 声功率级 $L_{WA} = \overline{L_{pA}} + 10\lg(6.28r^2)$												
样机编号	声 压 级										声功率级 dB(A)	振动 (m/s <sup>2</sup> )
	1	2	3	4	5	6	7	8	9	10		
3#	30.5	31.0	30.5	30.4	31.1	30.5	31.0	29.2	29.0	30.0	38.3	0.33
4#	36.0	31.6	32.2	33.1	33.6	34.6	33.8	34.0	34.5	33.0	41.6	0.36
四. 结论:												
五. 备注:												
R134a工质. (UNDO.项目)												

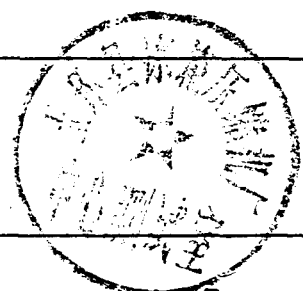


主检: 李小红    审核: 苏光    批准: 林建平    日期: 2000.11.20

浙江双龙电气集团  
玉环县冰箱压缩机厂  
压缩机噪声试验报告单

编号: ZC0403.1A  
部门编号: D0049

型号规格	QD57	试验日期	2000.11.20	测试数量	2台							
测试标准	GB/T9088-1996《电冰箱用全封闭型电动机—压缩机》 GB4214-1984《家用电器噪声声功率级的测定》											
<b>一. 测试环境条件</b>												
环境温度	20	℃	本底噪声	16	dB(A)							
<b>二. 测试仪器及布点</b>												
声级计	校准仪			包络面半径 r:m								
B.K 2610 精密声级计	B.K 4231 校对仪			1.0								
<b>三. 测试结果: 声功率级 <math>L_{wA} = \overline{L_{pA}} + 10\lg(6.28r^2)</math></b>												
样机编号	声 压 级										声功率级 dB(A)	振动 (m/s <sup>2</sup> )
	1	2	3	4	5	6	7	8	9	10		
3#	32.3	29.0	29.3	29.0	30.0	31.3	30.0	29.8	29.5	29.5	38.0	0.33
4#	32.5	31.0	30.5	31.5	31.0	31.0	30.3	29.5	30.2	31.5	38.9	0.35
<b>四. 结论:</b>												
<b>五. 备注:</b>												
R134a工质. (UNDO项目)												



主检: 邵爱云    审核: 苏光川    批准: 林建平    日期: 2000.11.20

浙江双龙电气集团  
玉环县冰箱压缩机厂  
压缩机噪声试验报告单

编号: ZC0403.1A  
部门编号: D0051

型号规格	QD51	试验日期	2000.11.20	测试数量	1台							
测试标准	GB/T9098-1996《电冰箱用全封闭型电动机—压缩机》 GB4214-1984《家用电器噪声声功率级的测定》											
一. 测试环境条件												
环境温度	20	℃	本底噪声	16	dB(A)							
二. 测试仪器及布点												
声级计	校准仪		包络面半径 r:m									
B.K 2610 精密声级计	B.K 4231 校对仪		1.0									
三. 测试结果: 声功率级 $L_{WA} = \overline{L_{pA}} + 10\lg(6.28r^2)$												
样机编号	声 压 级										声功 率级 dB(A)	振动 ( $m/s^2$ )
	1	2	3	4	5	6	7	8	9	10		
3#	35.5	30.2	31.7	31.3	30.0	32.0	32.0	31.0	32.0	28.5	39.4	0.38
四. 结 论:												
五. 备注: R134a工质. (DND0项目)												



主检: 邵爱云    审核: 岑光剑    批准: 林建平    日期: 2000.11.21

**Summary and evaluation table of calorimeter and noise tests of „0” production samples,  
tested in Yuhuan between 13. and 25. November 2000. december 1.**

Item	QD 66				QD 57				QD 51			
	Qo (W)	Pm (W)	COP (W/W)	Noise (dB A)	Qo (W)	Pm (W)	COP (W/W)	Noise (dB A)	Qo (W)	Pm (W)	COP (W/W)	Noise (dB A)
1.	149.1	139.4	1.07	39.2	128.4	130.2	0.99	37.2	111.0	114.4	0.97	38.3
2.	150.2	139.3	1.08	39.6	can't start	x	x	x	106.0	116.1	0.91	37.1
3.	146.8	137.9	1.06	38.3	127.7	130.3	0.98	38.0	106.9	114.4	0.93	39.4
4.*	142.2*	146.2*	0.97*	41.6*	122.4	133.4	0.92	38.9				
<b>Mean</b>	<b>148.7</b>	<b>138.9</b>	<b>1.07</b>	<b>39.0</b>	<b>126.2</b>	<b>131.3</b>	<b>0.96</b>	<b>38.0</b>	<b>108.0</b>	<b>115.0</b>	<b>0.94</b>	<b>38.3</b>
<b>R12</b>	155		1.00	41	135		1	41	115		1	40
<b>Diff</b>	-6.3		+0.07	-2	-8.8		-0.04	-3	-7.0		-0.06	-1.7
<b>Diff %</b>	-4.1 %		+7%		-6.5%		-4%		-6.1%		-6%	

Test condition: -23.3/ 54.4/ 32.2/ 32.2/ 32.2 °C

Qo.: Refrigerating capacity

Pm: Electric power input

COP: Coefficient of performances

\* : High power consumption, because of high friction (assembly fault ) – not able for evaluation

x: Faulty assembly, no data for evaluation

**Summary and evaluation of calorimeter and noise tests of ultimate QD samples, (3x3) made according to agreed drawings (April), tested in Berva in July 2000.**

	QD 66				QD 57				QD 51			
Item	Qo (W)	Pm (W)	COP (W/W)	Noise (dB A)	Qo (W)	Pm (W)	COP (W/W)	Noise (dB A)	Qo (W)	Pm (W)	COP (W/W)	Noise (dBA)
1.	158.1	143.8	1.10	39.4	143.7	125.8	1.14	39.2	119.9	112.0	1.07	37.6
2.	159.1	140.1	1.14	39.6	144.1	127.3	1.13	39.0	113.9	115.2	0.99	38.4
3.	151.4	137.6	1.10	38.3	132.0	124.3	1.06	37.9	112.8	113.1	1.00	39.0
<b>Mean</b>	<b>156.2</b>	<b>140.5</b>	<b>1.11</b>	<b>39.1</b>	<b>139.9</b>	<b>125.8</b>	<b>1.10</b>	<b>38.7</b>	<b>115.5</b>	<b>113.4</b>	<b>1.02</b>	<b>38.3</b>
<b>R12</b>	155		1.00	41	135		1	41	115		1	40
<b>Diff</b>	+1.2		+0.11	-1.9	+4.9		+0.10	-2.3	+0.5		+0.02	-1.7
<b>Diff %</b>	+0.8 %		+11%		+3.6%		+10%		+0.4%		+2%	

Test condition: -23.3/ 54.4/ 32.2/ 32.2/ 32.2 °C ( Ashrae )

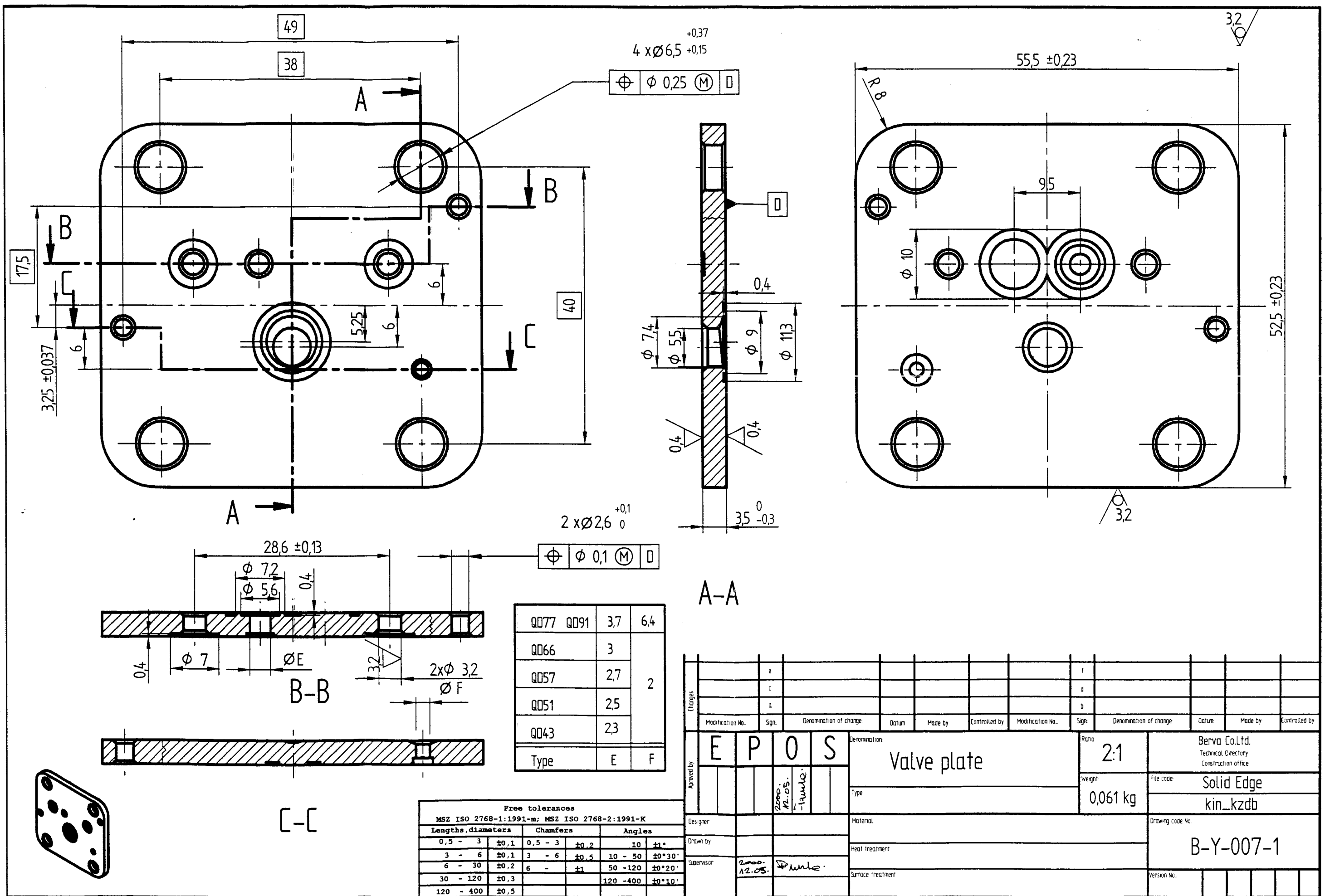
Qo.: Refrigerating capacity

Pm: Electric power input

COP: Coefficient of performances

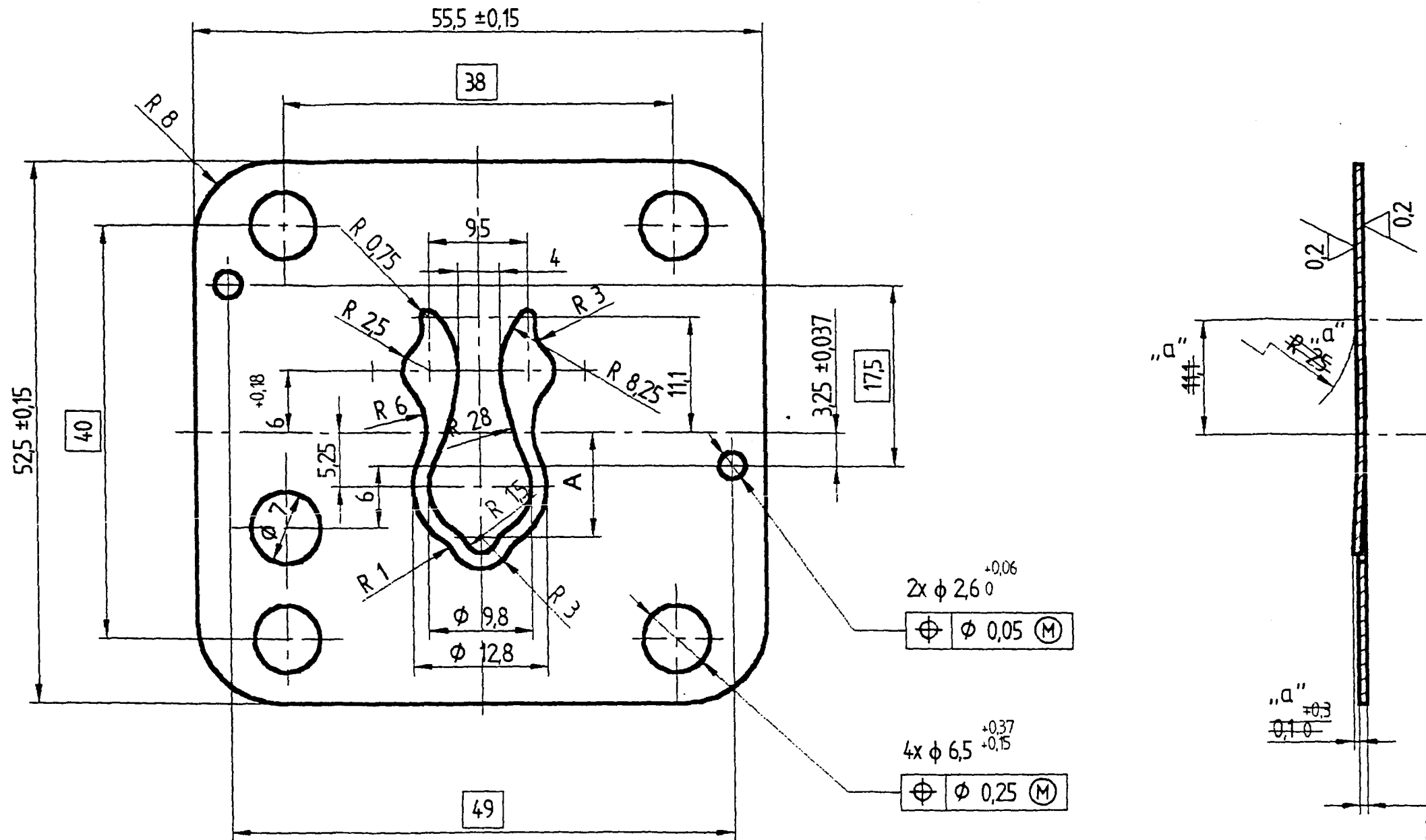
**Appendix 5      4 drawings**

Valve plate	B-Y-007-1	( size:A3 )
Suction valve leaf	B-Y 002	( size:A3 )
Fixing plate	B-Y 008/1	( size:A4 )
Suction muffler II.	B-Y-062/1	( size:A3 )



A-A

Changes	e	f										
	c	d										
	a	b										
Modification No.	Sign.	Denomination of change	Datum	Made by	Controlled by	Modification No.	Sign.	Denomination of change	Datum	Made by	Controlled by	
E	P	O	S	Denomination: Valve plate				Ratio: 2:1	Berva Co.Ltd. Technical Directory Construction office			
Approved by: 2000 12.05. P. Hume						Type:	Weight: 0,061 kg	File code: Solid Edge kin_kzdb				
Designer:	Material:					Drawing code No: B-Y-007-1						
Drawn by:	Heat treatment:					Version No:						
Supervisor: 2000 12.05. P. Hume	Surface treatment:											



2x  $\phi$  2,60<sup>+0,06</sup>  
 $\phi$  0,05 (M)

4x  $\phi$  6,5<sup>+0,37</sup>  
 $\phi$  0,25 (M)

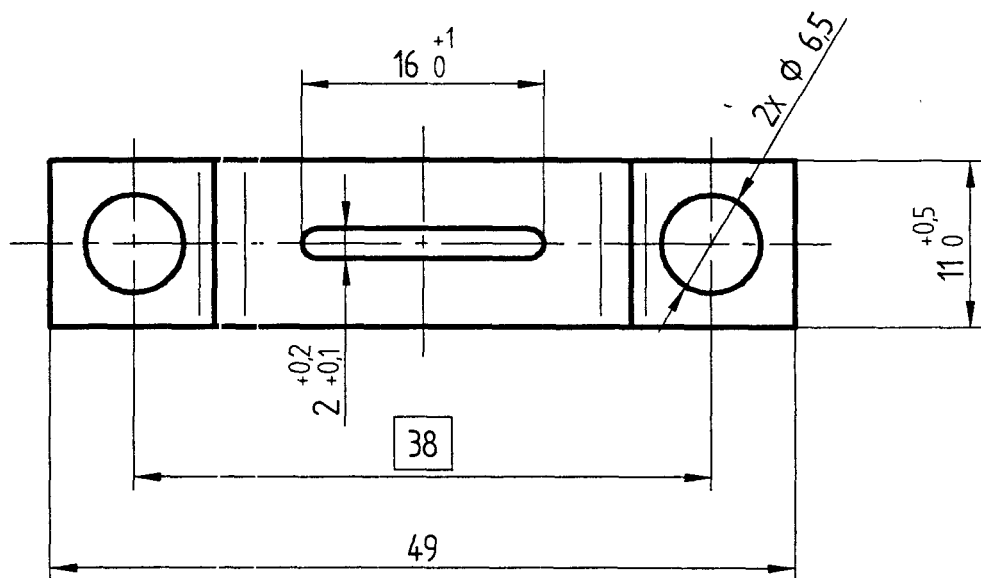
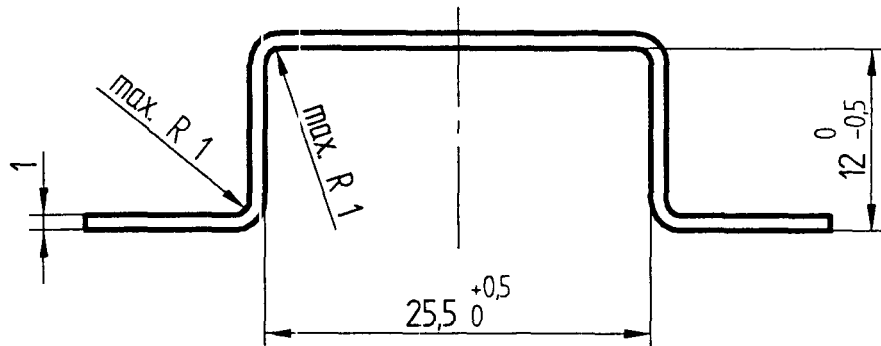
0,203 ± 0,006  
 2000042 *林*

0066	0077	11,5	
0043	0051	0057	10,2
Type		A	

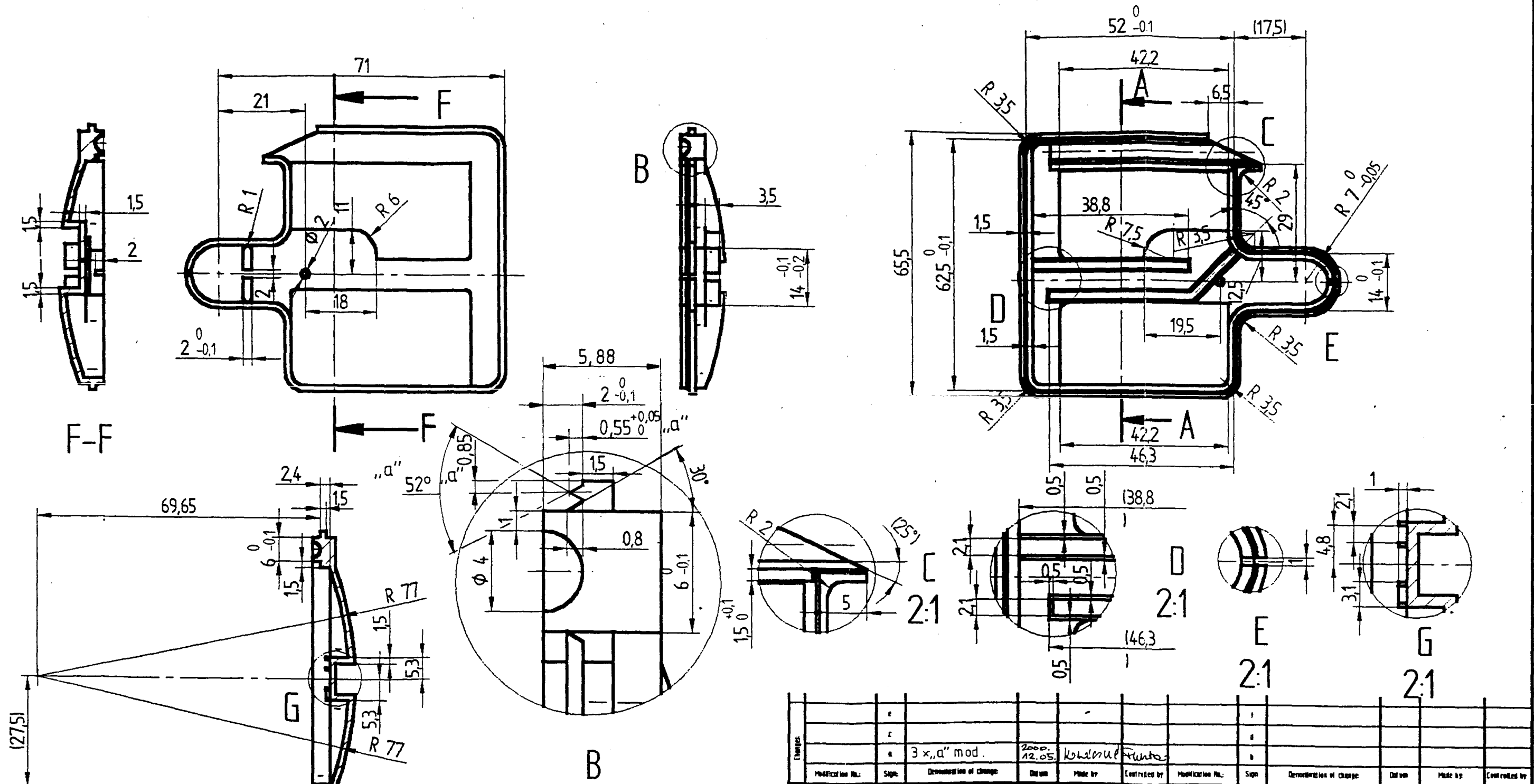
Free tolerances			
MZ ISO 2768-1:1991-m; MZ ISO 2768-2:1991-K			
Lengths, diameters	Chamfers	Angles	
0,5 - 3	±0,1	0,5 - 3	+0,2
3 - 6	±0,1	3 - 6	+0,5
6 - 30	±0,2	6 -	+1
30 - 120	±0,3		
120 - 400	±0,5		

Changes															
Modification No.	Sign	Description of change	Date	Made by	Controlled by	Modification No.	Sign	Description of change	Date	Made by	Controlled by				
E P O S			Suction valve leaf			Scale: 2:1			Berva Co.Ltd. Compressor Division Construction office						
Weight: 0,0029 kg			File code: kin_szs			Drawing code No: B-Y 002									
Material: Sandvick 20C or EBERLE 18			Heat treatment:			Surface treatment:			Version No:						





Változtatás	e							f				
	c							d				
	a							b				
	Értelmező sz.	Jele	Megnevezés	Kelte	Készítette	Ellenőr	Értelmező sz.	Jele	Megnevezés	Kelte	Készítette	Ellenőr
Járványja	K	P	O	S	Megnevezés Fixing plate			Méretarány 2:1	Berva Rt. Műszaki Igazgatóság Konstrukciós Iroda			
					Tipus			Kész suly	Filekód	Solid Edge kin_rug		
Tervező					Anyag steel			Rajzkódszám				
Rajzoló					Hőkezelés			B-Y 008/1				
Ellenőr	2500. 10. 11.				Felületkezelés			Változátszám				



A-A 20000422号  
材料

Free tolerances  
MZ ISO 2768-1:1991-m; MZ ISO 2768-2:1991-k

Lengths, diameters		Chamfers		Angles	
0,5 - 3	±0,1	0,5 - 3	±0,2	10	±1°
3 - 6	±0,1	3 - 6	±0,5	10 - 50	±0°30'
6 - 30	±0,2	6 -	±1	50 - 120	±0°20'
30 - 120	±0,3			120 - 300	±0°10'
120 - 400	±0,5				

Changes:															
Modification No.:	Sign:	Demonstration of Change:	Date:	Made by:	Controlled by:	Modification No.:	Sign:	Demonstration of Change:	Date:	Made by:	Controlled by:				
Approved by:	E P O S		Suction muffler II.		Scale:	1:1		Berva Co Ltd.		Technical Office		Construction office			
Designer:			Material:		Weight:		File code:		Drawing Code No.:						
Drawn by:			Crastin SK 605 (PBT)		0,013 kg		Solid Edge		B-Y-062/1						
Supervisor:			Heat treatment:				kin_htp6								
			Surface treatment:												