



Advanced Research Systems, Inc.



Design of an improved high-cooling-power 4.2 K stage G-M cryocooler and helium compressor

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NEW !



DE215S COLD HEAD (pneumatic-drive)

1.75 W @ 4.2 K, Min. Temp. < 2.7 K



ARS-20 HELIUM COMPRESSOR



Contents



1

Introduction

2

Experimental set-up

3

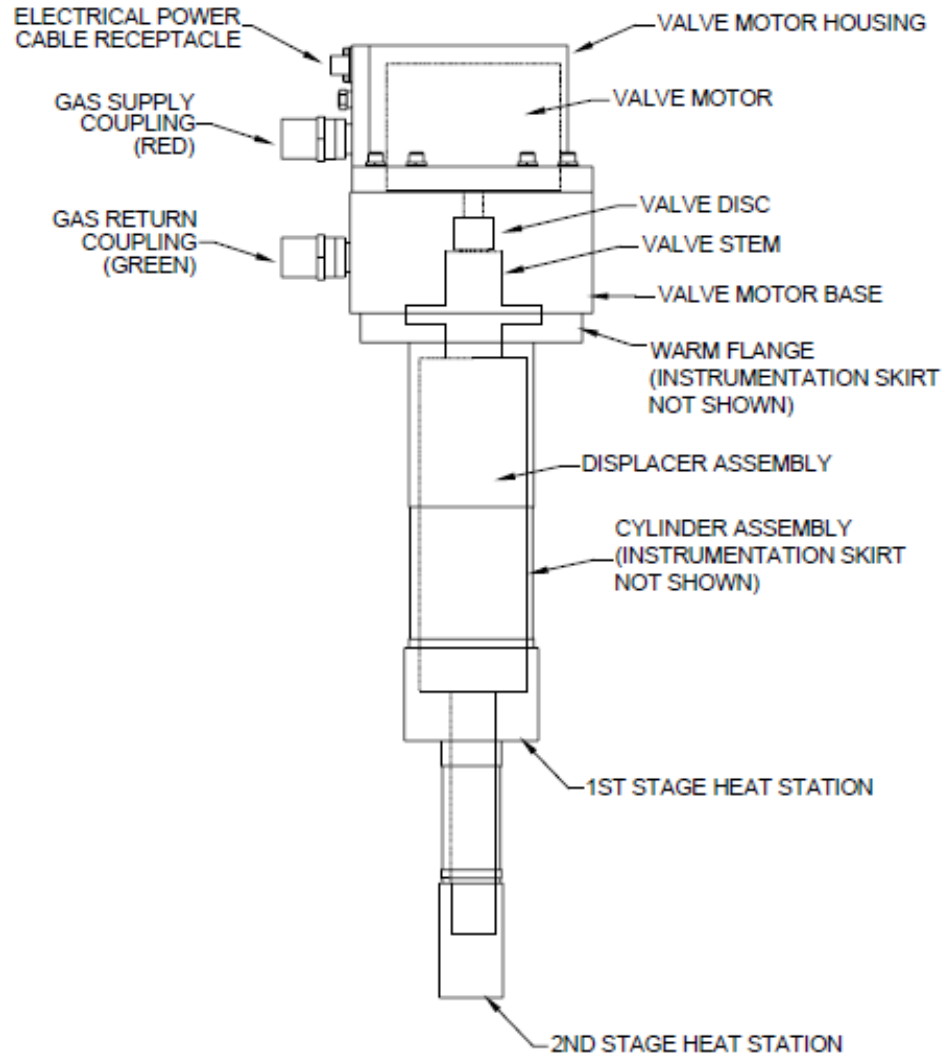
Test results

4

Conclusions



- With broad applications in low temperature superconductor, magnetic resonance imaging (MRI), infrared detector and cryogenic electronics, the development of a high performance 4.2 K two stage cryocooler is of great importance.
- Given the specific demands of some of these applications—for example, MRIs run 24 hours a day, 365 days per year—the 4.2 K two stage cryocooler's cooling efficiency, stability, reliability and service life are critical factors.



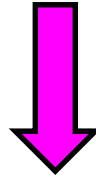
Pneumatic-drive





DE210S cold head (ARS-10 comp.)
0.8 W @ 4.2 K, Min. Temp. < 3.0 K

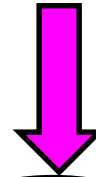
ARS



2013



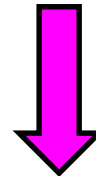
DE210SG cold head (ARS-10 comp.)
1.10 W @ 4.2 K, Min. Temp. < 2.7 K



2014



DE215S cold head (ARS-10 comp.)
1.50 W @ 4.2 K, Min. Temp. < 2.7 K



2015



ARS-20 compressor



DE215S cold head (ARS-20 comp.)
1.75 W @ 4.2 K, Min. Temp. < 2.7 K





Contents



1

Introduction

2

Experimental set-up

3

Test results

4

Conclusions

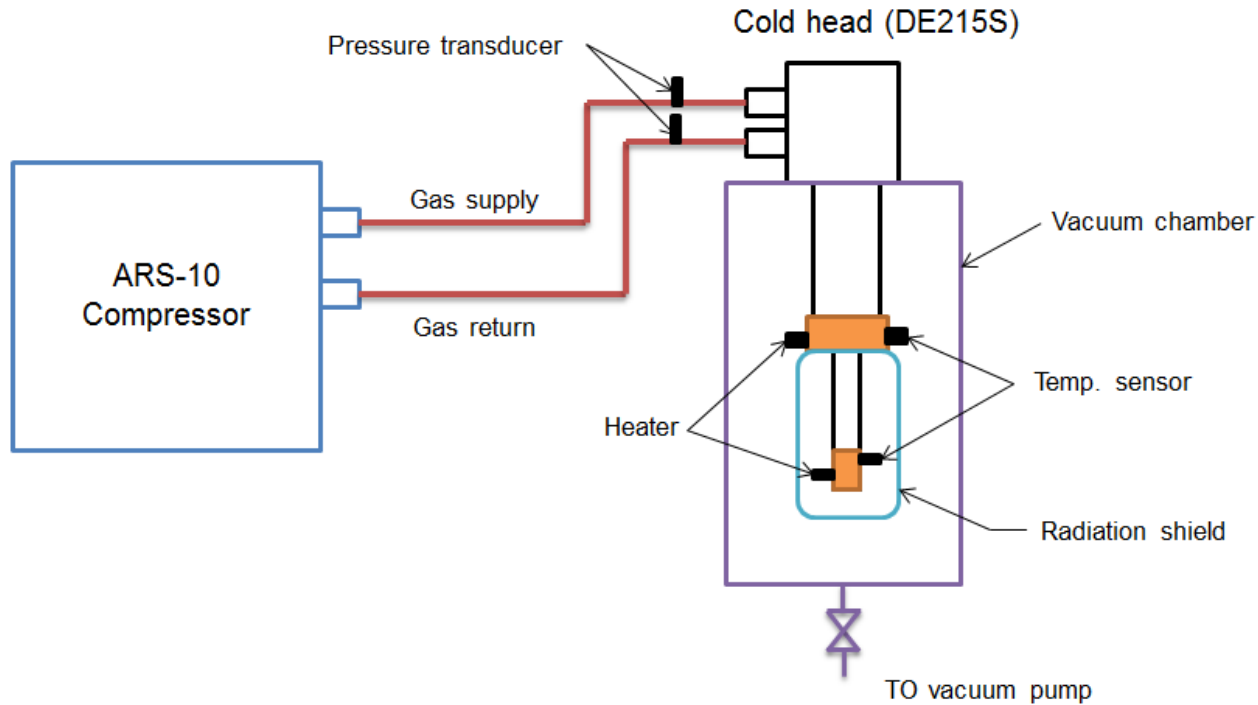


FIGURE 1. Schematic diagram of the experimental setup.



Two options !

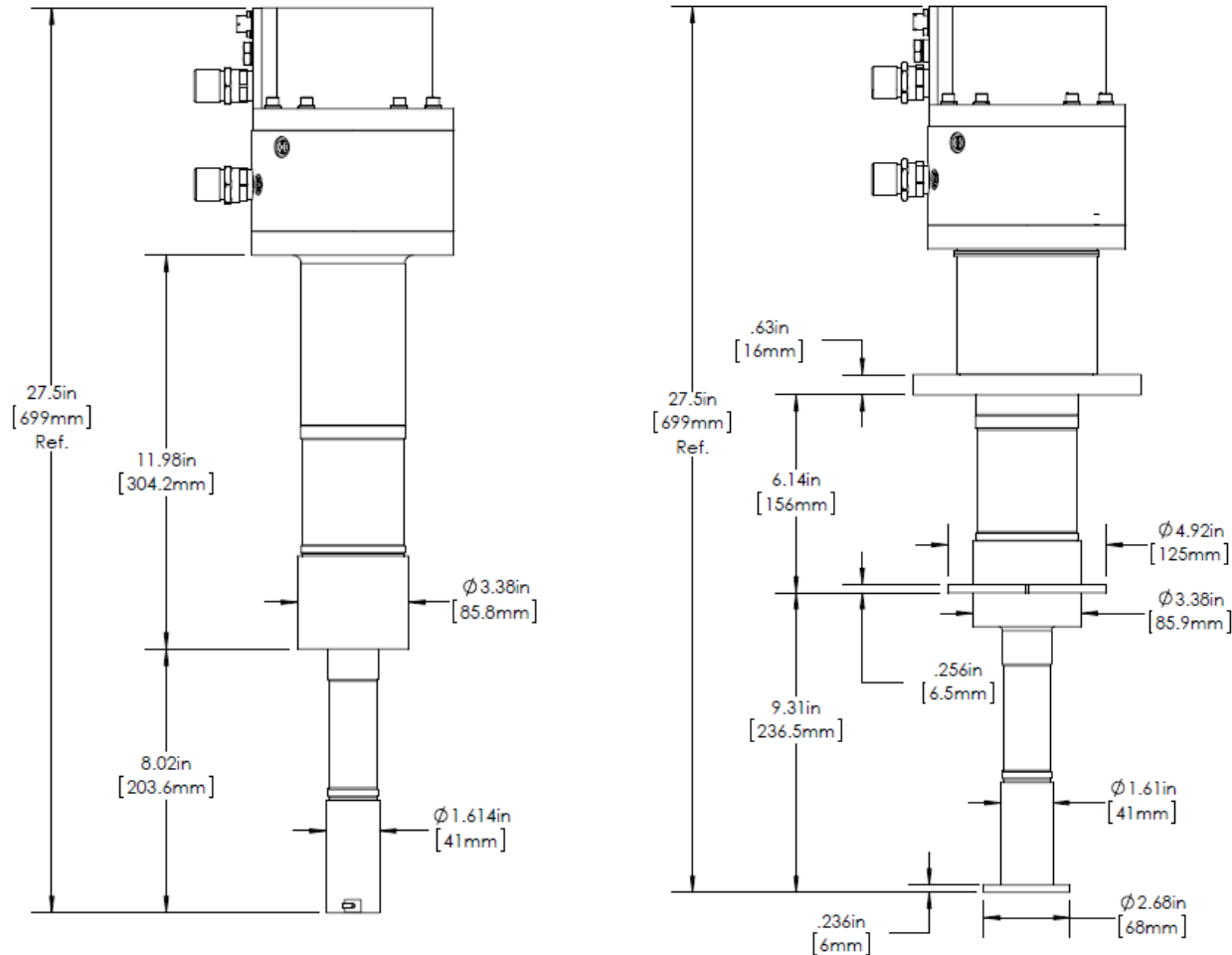
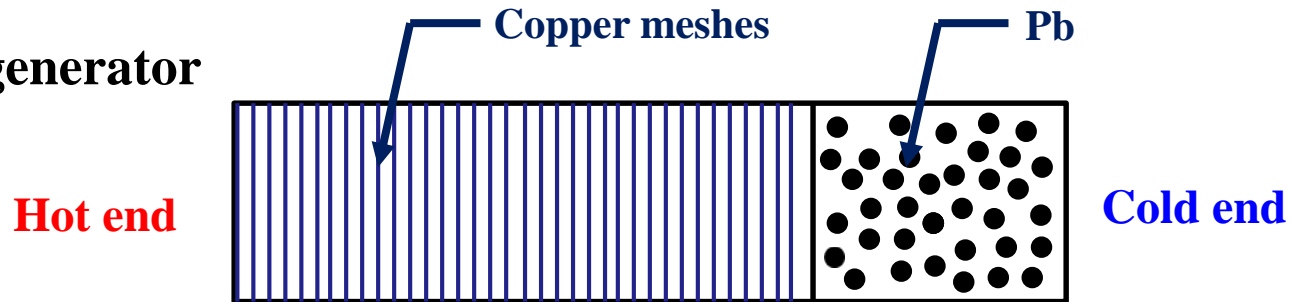


FIGURE 2. DE215S coldhead outline drawing



Regenerator materials

1st stage regenerator



2nd stage regenerator

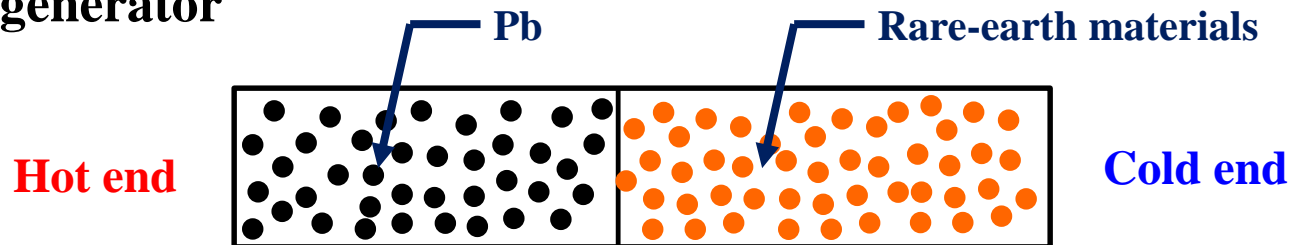


FIGURE 3. Regenerator packing methods.



Contents



1 Introduction

2 Experimental set-up

3 Test results

4 Conclusions

Displacer stroke and operation speed

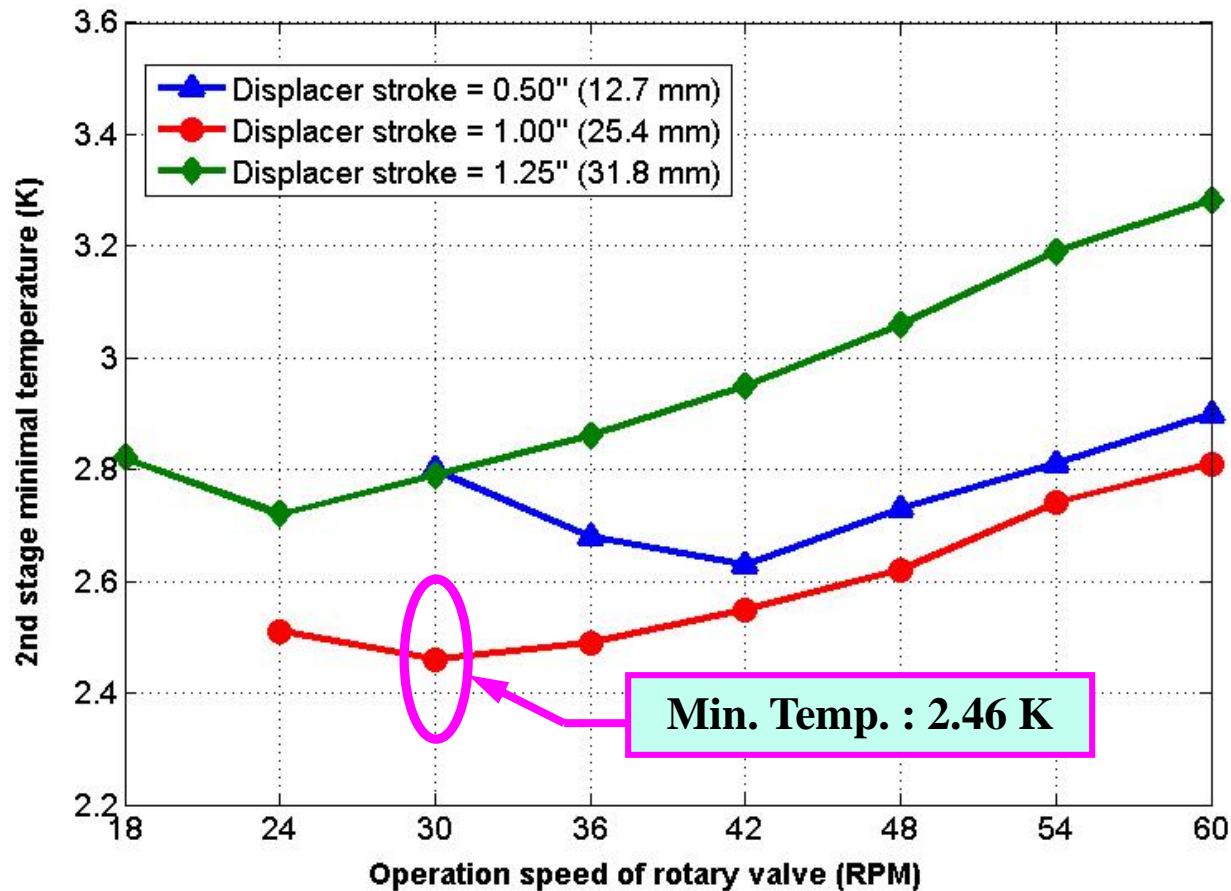


FIGURE 4. Plots of minimal temperatures of second stage as a function of operation speed.

Displacer stroke and operation speed

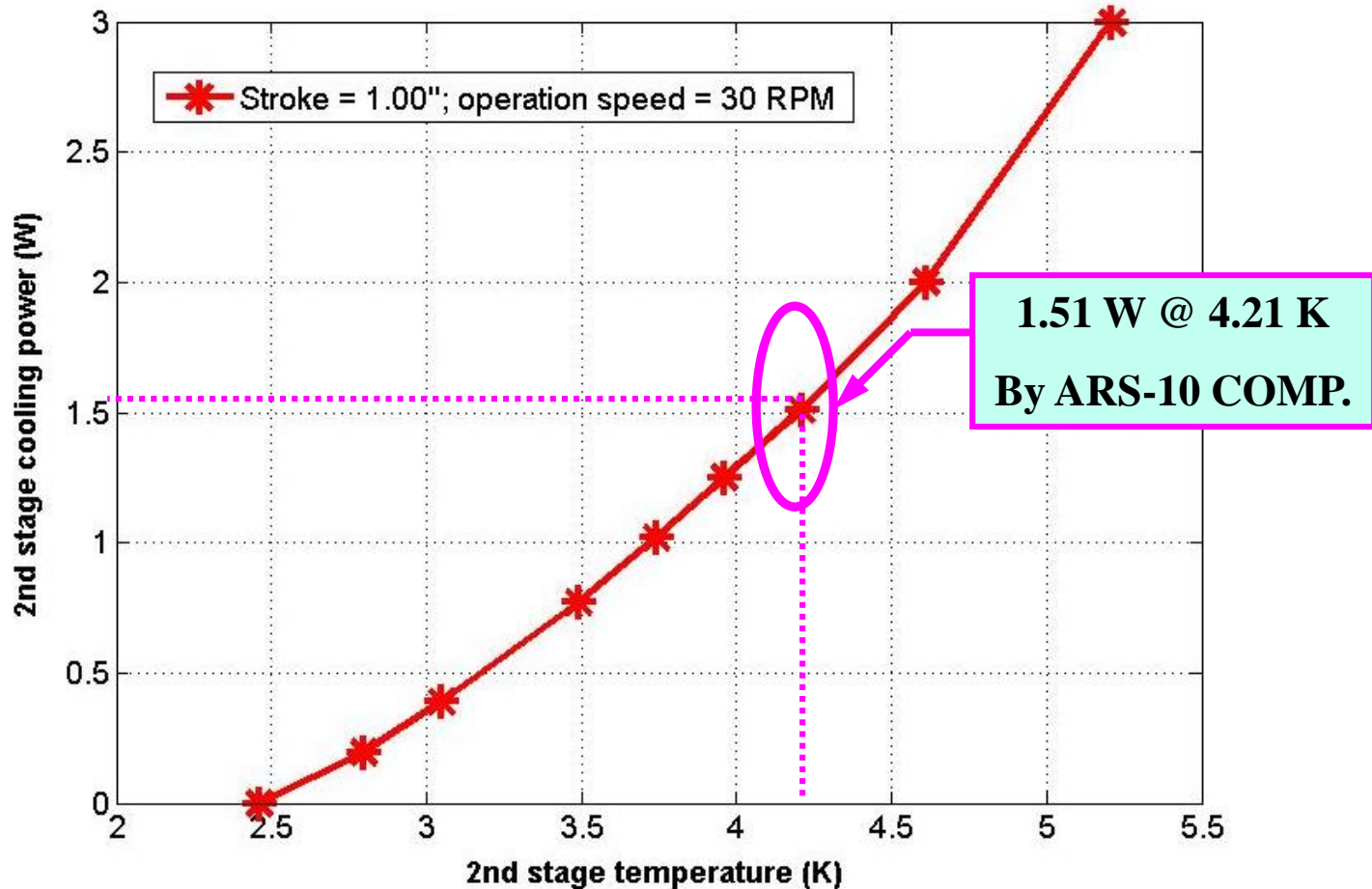


FIGURE 5. Plots of second stage cooling power as a function of temperature (driven by ARS-10).

Initial charge pressure

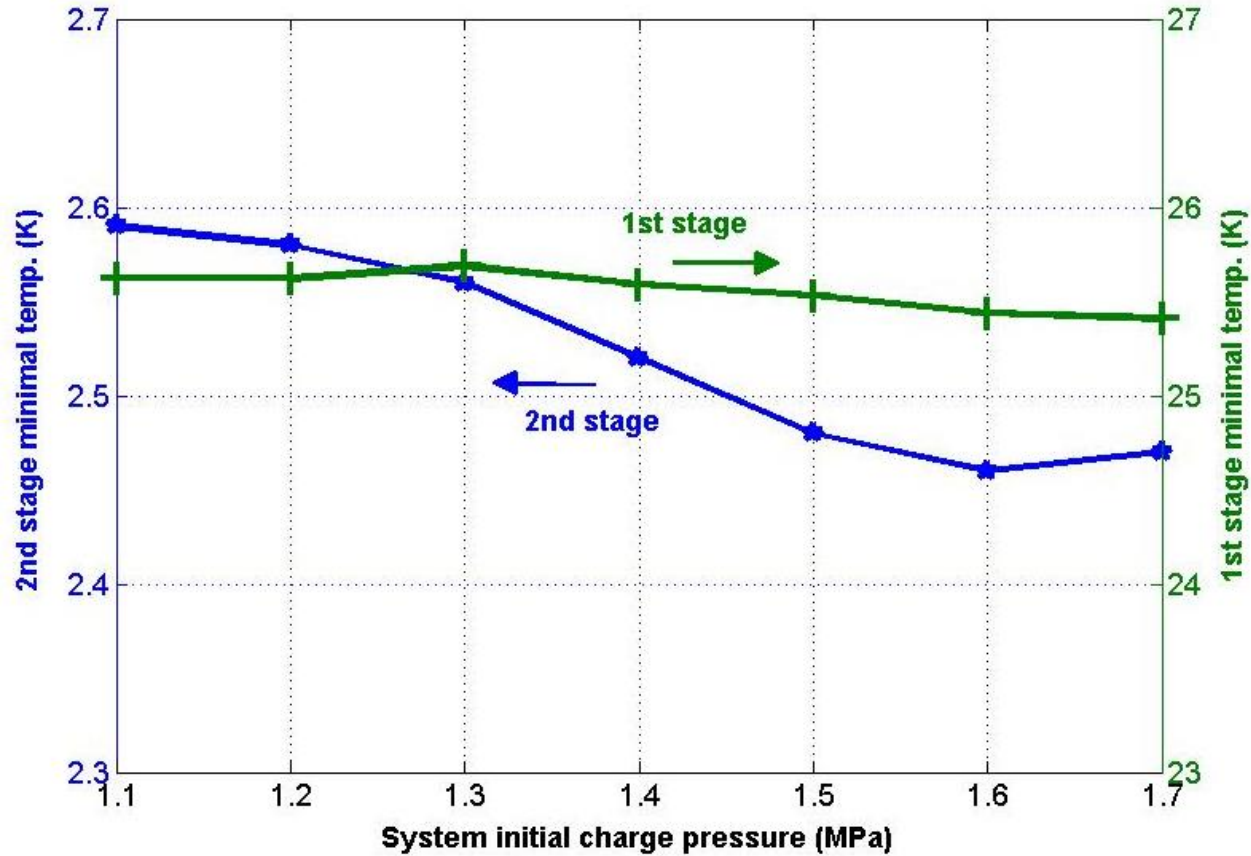


FIGURE 6. Plots of minimal temperatures of cold head as a function of charge pressure.



Initial charge pressure

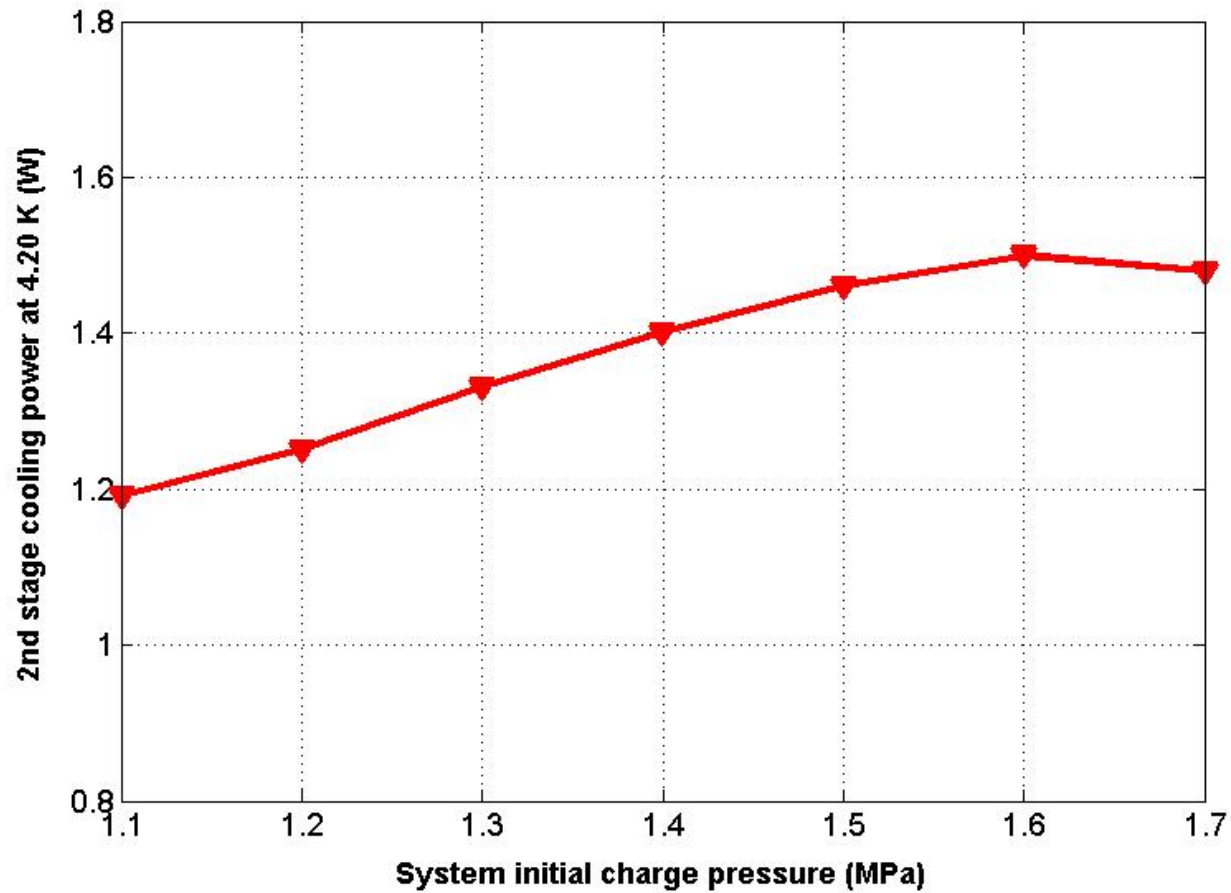


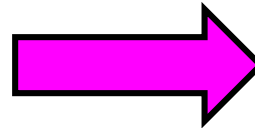
FIGURE 7. Plot of second stage cooling power at 4.20 K as a function of charge pressure.



Input power

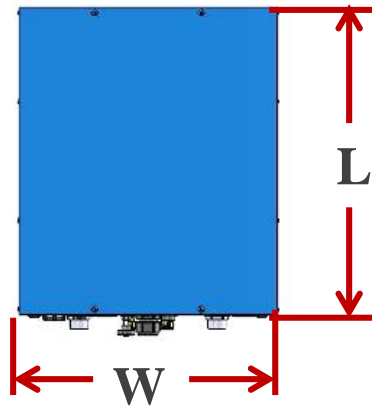
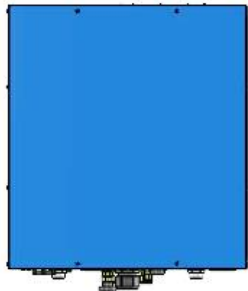
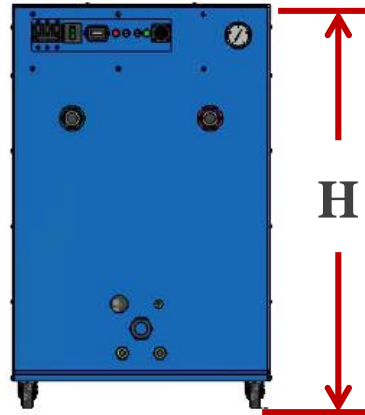
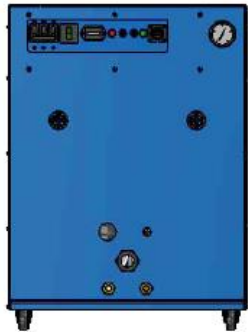


ARS-10



ARS-20

FIGURE 8. Compressor outline drawings



ARS-10

ARS-20

Dimensions (W x L x H):

ARS-10: 19 x 21 x 26 in

ARS-20: 20.5 x 24.5 x 33.5 in

Weight:

ARS-10: 250 lb. (113 kg)

ARS-20: 390 lb. (177 kg)

Gas flow rate (60 Hz):

ARS-10: 118 Nm³/h (300 Psi / 100 Psi)

ARS-20: 190 Nm³/h (300 Psi / 100 Psi)

Note: the gas flow rate is converted into values
at atmospheric pressure (0 C)

Motor input power (60 Hz):

ARS-10: 7 kW (300 Psi / 100 Psi)

ARS-20: 12 kW (300 Psi / 100 Psi)

Input power

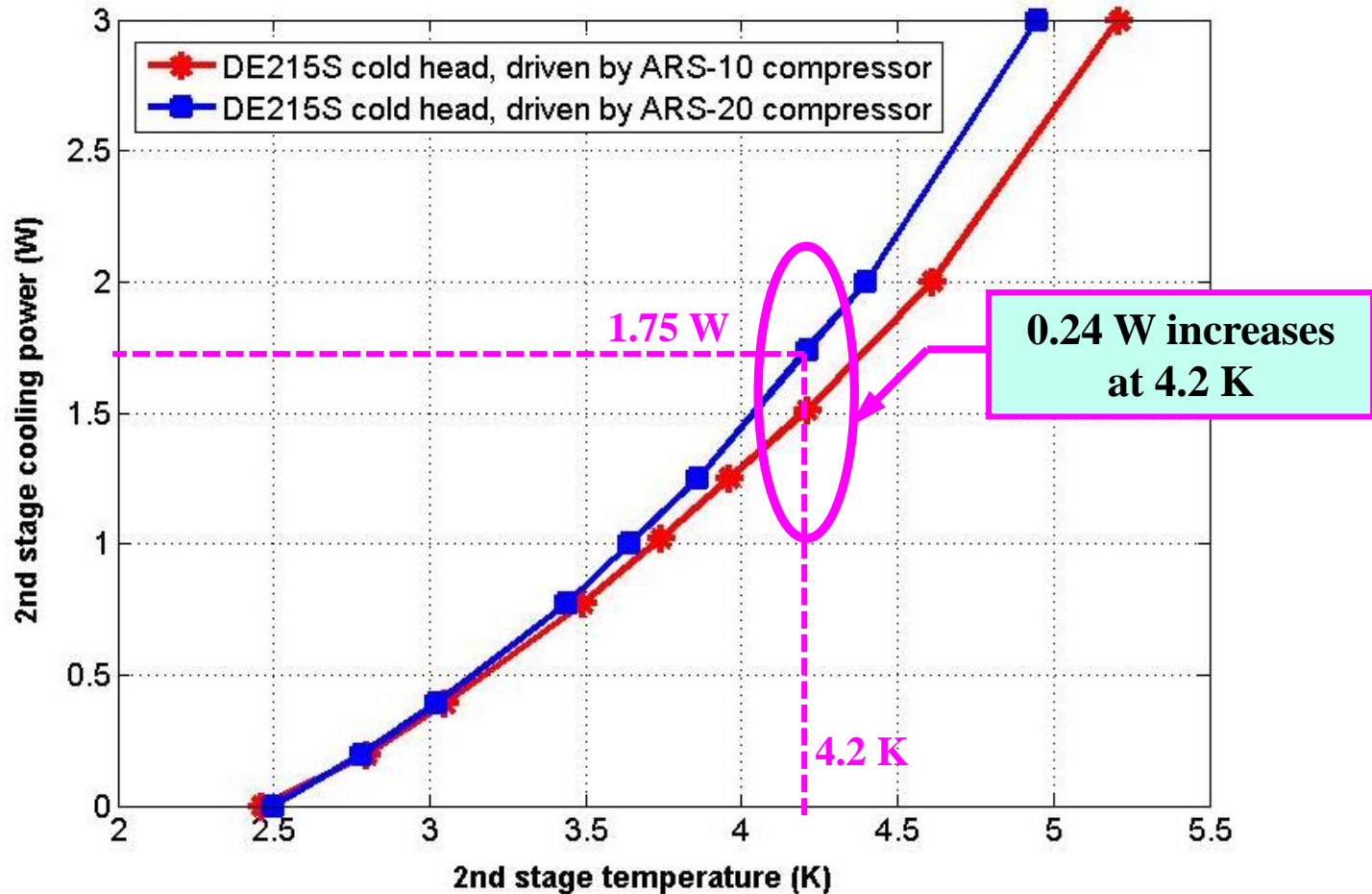


FIGURE 9. Comparisons of second stage cooling powers driven by ARS-10 and ARS-20 Comp.



Contents



1

Introduction

2

Experimental set-up

3

Test results

4

Conclusions



- A high efficiency 1.5 W/4.2 K pneumatic-drive G-M cryocooler has recently been designed and developed by ARS. A typical cooling power of 1.50 W/4.2 K has been achieved driven by ARS-10 compressor. A maximal cooling power of 1.75 W/4.2 K has been achieved driven by new developed ARS-20 compressor in test runs.
- The displacer stroke and operation speed are both critical to the design of the 4.2 K stage G-M cryocooler.
- The life-time tests on the ARS-20 compressor and DE215S cold head are on the way.



Thanks for your attention!