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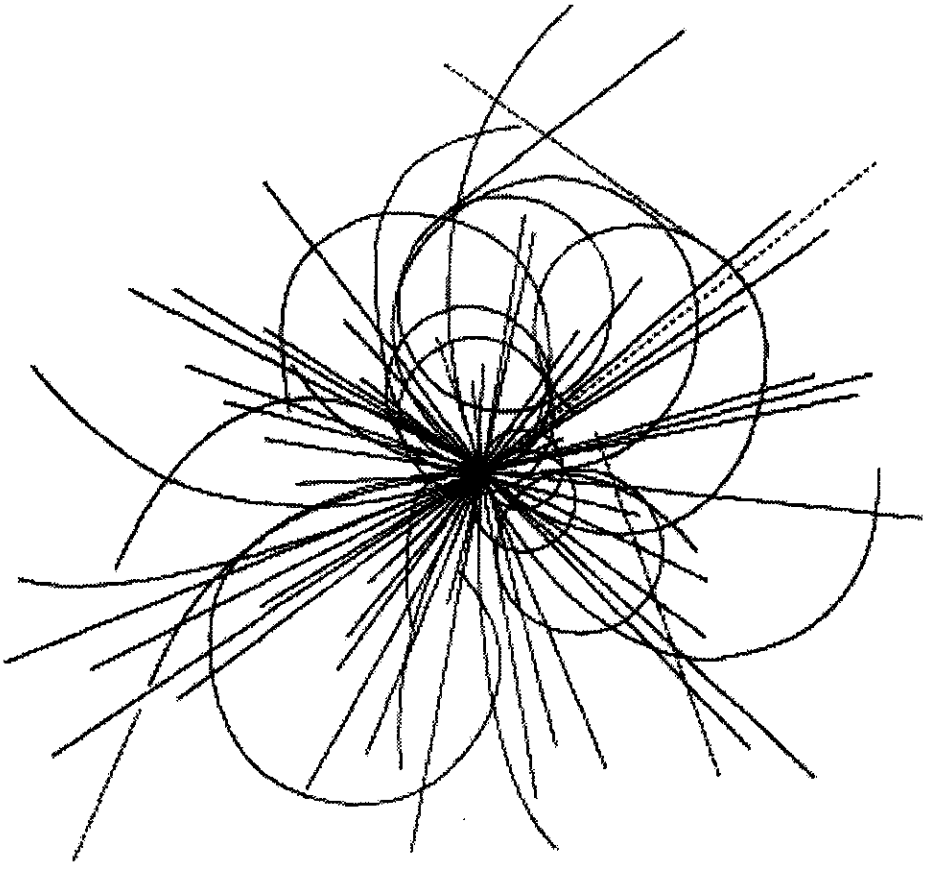
Data Sheets for the Helium Refrigeration Plants



Superconducting Super Collider Laboratory

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Data Sheets for the Helium Refrigeration Plants

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September 1994

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Data Sheets

for the

Helium Refrigeration Plants

SSCL - N - 878

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September 1, 1994

DATA SHEETS FOR THE HELIUM REFRIGERATION PLANTS

This document contains data sheets for the three N15 Refrigerators/Liquefiers:
MTL Plant (pages MTL-1 to MTL-57),
ASST Plant (pages ASST-1 to ASST-48)
and N15B Plant (pages N15B-1 to N15B-48)

and for the Plan "B" (pages Plan "B"-1 to Plan "B"-23) which is a small stand alone refrigerator.

1. N15 Refrigerators / Liquefiers

The three helium refrigerator systems (MTL, ASST and N15B) installed at the N15 site have similar characterisrtics and design. The main differences between the three are in the interfaces and connections to the designed loads. The basic modes of operation of each system are:

1. 50L-50R: 50% liquefaction–50% refrigeration mode
2. 100R: 100% refrigeration mode
3. 100L: 100% liquefaction mode

The basis for the system design is the 50L-50R mode, with a design capacity of 2200 W of refrigeration and 22 g/s of liquefaction at 4.5 K, *i.e.* the equivalent of 4.4 kW of refrigeration at 4.5 K. In the 100R mode, when all the available system capacity is used for refrigeration, the design refrigeration capacity is 3500 W. (The ASST system has been tested at 4000 W.) The systems can provide 37 g/s of liquefaction in the full liquefaction mode (100L).

The systems are designed to operate efficiently over a wide load range. The compressor system contains two first stage and two second stage compressors. Under reduced loads, only one first stage and one second stage compressor can be used for reduced power consumption and efficient operation. Under this configuration, the systems can deliver: (1) 765 W refrigeration and 7.65 g/s liquefaction in the 50L-50R mode, (2) 1370 W refrigeration in the 100R mode and (3) 15.6 g/s liquefaction in the 100L mode.

The system design capacities under the full compressor design flow and 50% compressor design flow conditions are plotted in Figure 1 and summarized in Table 1. The guarenteed

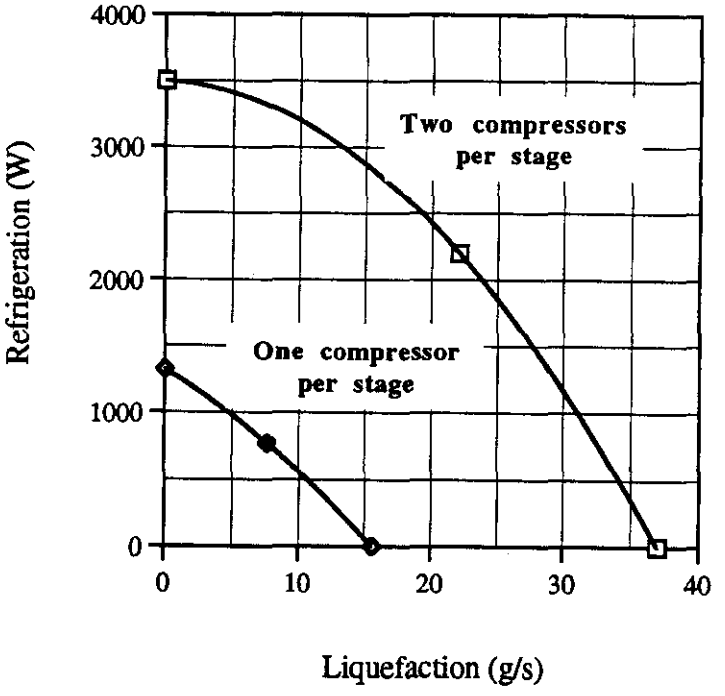

Figure 1. Refrigeration vs. Liquefaction Capacity for the N15 Helium Refrigerators

Table 1. Operating Modes and Capacities for the N15 Refrigerator Systems

	SYSTEM DESIGN CAPACITY	
OPERATING MODE	**REFRIGERATION**	**LIQUEFACTION**
Design Flow – 100R	3495 W	0 g/s
Design Flow – 50L-50R	2200 W	22 g/s
Design Flow – 100L	0 W	37 g/s
50% Design Flow – 100R	1370 W	0 g/s
50% Design Flow – 50L-50R	765 W	7.65 g/s
50% Design Flow – 100L	0 W	15.60 g/s

N15 Refrigerator/Liquefier System Operating Costs

There are two basic operating costs associated with the running the N15 refrigeration systems: a) electrical power required for the compressors, and b) LN2 consumption for helium precooling in the coldbox. Table 2 lists the power input to the compressors,and the LN2 consumption, together with the associated costs for the basic modes of operation.

The compressor power requirements are around 1400 kW for design flow operation, and about 670 kW for 50% flow operation. Power costs in Table 2 are based on the current electricity price of $0.043/kWh for the N15 site.

LN2 consumption varies greatly depending on the operating mode of the refrigerator. The 100% refrigeration mode has the lowest LN2 consumption; the 100% liquefaction mode has the highest LN2 consumption, comparable in cost to the electrical power. The LN2 consumption numbers include a fixed allowance of 12.5 g/s for utility purposes (dewar makeup, *etc.*); LN2 demand for the load is not included. The LN2 costs are based on a bulk price of $0.09 per liter.

Reduced Capacity Operation and Efficiencies

The N15 refrigeration systems can operate efficiently over wide load range, from 1000 W to 4000 W. Although the refrigerator design is optimized for the higher end loads (22% Carnot efficiency), cost-efficient operation is maintained at the low end (about 1400 W) by using only one compressor per stage. Figure A.2-2 shows the specific power consumption of the refrigerators, normalized to the design point at 100R. The specific power consumption is defined as the ratio of the power input to the refrigeration capacity (W/W). It is seen that the refrigerators can operate at 70% or better efficiency relative to the design point in the range from about 2000 W to 4000 W, and also from 1200 W to 1400 W.

Table 2. Operating Costs for the N15 Refrigerators

	COMPRESSOR POWER	LN2 CONSUMPTION	POWER COST[a]	LN2 COST[b]	TOTAL COST
OPERATING MODE	kW	liters/day	$/day	$/day	$/day
Design Flow – 100R	1308	3121	1350	281	1631
Design Flow – 50L-50R	1472	9266	1519	834	2353
Design Flow – 100L	1488	13262	1536	1194	2730
50% Design Flow – 100R	670	2618	691	236	927
50% Design Flow – 50L-50R	668	4494	689	404	1093
50% Design Flow – 100L	662	6430	683	579	1262

[a] at $0.043 per kWh

[b] at $0.09 per liter

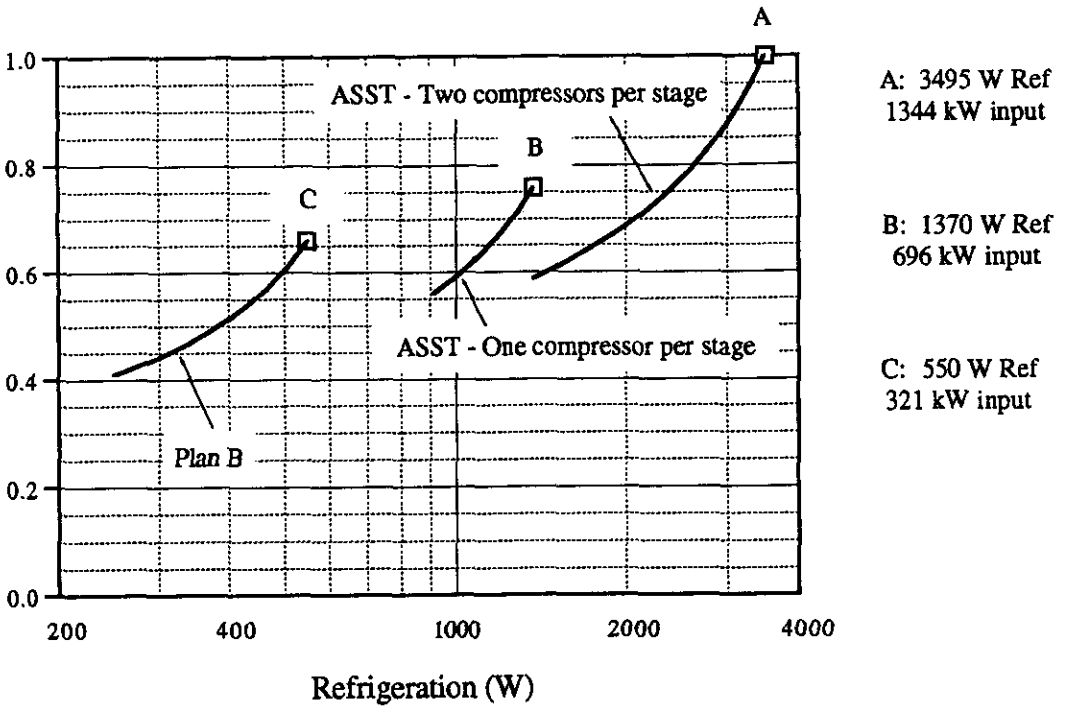

Figure 2. Normalized Specific Power Consumption for the N15 Helium Refrigerators

Also presented in Figure 2 is the performance characteristic for the Plan B refrigerator. This refrigerator is suitable for small loads (designed for 550 W at 4.5 K, 430 HP).

2. "Plan "B" Refrigerator

This smaller refrigerator (550W,4.5 K, 430 HP) is currently located at the Spool Piece facility in the Central Facility in Waxahachie. It can easily be moved and installed back at N15.

References

1. V. Ganni and T. Apparao, "Design Verification and Acceptance Test of the ASST-A Helium Refrigeration System," Advances in Cryogenic Engineering, Vol. 39, P. Kittel, ed., Plenum Press, New York, pp. 779-787, 1994.
2. T. Apparao and V. Ganni, "Comparison of ASST-A Helium Refrigeration System Performance: Design vs. Actual Test at 50% of Compressor Flow Conditions," SSC Cryo Note 93-22, 1993.

MTL
CRYO PLANT
Data Sheets

Compiled and arranged
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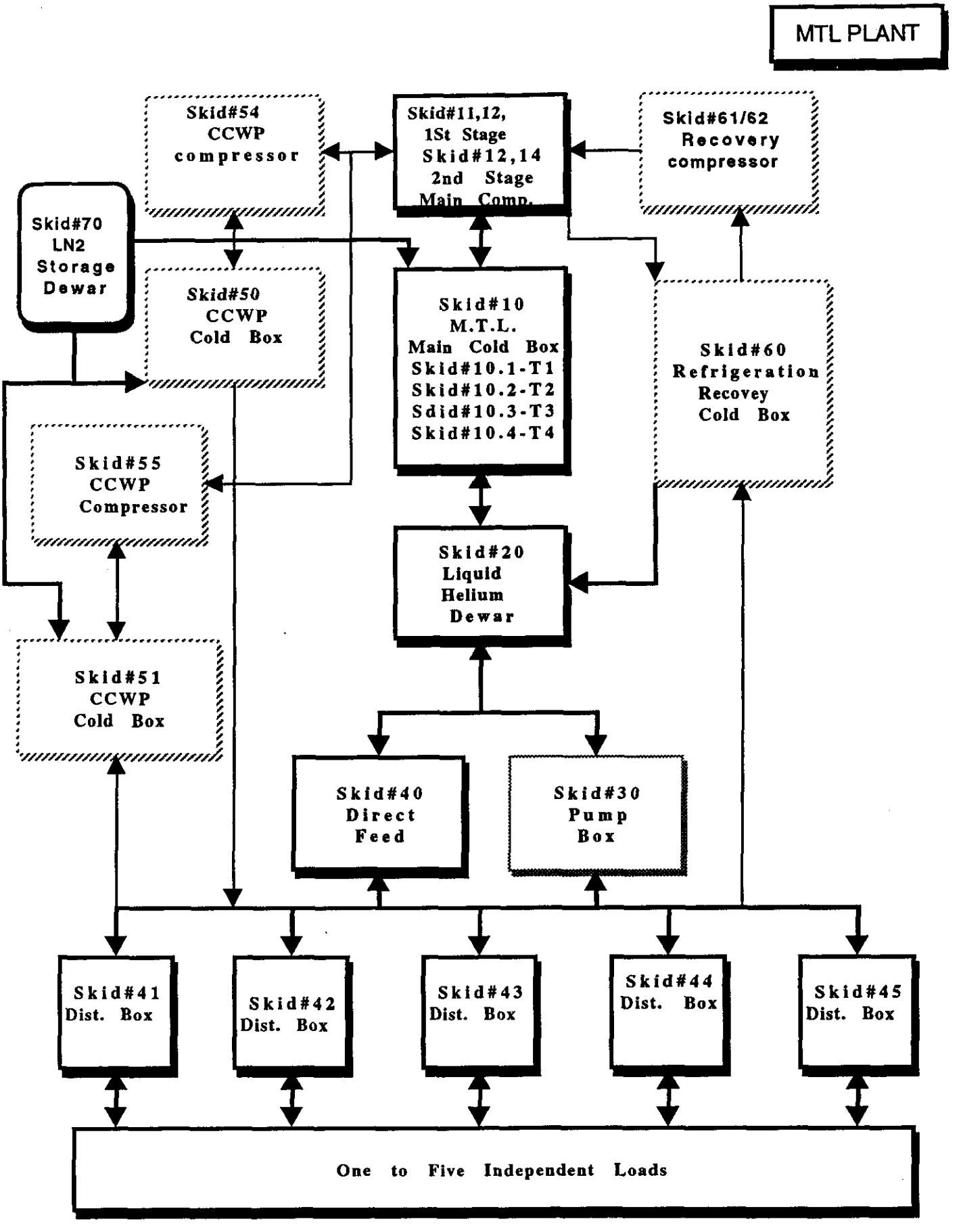
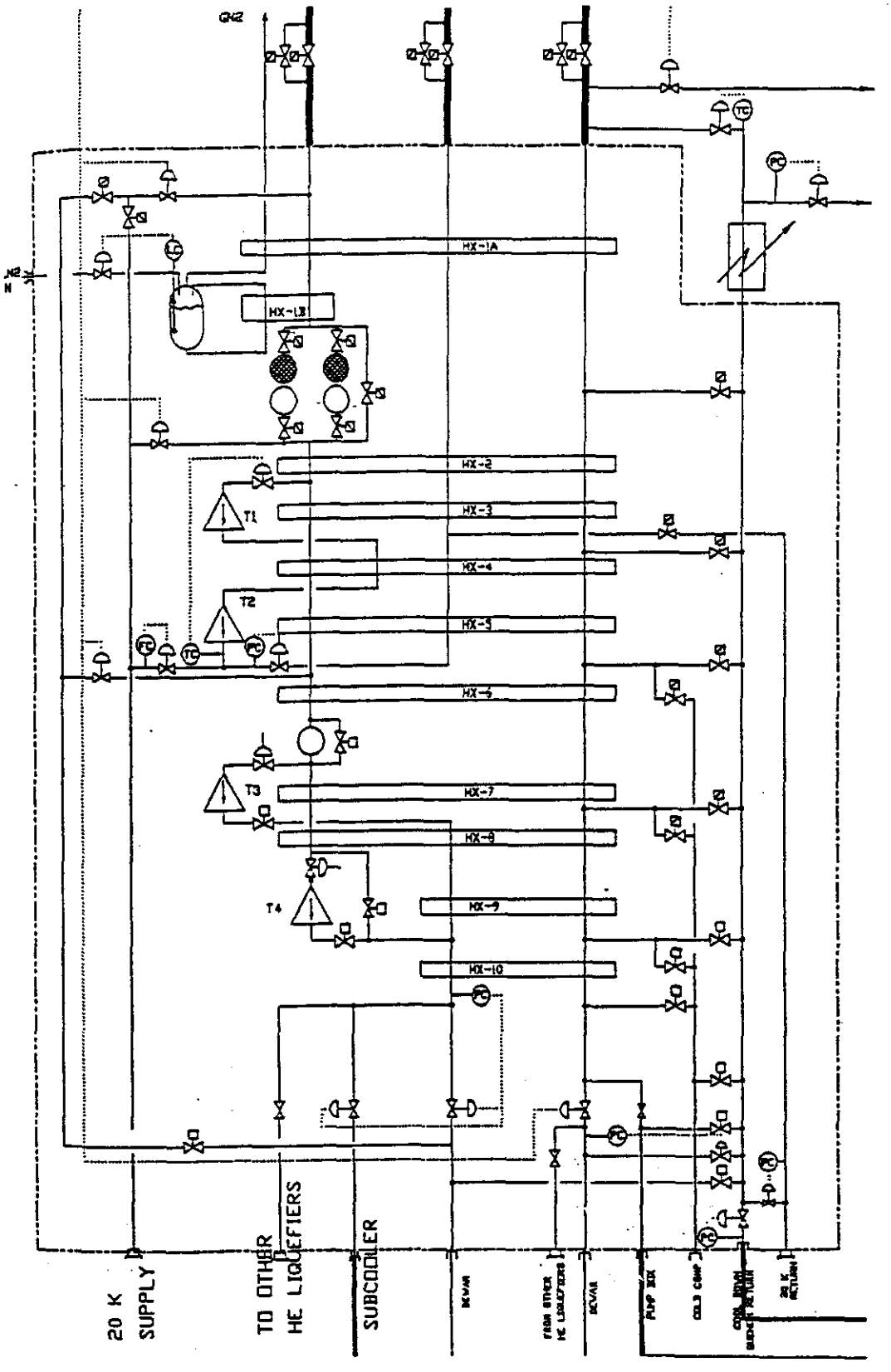
August 1994


MTL PLANT
Skid#54 CCWP compressor
Skid#11,12, 1St Stage Skid#12,14 2nd Stage Main Comp.
Skid#61/62 Recovery compressor
Skid#70 LN2 Storage Dewar
Skid#50 CCWP Cold Box
Skid#10 M.T.L. Main Cold Box Skid#10.1-T1 Skid#10.2-T2 Sdid#10.3-T3 Skid#10.4-T4
Skid#60 Refrigeration Recovey Cold Box
Skid#55 CCWP Compressor
Skid#20 Liquid Helium Dewar
Skid#51 CCWP Cold Box
Skid#40 Direct Feed
Skid#30 Pump Box
Skid#41 Dist. Box
Skid#42 Dist. Box
Skid#43 Dist. Box
Skid#44 Dist. Box
Skid#45 Dist. Box
One to Five Independent Loads



ASST / MTL / N15 Cold Box

Skid #10 COLD BOX (main)

Drawing #	SCl-0-10-002 thru 009
Operating Procedure Unit	5, 7, and 8
Location	MTL Service Building
Function	Helium Refrigeration / Liquefaction
Skid Dimensions	13'-6" Square
Type:	Vertical Cylinder
Capacity:	4000 W or 2000 W + 20 g/s
Flow:	400 g/s
Carnot Efficiency:	>25%
80 K Carbon Adsorbers:	ADS-1001A / B
National Board	931 (A) / 934 (B)
Year	1991
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Length	2057 mm (81 in)
Outside Diameter	457 mm (18 in)
Flow	400 g/s
Adsorber	Charcoal 108 kg (238 lb)
Designed Removal	100 ppm N2, 40 ppm 02
On-line Oper. Before Regen.	12 hr
Regeneration Cycle	<12 hr
MAWP @ 339 K (150°F)	21.7 bar (300 psig)
Design Press.	21.7 bar(300 psig) / Full Vac.
Design Temp.	77 / 339K (-320 / 150°F)
Operating Pressure	16.9 bar (230 psig)
Safety Relief	20 bar (275 psig)
ACTIVATION	
Design Press.	4 bar (45 psig) / Full Vac.
Design Temp.	422 K (300°F)
20 K Carbon Adsorber (non-regen.)	ADS-1002
National Board	939
Year	1991
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Length	1930 mm (76 in)
Outside Diameter	324 mm (12.75 in)
Flow	117.25 g/s
Adsorber	Charcoal 60 kg (132 lb)
Designed Removal	trace amount of Neon
MAWP @ 339 K (150°F)	21.7 bar (300 psig)
Design Press	21.7 bar (300 psig) / Full Vac.
Design Temp.	4.5 / 339 K (-451 / 150°F)
Operating Pressure	16.9 bar (230 psig)
Safety Relief	20 bar (275 psig)
ACTIVATION	
Design Press.	4 bar (45 psig)
Design Temp.	422 K (300°F)

Skid #10 COLD BOX, cont.

Carbon Ads. Outlet Filters:

Unit #	F-1001A/B
Filtration	5 micron
Type	Bayonet
Manufacturer	CPC
Material	304 Stainless Steel
Design Temp.	77 / 339 K (-320 / 150°F)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	422 K (300°F)
Design Press.	4 bar (45 psig) / Full Vac.

Unit #	F-1002
Filtration	5 micron
Type	Bayonet
Manufacturer	CPC
Material	304 Stainless Steel
Design Temp.	4.5 / 339 K (-451 /150°F)
Design Press.	21.7 bar (300 psig) / Full Vac
Design Temp.	422 K (300°F)
Design Press.	4 bar (45 psig)

Getters

Unit #	G-1001
Type	ST 507 Zirconium
Manufacturer	Ergenics, Inc.

Unit #	G-1002
Type	Activated Charcoal
Manufacturer	Ergenics, Inc.

Unit #	G-1003
Type	Activated Charcoal
Manufacturer	Ergenics, Inc.

Warmup Heater:	HTR-1001
Type	Ambient Vaporize
Model #	TF488HF-DH
Manufacturer	Thermax Inc.
Material	Aluminum
Design Temp.	77/339 K (-320/150 °F)
Design Press.	11.4 bar (150 psig)

Skid #10 COLD BOX, cont.

Heat Exchangers:	HX-1000 thru HX-1010
Type	Br. Alum. Plate-Fin
Manufacturer	Sumitomo Precision Products Co. Ltd.
HX-1000	2 Stream
National Board #	2231
HX-1001	4 Stream
National Board #	2228
HX-1002/1003	3 Stream
National Board #	2233
HX-1004/1005	4 Stream
National Board #	2232
HX-1006/1007/1008	4 Stream
National Board #	2235
HX-1009/1010	2 Stream
National Board #	2227
Nitrogen Phase Separator:	V-1004
National Board	925
Year	1991
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Length	0.61 m (24 in)
Outside Diameter	0.406 m (16 in)
MAWP @ 339 K (150°F)	11.4 bar (150 psig)
Design Press.	6.2 bar (75 psig) / Full Vac.
Design Temp.	77 / 339 K (-320 / 150°F)
Operating Pressure	4.5 bar (50 psig)
Water Separator:	V-1001
National Board	850
Year	1991
Manufacturer	Process Systems International Inc.
MAWP @ 339 K (150°F)	21.7 bar (300 psig)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	77 / 339 K (-320 / 150°F)
Operating Pressure	16.9 bar (230 psig)
Helium Supply Strainer:	STR-1001
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Mesh	100
Design Temp.	339 K (150°F)
Design Press.	21.7 bar (300 psig) / Full Vac.
Turbo Expanders (4)	See 10.1-10.4

Skid #10 COLD BOX, cont.

Vacuum Vessel	V-1000
Manufacturer	Process Systems International Inc.
Material	Carbon Steel
Length	7.62 m (25ft)
Diameter	3.81 m (12ft - 6")
Design Temp.	339 K (150°F)
Design Press.	Full Vac. / 2.1 bar (15 psig)

10.1 TURBINE ASSEMBLY # T1

Drawing #	SCl-0-10-006
Operating Procedure Unit	9
Location	Cold Box Turbine Pod #1 & 2
Function	Turboexpander runs in series with #T2 expander.
Turbine Speed:	
Norm. Oper. (Temp. <50 K)	2500 rps
Cooldown (Temp. >55 K)	2000 rps
High Temp. Alarm/Trip:	363K (194°F)
High Speed Alarm:	2550 rps
High Speed Trip:	2600 rps
Low Speed Alarm/Trip:	500 rps
Software Switchpoint	50 rps
Turbo Expander/Brake:	T-1001
Type	Gas Bearing TGL 32-28 B50
Manufacturer	Sulzer
Brake Cooler:	HX-1011
National Board	18604
Year	1991
Manufacturer	Graham Manufacturing Co. Inc.
MAWP (Shell) @ 422 K (300°F)	11.4 bar (150 psig)
MAWP (Tube) @ 422 K (300°F)	FV/ 21.7 bar (300 psig)
Min. Design Temp. @ MAWP (both)	244 K (-20°F)
Heat Load	8.83 kw (30,130 Btu/h)
Cooling Water	15 liter / min (4.0 gal / min)
Inlet Filters	F-1003 A/B
Manufacturer	CPC
Design Temp.	4.5 / 339 K (-451 / 150°F)
Design Press.	21.7 bar (300 psig) / Full Vac.
Nominal Retention	10 micron
Brake Filter	F-1006
Manufacturer	CPC
Design Temp.	4.5 / 339 K (-451 / 150°F)
Design Press.	21.7 bar (300 psig)
Nominal Retention	10 micron

10.2 TURBINE ASSEMBLY # T2

Drawing #	SC1-0-10-007
Operating Procedure Unit	9
Location	Coldbox Turbine Pod # 1&2
Function	Turboexpander running in series with # Tl expander.
Turbine Speed:	
Norm. Oper. (Temp. <30 K)	2200 rps
Cooldown (Temp. >35 K)	2500 rps
High Temp. Alarm/Trip:	363 K (194°F)
High Speed Alarm:	2550 rps
High Speed Trip:	2600 rps
Low Speed Alarm/Trip:	500 rps
Software Switchpoint	50 rps
Turbo Expander/Brake:	T-1002
Type	Gas Bearing TGL 32-28 A56
Manufacturer	Sulzer
Brake Cooler:	HX-1012
National Board	18607
Year	1991
Manufacturer	Graham Manufacturing Co. Inc.
MAWP (Shell) @ 422 K (300°F)	11.4 bar (150 psig)
MAWP (Tube) @ 422 K(300°F)	FV/ 21.7 bar (300 psig)
Min. Design Temp. @ MAWP (both)	244 K (-20°F)
Heat Load	6.97 kW (23,800 Btu/h)
Cooling Water	12 liter/min (3.2 gal/min)
Brake Filter	F-1007
Manufacturer	CPC
Design Temp.	4.5 / 339 K (-451°F / 150°F)
Design Press.	21.7 bar (300 psig)
Nominal Retention	10 micron

10.3 TURBINE ASSEMBLY # T3

Drawing #	SCl-0-10-008
Operating Procedure Unit	10
Location	Coldbox Turbine Pod
Function	Turboexpander arranged in parallel w/T4 37% of stream flow through #T3.
Turbine Speed:	
Cartridge TGL22 12 B32	3600 rps
Cartridge TGL22 12 B32	3200 rps
High Temp. Alarm/Trip:	90°C
High Speed Alarm:	3700 rps
High Speed Trip:	3800 rps
Low Speed Alarm/Trip:	500 rps
Software Switchpoint	50 rps
Turbo Expander/Brake:	T-1003
Type	Gas Bearing TGL 22-12 B32
Manufacturer	Sulzer
Brake Cooler:	HX-1013
National Board	18609
Year	1991
Manufacturer	Graham Manufacturing Co. Inc.
MAWP (Shell) @ 422 K (300°F)	11.4 bar (150 psig)
MAWP (Tube) @ 422 K (300°F)	FV/ 21.7 bar (300 psig)
Min. Design Temp. @ MAWP (both)	244 K (-20°F)
Heat Load	1.17 kW (4,000 Btu/h)
Cooling Water	1.9 liter/min (0.5 gal/min)
Inlet Filters	F-1004 A/B
Manufacturer	CPC
Design Temp.	4.5 / 339 K (-451/150°F)
Design Press.	21.7 bar (300 psig) / Full Vac.
Nominal Retention	10 micron
Brake Filter	F-1008
Manufacturer	CPC
Design Temp.	4.5 / 339 K (-451 / 150°F)
Design Press.	21.7 bar (300 psig)
Nominal Retention	10 micron

10.4 TURBINE ASSEMBLY # T4

Drawing #	SC1-0-10-009
Operating Procedure Unit	11
Location	Coldbox Turbine Pod
Function	Turboexpander arranged in parallel with #T3. 63% of the cold end flow through #T4.
Turbine Speed:	2800 rps (any mode)
High Temp. Alarm/Trip:	363 K (194°F)
High Speed Alarm:	3700 rps
High Speed Trip:	3800 rps
Low Speed Alarm/Trip:	500 rps
Software Switchpoint	50 rps
Turbo Expander/Brake:	T-1004
Type	Gas Bearing TGL 22-12 B40
Manufacturer	Sulzer
Brake Cooler:	HX-1014
National Board	18611
Year	1991
Manufacturer	Graham Manufacturing Co. Inc.
MAWP (Shell) @ 422 K (300°F)	11.4 bar (150 psig)
MAWP (Tube) @ 422 K (300°F)	FV/ 21.7 bar (300 psig)
Min. Design Temp. @ MAWP (both)	244 K (-20°F)
Heat Load	1.52 kW (5,200 Btu/h)
Cooling Water	2.6 liter/min (0.7 gal/min)
Inlet Filters	F-1005 A/B
Manufacturer	CPC
Design Temp.	4.5 K (-451°F)
Design Press.	21.7 bar (300 psig) / Full Vac.
Nominal Retention	10 micron
Brake Filter	F-1009
Manufacturer	CPC
Design Temp.	339 K
Design Press.	21.7 bar (300 psig)
Nominal Retention	10 micron

Skid #11 FIRST STAGE COMPRESSOR

Drawing #	SC1-0-11-001
Operating Procedure Unit	3
Location	Compressor Building
Function	Compress helium gas from storage tank farm.
Skid Dimensions	1.83 m x 3.96 m (6 ft x 13 ft)
Process Conditions:	
Pressure In	1.01 bar (15.44 psia)
Pressure Out	3.45 bar (49.98 psia)
Temperature In	316.5 K (109.8°F)
Temperature Out	352.1 K (174°F)
Flow Required	108.5 g/s each
Flow Max.	112.29 g/s -0, +5% each
Brake Horsepower @Req'd Flow	198 bhp
Brake horsepower @Max. Flow	204 bhp
Volumetric Efficiency	90 - 92 %
Isothermal Efficiency	56 %
Oil Type:	Ucon LB-170
Vapor Pressure After Processing	51 mbar @ 373-393 K (200-250,F)
Viscosity:	170 SUS @ 311 K (100°F)
Characteristics:	water-white to light yellow color; no odor. SEE MSD
Aftercooler	HX-1101
National Board	34567
Type	Tube / Shell
Manufacturer	Basco
Compressors	C-1101
Type	Two Parallel Oil Injected Rotary Screw (50% Each)
Manufacturer	Sullair Inc.
Model #	C25 LB 704-22
Electric Heater	HTR-1106
Function	Oil Heater
Manufacturer	Hotwatt
Power	500 W, 115 V

Skid #11 FIRST STAGE COMPRESSOR cont.

Electric Motors

Unit #	EM-1101
Function	Drive compressor
Manufacturer	Reliance Electric
Power	250 hp, 3560 rpm, 460 V, 3ø
Service Factor	1.2
Unit #	EM-1102
Function	Drive slide valve
Manufacturer	RCS
Voltage	115 V
Unit #	EM-1117
Function	Drive oil pump P-1117
Manufacturer	Franklin
Power	3/4 hp, 115 V
Oil Cooler	HX-1102
National Board	34568
Manufacturer	Basco
Oil Pump	P-1117
Manufacturer	Tuthill
Oil Separator	V-1101
National Board	80488158
Year	1991
Manufacturer	Manchester
Volume	1003 liter (265 gal)
MAWP @ 394 K (250°F)	10.3 bar (150 psi)
Min. Design Temp. @ 10.3 bar (150 psi)	244 K (-20°F)
Type	Three Stage w/ Oil Heater
Carryover	<10 ppm (By Weight)

Skid #12 FIRST STAGE COMPRESSOR

Drawing #	SC1-O-11-OO1
Operating Procedure Unit	3
Location	Compressor Building
Function	Compress helium gas from storage tank farm.
Skid Dimensions	1.83 m x 3.96 m (6 ft x 13 ft)
Process Conditions:	
Pressure In	1.01 bar (15.44 psia)
Pressure Out	3.45 bar (49.98 psia)
Temperature In	316.5 K (109.8°F)
Temperature Out	352.1 K (174°F)
Flow Required	108.5 g/s each
Flow Max.	112.29 g/s -0, +5% each
Brake Horsepower @Req'd Flow	198 bhp
Brake horsepower @Max. Flow	204 bhp
Volumetric Efficiency	90 - 92 %
Isothermal Efficiency	56%
Oil Type:	Ucon LB-170
Vapor Pressure After Processing	51 mbar @ 373-393K (200-250°F)
Viscosity:	170 SUS @ 311 K (100°F)
Characteristics:	water-white to light yellow color no odor. SEE MSD
Aftercooler	HX-1201
National Board	34566
Type	Tube / Shell
Manufacturer	Basco
Compressors	C-1201
Type	Two Parallel Oil Injected Rotary Screw (50% Each)
Manufacturer	Sullair Inc.
Model #	C25 LB 704-22
Electric Heater	HTR-1206
Function	Oil Heater
Manufacturer	Hotwatt
Model	SC62-175
Power	500 W, 115 V

12 FIRST STAGE COMPRESSOR, cont.

Electric Motors

Unit #	EM-1201
Function	drive compressor
Manufacturer	Reliance Electric
Power	250 hp, 3560 rpm, 460 V, 3ø
Service Factor	1.2
Unit #	EM-1202
Function	drive slide valve
Manufacturer	RCS
Voltage	115 V
Unit #	EM-1217
Function	drive oil pump P-1217
Manufacturer	Franklin
Power	3/4 hp, 115 V
Oil Cooler	HX-1202
National Board	34569
Manufacturer	Basco
Oil Pump	P-1217
Manufacturer	Tuthill
Oil Separator	V-1201
National Board	80488157
Year	1991
Manufacturer	Manchester
Volume	1003 liter (265 gal)
MAWP @ 394 K (250°F)	10.3 bar (150 psi)
Min. Design Temp. @ 10.3 bar (150 psi)	244 K (-200F)
Type	Three Stage w/ Oil Heater
Carryover	<10 ppm (By Weight)

Skid #13 SECOND STAGE COMPRESSOR

Drawing #	SCl-0-13-001
Operating Procedure Unit	4
Location	Compressor Building
Function	Compress helium gas from storage tank farm.
Skid Dimensions	1.83 m x 3.96 m (6 ft x 13 ft)
Process Conditions:	
Pressure In	3.2 bar (47.04 psia)
Pressure Out	18 bar (264.6 psia)
Temperature In	312 K (101.7°F)
Temperature Out	364.3 K (196°F)
Flow Required	197.5 g/s each
Flow Max.	224.49 g/s -0, +5% each
Brake Horsepower	@ Req'd Flow 582 bhp
Brake horsepower	@ Max. Flow 625 bhp
Volumetric Efficiency	80 -87 %
Isothermal Efficiency	53%
Oil Type:	Ucon LB-170
Vapor Pressure After Processing	50 microns @ 373-393 K (200-250°F)
Viscosity:	170 SUS @ 311 K (1000°F)
Characteristics:	water-white to light yellow color; no odor
	SEE MSD
Aftercooler	HX-1301
National Board	34603
Type	Tube / Shell
Manufacturer	Basco
Compressor	C-1301
Type	Two Parallel Oil Injected Rotary Screw (50% Each)
Manufacturer	Sullair Inc.
Model #	C25MA704-26
Electric Heater	HTR-1306
Function	Oil Heater
Manufacturer	Hotwatt
Model	SC62-175
Power	500 W, 115 V

Skid #13 SECOND STAGE COMPRESSOR, cont.

Electric Motors

Unit #	EM-1301
Function	drive compressor
Manufacturer	Reliance Electric
Power	700 hp, 3600 rpm, 4160 V, 3ø
Service Factor	1.2
Unit #	EM-1302
Function	drive slide valve
Manufacturer	RCS
Voltage	115V
Unit #	EM-1317
Function	drive oil pump P-1317
Manufacturer	Franklin
Power	3/4 hp, 115 V
Oil Cooler	HX-1302
National Board	3455.7
Manufacturer	Basco
Oil Pump	P-1317
Manufacturer	Tuthill
Oil Separator	V-1301
National Board	80488156
Year	1991
Manufacturer	Manchester
Volume	1003 liter (265 gal)
MAWP @ 394 K (250°F)	10.3 bar (150 psi)
Min. Design Temp. @ 10.3 bar (150 psi)	244 K (-200F)
Type	Three Stage w/ Oil Heater
Carryover	<10 ppm (By Weight)

Skid #14 SECOND STAGE COMPRESSOR

Drawing #	SCl-0-13-001
Operating Procedure Unit	4
Location	Compressor Building
Function	Compress helium gas from storage tank farm.
Skid Dimensions	1.83 m x 3.96 m (6 ft x 13 ft)
Process Conditions:	
Pressure In	3.2 bar (47.04 psia)
Pressure Out	18 bar (264.6 psia)
Temperature In	312 K (101.7°F)
Temperature Out	364.3 K (196°F)
Flow Required	197.5 g/s each
Flow Max.	224.49 g/s -0, +5% each
Brake Horsepower @Req'd Flow	582 bhp
Brake horsepower @Max. Flow	625 bhp
Volumetric Efficiency	80 -87 %
Isothermal Efficiency	53%
Oil Type:	Ucon LB-170
Vapor Pressure After Processing	51 mbar @ 373-393 K (200-250°F)
Viscosity:	170 SUS @ 311 K (100°F)
Characteristics:	water-white to light yellow color; no odor. SEE MSD
Aftercooler	HX-1401
National Board	34604
Type	Tube / Shell
Manufacturer	Basco
Compressor	C-1401
Type	Two Parallel Oil Injected Rotary Screw (50% Each)
Manufacturer	Sullair Inc.
Model #	C25MA704-26
Electric Heater	HTR-1406
Function	Oil Heater
Manufacturer	Hotwatt
Model	SC62-175
Power	500 W, 115 V

Skid #14 SECOND STAGE COMPRESSOR, cont.

Electric Motors	
Unit #	EM-1401
Function	drive compressor
Manufacturer	Reliance Electric
Power	700 hp, 3600 rpm, 4160 V, 3ø
Service Factor	1.2
Unit #	EM-1402
Function	drive slide valve
Manufacturer	RCS
Voltage	115 V
Unit #	EM-1417
Function	drive oil pump P-1417
Manufacturer	Franklin
Power	3/4 hp, 115V
Oil Cooler	HX-1402
National Board	34558
Manufacturer	Basco
Oil Pump	P-1417
Manufacturer	Tuthill
Oil Separator	V-1401
National Board	80488155
Year	1991
Manufacturer	Manchester
Volume	1003 liter (265 gal)
MAWP @ 394 K (250°F)	10.3 bar (150 psi)
Min. Design Temp. @ 10.3 bar (150 psi)	244 K (-200F)
Type	Three Stage w/ Oil Heater
Carryover	<10 ppm (By Weight)

Skid #15 COMPRESSOR OIL REMOVAL

Drawing #	SCl-0-15-001
Operating Procedure Unit	2
Location	Outside compressor building.
Function	Remove oil vapor and droplett from helium gas flow.

Skid Dimensions:

Length	3.45 m (11 ft - 4 in)
Height	3.63 m (11 ft - 11 in)
Width	2.3 6 m (7 f t - 9 in)

Adsorber: ADS-150OA/B

National Board	855 (A),858 (B)
Year	1991
Manufacturer:	Process Systems International Inc.
Type:	Carbon Bed
Operating Life:	Two Year @ Full Flow Rate
Adsorbent:	Charcoal
Number Of Stages:	1
Impurities At Outlet:	< 1 ppb Oil
MAWP @ 422 K (300°F)	22 bar (300 psig)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	339 K (150"F)
Operating Pressure	17 bar (235 psig)

Coalescers: CLS-1500/1501/1502/1503

National Board	867 (0), 870 (1), 873 (2), 876 (3)
Year	1991
Type:	Single Coalescing Element
Manufacturer:	Process Systems International Inc.
Face Velocity:	< 5 cm/s
MAWP @ 339 K (150°F)	22 bar (300 psig)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	339 K (150°F)
Operating Pressure	17 bar (235 psig)

Skid #15 COMPRESSOR OIL REMOVAL cont.

Filters

Unit	F-150OA/B
National Board	41481 (A),41479 (B)
Year	1991
Manufacturer:	Dollinger
Type: Element	Polyester-99
Nominal Retention:	5 micron
MAWP @ 339 K (150°F)	22 bar (300 psig)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp	339 K (150°F)
Unit #	F-1501-1504
National Board	N/A
Year	
Type	
Manufacturer	Koch
Nominal Retention	40 micron
MAWP @ 339 K (150°F)	300 psig
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	339 K (150°F)

System #16 HELIUM GAS STORAGE

Drawing #	SCl-0-16-001 thru 004
Operating Procedure Unit	2
Location	Tank Farm
Function	Provide storage for gaseous helium.
Gas Storage 1, 2	V-1601, V-1602
National Board	250,251
Year	1991
Manufacturer	Trinity Industries, Inc.
Material	SA.612
Length	16.5 m (652.375 in)
Diameter	3.35 m (131.875 in)
Volume	132,475 L (35,000 U.S. gal)
MAWP @ 328K (131°F)	20bar (275 psig)
Design Press.	20 bar (275 psig) / Full Vac.
Design Temp.	339 K (150°F)
Mechanical Safety Relief:	19.6 bar (270 psig)
Compressor Inlet Strainer	STR-1652
Manufacturer	Process Systems International Inc.
Material	Stainless Steel
Design Press.	11.4bar (150 psig) /Full Vac.
Design Temp.	339 K (150°F)
Size	30 mesh
Filter	
Unit #	F-1601
Type	27/80
Manufacturer	Balst
Design Press.	19.6 bar (270 psig)
Design Temp.	339 K (150°F)
Nominal Retention	5 micron
Unit #	F-1628/1630
Type	High Press. Reg.
Manufacturer	Tescom
Design Press.	415 bar (6,000 psig)
Design Temp.	339 K (150°F)
Nominal Retention	7 micron

Skid #17 COLD BOX REGENERATION

Drawing #	SCl-0-17-001
Operating Procedure Unit	15
Location	MTL Service Building
Function	Activate and regenerate carbon adsorber beds in R/L module and recycle pure helium back to medium pressure helium gas header.
Skid Dimensions:	
Length	3.2 m (126 in)
Width	2.59 m (102 in)
Electric Motors	
Unit #	EM-1700
Function	Drive Lamson Blower.
Manufacturer	Toshiba
Power	3 hp, 3500 rpm, 460 V, 3ø, 60 Hz
Unit #	EM-1702
Function	Drive vacuum pump (Leybold)
Manufacturer	Brook Crompton Inc.
Power	3 hp, 1750 rpm, 460 V, 3ø, 60 Hz
Filter	F-1702
Manufacturer	Leybold
Design Press.	Full Vac. / 3.1 bar (30 psig)
Design Temp.	339 K (150°F)
Nominal Retention	10 micron
Gas Heaters:	
Unit #	HTR-1701
National Board	45
Year	1991
Type	Incoloy Elements
Manufacturer	Watlow / Process Systems Inc.
Material	304 Stainless Steel
MAWP @ 422 K (300°F)	20.7 bar (300 psi)
Design Press.	21.7 bar (300 psig) / Full Vac.
DesignTemp.	478 K (400°F)
Watts	5 KW, 480 V, 3ø, WYE
Unit #	HTR-1702
Type	Ambient Air Fin
Manufacturer	KPS Thermax
Material	Aluminum
Design Press.	12 bar (175 psig)
DesignTemp.	78 / 422 K (-320 / 300°F)
Flow @ design press. and temp.	53 g/s

Skid #17 COLD BOX REGENERATION, cont.

Unit #	HTR-1703
Type	Ambient Air Fin
Manufacturer	KPS Thermax
Material	Aluminum
Design Press.	21.7 bar (300 psig)
DesignTemp.	20 / 339 K (-423 / 150°F)
Flow @ nominal press and temp	5 g/s
Gas Blower:	C-1700
Manufacturer	Lamson
Material	Cast Iron / Ductile Iron
Design Press.	2.7 bar (25 psig)
Design Temp.	422K (300°F)
Flow	119 m3/hr (70 acfm)
Pressure Change	138 mbar (2 psi)
Regen. Vacuum Pump:	P-1702
Manufacturer	Leybold Sogevac
Type	Rotary Vane
Mist Eliminator:	CLS-1702
Manufacturer	Leybold
Design Press.	Full Vac. / 3.1 bar (30 psig)
Design Temp.	339 K (150°F)
Strainer:	STR-1701
Design Temp.	233 / 422 K (-40 / 300°F)
National Board	*none*
Year	1991
Type	100 Mesh
Manufacturer	Mueller Steam Specialty
MAWP @ 311K (100°F)	19.7bar(285psi)
Design Press.	3.1 bar (30 psig) / Full Vac.

Skid #18 VACUUM SYSTEM

Drawing #	SCl-0-18-001
Operating Procedure Unit	1 6
Location	MTL service building
Function	Provide insulating vacuum for main cold box.
Normal Operating Pressure:	<lxl0-7 mbar
Max. Helium Leak Rate:	lxl0-6 scc/sec
Chiller Motor	EM-1803
Function	Cool Turbomolecular-pump bearing
Manufacturer	Leybold
Voltage	110v
Electric Motors	
Unit #	EM-1801
Function	drive turbomolecular pump P-1801
Manufacturer	Leybold
Power	5 hp, 115 V, 60 Hz
Unit #	EM-1802
Function	drive roughing pump P-1802
Manufacturer	GE Motor
Power	3 hp, 1725 rpm, 460 V, 3ø, 60 Hz
Filter	F-1802
Manufacturer	Leybold
Type	AR65
Mist Eliminator	CLS-1802
Manufacturer	Leybold
Roughing Pump:	P-1802
Type	Rotary Vane
Manufacturer	Leybold
Pumping Speed	24.9 liter / s (53 cfm)
Turbomolecular Pump:	P-1801
Manufacturer	Leybold
Pumping Speed	110 liter / s

Skid #20 LIQUID HELIUM DEWAR

Drawing #	SCl-0-20-002
Operating Procedure Unit	12
Location	MTL / outside
Function	Separate helium phases, store liquid helium, store energy during quench, vaporize helium during ref/liq performance test, and provide decant to portable dewars.
Liquid Helium Dewar	V-2001
Manufacturer	Cryenco
LN2 Shield	Yes
LHe Vessel	
Mfg Serial #	D843-1
Year	1991
Material	304 Stainless Steel
Volume	40,000 / L (10567 gal)
MAWP @ 4 / 339 K (-452 / 150°F)	60 psig
Design Temp.	4/339 K (-452 / 150°F)
Design Press.	4.13 bar (45.3 psig)
Mechanical Safety Relief	4.0 bar (43 psig)
Liquid Nitrogen Tank	V-2001
Manufacturer	Minnesota Valley
Pressure Vessel	
National Board	HL 190-55-50
Year	1991
Material	T304
Volume	719 liter (190 gal)
MAWP @ 77 / 339K (-321 / 150°F)	50 psig
Design Temp:	77 / 339K (-321 / 150°F)
Design Pressure:	4 bar (43 psig)
Mechanical Safety Relief	43 psig
Calorimeter:	HTR-2003
Type	Three 2kw Heaters
Power	240 V, 3ø, 60 Hz

Skid #30 LIQUID HELIUM PUMP BOX

Drawing #	20114-D
Operating Procedure Unit	49
Location	MTL Service Building
Function	Isolate helium dewar press. from magnet test stand press. and provide continuous supply of single phase helium to subcooler and test stand.
Total Static Heat Load:	< 145 W
Static Heat Leak:	75 W approx.
Pump Efficiency:	> 50 %
Capacity Modulation:	10-100 % of full pump output
Temp. Before and After:	< 4.3 K (-452°F)
Surge Vessels: Two Each	Temperature gradient 20K-4K
National Board	164 (V-30-8),166 (V-30-9)
Dimensions:	
Length	Volume 11 ft3 (300 liters)
Height	90 "
Width	16 "
Subcooler	V-30-1
National Board	162
Intake Surge Vessels: Three Each	
National Board #	172 (Bl),173 (B2),174 (B3)
Filter Housings: Three Each	
National Board	178 (Bl),180 (B2),179 (B3)
Booster Pump:	
Manufacturer	CCI
Flow Rate	<200 g/s
Density	125 g/liter
Differential Pressure	< 3 bar
Flow Bypass Rate	200 g/s
Circulation Pumps (2):	
Manufacturer	CCI
Flow Rate	<250 g/s
Density	125 g/liter
Differential Pressure	.5 bar
Flow Bypass Rate	500 g/s
Suct. & Dis. Surge Tanks (2):	
Manufacturer	CCI
Volume	> .25 m3

Skid #40 TEST STAND DISTRIBUTION BOX SYSTEM

Drawing #	SCl-0-40-002
Operating Procedure Unit	20
Location	MTL High Bay
Function	Distributes helium and nitrogen flows to the five distribution boxes.
4K Header Vacuum Jacket	E-4021
Manufacturer	Process Systems International
Material	Carbon Steel
Design Temp.	339 K (150°F)
Design Press.	Full Vac./2.1bar(15 psig)
80K Header Vacuum Jacket	E-4022
Manufacturer	Process Systems International
Material	Carbon Steel
Design Temp.	339 K (150°F)
Design Press.	Full Vac./2.1bar(15 psig)
Getters	
Unit	G-4015
Manufacturer	Ergenics, Inc.
Material Type	St 507 Zirconium
Unit #	G-4020
Manufacturer	Ergenics, Inc.
Material Type	St 507 Zirconium

Skid #41-45 TEST STAND DISTRIBUTION BOXES

Drawing #	SC1-0-41-002
Operating Procedure Unit	
Location	MTL High Bay
Function	Distributes helium and nitrogen to magnet test stands
Vacuum Vessel	V-4100 / 4200 / 4300 / 4400 / 4500
Manufacturer	Process Systems International
Material	Carbon Steel
Design Temp.	339 K (150°F)
Design Press.	Full Vac./ 2.1 bar(15 psig)
Subcooler Separator	V-4101 / 4201 / 4301 / 4401 / 4501
National Board	960 / 961 / 959 / 958 / 957
Year	
Manufacturer	Process Systems International
Design Press.	19 bar (261 psig)
Design Temp.	2 / 339 K (-456 / 150°F)
Heat Exchanger	HX-4101 / 4201 / 4301 / 4401 / 4501
National Board	2237 / 2241 / 2240 / 2238 / 2239
Manufacturer	Sumitomo
Type	Brazed Aluminum Plate-Finned
# Of Streams	3
Heat Stationing	HX-4102 / 4202 / 4302 / 4402 / 4502
Manufacturer	Process Systems International
Type	LN2 Shield w/ Valve Stationing
Material	Aluminum
Getters	
Unit #	G-4101 / 4201 / 4301 / 4401 / 4501
Manufacturer	Ergenics, Inc.
Material Type	St 507 Zirconium
Unit #	G-4102 / 4202 / 4302 / 4402 / 4502
Manufacturer	Ergenics, Inc.
Material Type	Activated Charcoal

Skid #47 TEST STAND DISTRIBUTION BOX VACUUM SYSTEM

Drawing	SCI-0-47-001
Location	Portable
Function	Perform evacuation, repressurization and pressure monitoring of distribution boxes and other systems.
Roughing Pump	P-4702
Manufacturer	Leybold
Type	Rotary Vane
Pump Speed	24.9 liter/s (53 cfm)
Turbomolecular Pump	P-4701
Manufacturer	Leybold
Pump Speed	110 f/s
Mist Eliminator	CLS-4702
Manufacturer	Leybold
Filter F-4701	
Manufacturer	Leybold
Electric Motor	EM-4702
Function	Drive rotary vane roughing pump P-4702
Manufacturer	GE Motor
Power	3 hp, 1725 rpm, 460 V, 3 ø, 60 Hz

Skid #50 CCWP

Drawing #	SC1-0-50-001
Operating Procedure Unit	27
Location	MTL Service Building
Function	Perform cleanup, cooldown, and warmup functions for magnets, and purification of circulating helium.
Skid Dimensions	
Length	3 m (9 ft - 10 in)
Width	3 m (9 ft - 10 in)
Vacuum Vessel	V-5002
Manufacturer	Process Systems International Inc.
Material	Carbon Steel
Design Temp.	339 K (150°F)
Design Press.	2.1 bar (15psig) Full Vac.
Heat Exchangers	
Unit #	HX-5000
National Board	2230
Manufacturer	Sumitomo
Type	Brazed Aluminum Plate-Finned
# Of Streams	4 Stream
Unit #	HX-5001
National Board	2226
Manufacturer	Sumitomo
Type	Brazed Aluminum Plate-Finned
# Of Streams	2-Stream
LN2 Separator	V-5000
National Board	901
Year	1991
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Length	1.016 m (40 in)
Diameter	.660 m (26 in)
MAWP @ 339 K (150°F)	11.4 bar (150 psig)
Design Press.	11.3 bar (150 psig) Full Vac.
Design Temp.	77 / 339 K (-320 / 150°F)
Operating Pressure	4.5 bar (50 psig)

skid #50 CCWP, cont.

Water Separator	V-5001
National Board	853
Year	1991
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Length	.609 m (24 in)
Diameter	.203 m (8 in)
MAWP @ 339 K (150°F)	13.1 bar (175 psig)
Design Press.	11.3 bar (150 psig) / Full Vac.
Design Temp.	77 / 339 K (-320 / 150°F)
Operating Pressure	9.0 bar (116 psig)
Carbon Adsorber	ADS-5000
National Board	942
Year	1991
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Length	2057 mm (8 ft 10 in)
Diameter	457 mm (18 in)
MAWP @ 339 K (150°F)	21.7 bar (300 psig)
Design Press.	11.3 bar (150 psig) / Full Vac.
Design Temp.	77 / 400 K(-320 / 260°F)
Operating Pressure	16.9 bar (230 psig)
Flow	110 g/s
On-line Oper.Before Regen.	24 hr
Regeneration Cycle	< 12 hr
Inlet Press.	7 bar (1 02 psi)
Outlet Press.	6 bar (87 psig)
Adsorber	Charcoal 102 kg (225 lb)
Getter	
Unit #	G-5000
Manufacturer	Ergenics, Inc.
Material Type	St 502 Zirconium
Unit #	G-5001
Manufacturer	Ergenics, Inc.
Material Type	Activated Charcoal
Filter	
Unit #	F-5000
Manufacturer	CPC
Design Temp.	77 / 339 K (-320 / 150°F)
Design Press.	11.3 bar (150 psig) / Full Vac.
Nominal Filtration	10 micron
Unit #	F-5001
Manufacturer	CPC
Design Temp.	77 / 400 K (-320 / 260°F)
Design Press.	11.3 bar (150 psig) / Full Vac.
Nominal Filtration	5 micron

Skid #50 CCWP, cont.

Unit #	F-5002
Manufacturer	CPC
Design Temp.	77 to 339 K (-320 to 150°F)
Design Press.	139 bar (2,000 psig) / Full Vac.
Nominal Filtration	2 micron

Skid #51 CCWP

Drawing #	SCl-0-50-001
Operating Procedure Unit	27
Location	MTL Service Building
Function	Perform cleanup, cooldown, and warmup functions for magnets, and purification of circulating helium.
Skid Dimensions	
Length	3 m (9 ft - 10 in)
Width	3 m (9 ft - 10 in)
Vacuum Vessel	V-5102
Manufacturer	Process Systems International Inc.
Material	Carbon Steel
Design Temp.	339 K (150°F)
Design Press.	2.1 bar (15 psig)/Full Vac.
Heat Exchangers	
Unit #	HX-5100
National Board	2195
Manufacturer	Sumitomo
Type	Brazed Aluminum Plate-Finned
# Of Streams	4 Stream
Unit #	HX-5101
National Board	2242
Manufacturer	Sumitomo
Type	Brazed Aluminum Plate-Finned
# Of Streams	2-Stream
LN2 Separator	V-5100
National Board	902
Year	1991
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Length1	.016 m (40 in)
Diameter	.660 m (26 in)
MAWP @ 339 K (150°F)	11.4 bar (150 psig)
Design Press.	11.3 bar (150 psig) / Full Vac.
Design Temp.	77 / 339 K (-320 / 150°F)
Operating Pressure	4.5 bar (50 psig)

Skid #51 CCWP, cont.

Water Separator	V-5101
National Board	854
Year	1991
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Length	.609 m (24 in)
Diameter	.203 m (8 in)
MAWP @ 339 K (150°F)	13.1 bar (175 psig)
Design Press.	11.3 bar (150 psig) / Full Vac.
DesignTemp.	77 / 339 K (-320 / 150°F)
Operating Pressure	9.0 bar (116 psig)
Carbon Adsorber	ADS-5100
National Board	943
Year	1991
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Length	2057 mm (8 ft 10 in)
Diameter	457 mm (18 in)
MAWP @ 339 K (150° F)	21.7 bar (300 psig)
Design Press.	11.3 bar (150 psig) / Full Vac.
Design Temp.	77 / 400 K (-320 / 260°F)
Operating Pressure	16.9 bar (230 psig)
Flow	110 g/s
On-line Oper.Before Regen.	24 hr
Regeneration Cycle	< 12 hr
Inlet Press.	7 bar (102 psi)
Outlet Press.	6 bar (87 psi)
Adsorber	Charcoal 102 kg (225 lb)
Getter	
Unit #	G-5100
Manufacturer	Ergenics, Inc.
Material Type	St 502 Zirconium
Unit #	G-5101
Manufacturer	Ergenics, Inc.
Material Type	Activated Charcoal
Filter	
Unit #	F-5100
Manufacturer	CPC
Design Temp.	77 / 339 K (-320 / 150°F)
Design Press.	11.3 bar (150 psig) / Full Vac.
Nominal Filtration	10 micron
Unit #	F-5101
Manufacturer	CPC
Design Temp.	77 / 400 K (-320 / 260°F)
Design Press.	11.3 bar (150 psig) / Full Vac.
Nominal Filtration	5 micron

Skid #51 CCWP, cont.

Unit #	F-5102
Manufacturer	CPC
Design Temp.	77 to 339 K (-320 to 150°F)
Design Press.	139 bar (2,000 psig) / Full Vac.
Nominal Filtration	2 micron

Skid #52 CCWP REGENERATION

Drawing #	SCl-0-52-001
Operating Procedure Unit	29
Location	MTL Service Building
Function	Warmup and cooldown of CCWP adsorber bed and activation of carbon in adsorber bed.
Skid Dimensions	
Length	3.2 m (126 in)
Width	2.59 m (102 in)
Gas Heaters	
Unit #	HTR-5201
National Board	34
Year	1991
Manufacturer	Watlow / Process System Inc.
Manuf. Serial	T7O6-lAlD4-1
Type	Incoloy Elements
Material	304 Stainless Steel
MAWP @ 422 K (300°F)	13 bar (175 psig)
Design Press.	13 bar (175 psig) / Full Vac.
DesignTemp.	422 K (300°F)
Power	5 k Watts, 480 V, 3 ø
Unit #	HTR-5202
Manufacturer.	Thermax Inc.
Manuf.Model	TF208HF-P8-V ser. C-16-1
Type	Ambient Air Fin
Material	Aluminum
Design Press.	13 bar (175 psig)
Design Temp.	77 / 422 K (-320 / 300°F)
Gas Blower	C-5200
Manufacturer	Lamson
Material	Cast Iron / Ductile Iron
Design Temp.	422 K (300°F)
Design Press.	2.7 bar (25 psig)
Flow	119 m3/ hr (70 acmf)
Pressure Change	138 mbar (2 psi)
Strainer	STR-5201
Manufacturer	Mueller Stream Specialty
Type	100 Mesh
Year	1991
MAWP @ 311 K (100°F)	19.7 bar (285 psi)
Design Press.	13 bar (175 psig)
Design Temp.	233 / 339 K (-40 / 150°F)
Electric Motor	EM-5200
Manufacturer	Toshiba
Power	3 hp,460 V,3ø

Skid #53 CCWP DEHYDRATION

Drawing #	SC1-0-53-001
Operating Procedure Unit	30
Location	MTL Service Building
Function	Dehydration of helium stream returning from CCWP to compressors.
Skid Dimensions	
Length	4.88 m (16 ft)
Width	1.68 m (66 in)
Mol.Sieve Adsorber	ADS-530OA/B
National Board	908 (A) / 911(B)
Year	1991
Manufacturer	Process Systems International Inc.
Material	Carbon Steel
Length	2133 mm (7 ft)
Diameter	609 mm (24 in)
MAWP @ 600 K (620°F)	9.6 bar (125 psig)
Design Press.	9.6 bar (125 psig) / Full Vac.
Design Temp.	600 K (620°F)
Capacity	
Coalescer	CLS-5301 A/B
National Board	914 (A) / 917 (B)
Year	1991
Manufacturer	Process Systems International Inc.
Type	Water Droplet Separator
Material	Carbon Steel
MAWP @ 339 K (150°F)	11.3 bar (150 psig)
Design Press.	13 bar (175 psig) / Full Vac.
Design Temp.	339 K (150°F)
Face Velocity	
Efficiency	
Filter	F-5301 A/B
National Board	41592 (A) / 41594 (B)
Year	1991
Manufacturer	Dollinger
Material	Stainless Steel
MAWP @ 339 K (150°F)	12 bar (175 psi)
Design Press.	13 bar (175 psig) / Full Vac.
Design Temp.	339 K (150°F)
Components Limit Temp.	291 K (650°F)
Nominal Filtration	3 micron

Skid #53 CCWP DEHYDRATION, cont.

GN2 Heater	HTR-5306
National Board	44
Year	1991
Manufacturer	Watlow / Process Systems Inc.
MAWP @ 616 K (650°F)	8.6 bar (125 psi)
Design Press.	9.6 bar (125 psig)
Design Temp.	617 K (650°F)
Power	5 kW,480 V,3ø,60 Hz
Heater	HTR-5300
National Board	42
Year	1991
Manufacturer	Watlow / Process Systems Inc.
Material	340 Stainless Steel
MAWP @ 477 K (400°F)	12 bar (175 psi)
Design Press.	13 bar (175 psig) / Full Vac.
Design Temp.	77 / 477 K (-320 / 400°F)
Power	145 kW, 480 V, 3ø, 60 Hz
Strainer	STR-5300
Manufacturer	Mueller Stream Specialty
Year	1991
MAWP @ 311 K (100°F)	19.7 bar (285 psi)
Design Press.	11.4 bar (150 psig)
Design Temp.	339 K (150°F)
Type	30 Mesh

Skid #54 CCWP COMPRESSOR

Drawing #	SCl-0-54-001
Operating Procedure Unit	31
Location	MTL compressor building
Function	Compress helium recieved from CCWP return header.
Skid Dimensions:	
Length	3.35 m (11 ft)
Width	1.52 m (5 ft)
Process Conditions:	
Pressure In	2 bar (29 psi)
Pressure Out	7 bar (102 psi)
Temperature In	300 K
Temperature Out	300 K
Flow Required	55 g/s
Flow Max.	110 g/s
Brake Horsepower @Req'd Flow	
Brake horsepower @Max. Flow	
Oil Type:	Ucon LB-170
Vapor Pressure After Processing	51 mbar @ 373-393 K (200-250°F)
Viscosity:	170 SUS @ 311 K (100°F)
Characteristics:	water-white to light yellow color; no odor.
	SEE MSD
Compressor	C-5401
Manufacturer	Sullair
Type	Rotary Screw
Model	C16LA
Oil Separator	V-5401
National Board	486974
Year	1991
Manufacturer	Manchester
Volume	348 liter (92 gal)
MAWP @ 394 K (250°F)	10.3 bar (150 psi)
Min. Design Temp. @ 10.3 bar (150 psi)	244 K (-200F)
Type	Three Stage w/ Oil Heater
Carryover	<10 ppm (By Weight)

Skid #54 CCWP COMPRESSOR, cont.

Aftercooler	HX-5401
National Board #	34243
Manufacturer	Basco
Oil Cooler	HX-5402
National Board #	34240
Manufacturer	Basco
Heater	HTR-5406
Function	Oil Heater
Manufacturer	HOTWATT
Power	500 W Heater 1ø / 60HZ / 120V
Oil Pump	P-5417
Manufacturer	TUTHILL
Pressure Flow	
Electric Motors:	
Unit #	EM-5401
Function	drive compressor
Manufacturer	Reliance Electric Co.
Power	125 hp, 3570 rpm, 460 V, 137 amp,60Hz,3ø
Service Factor	1.2
Unit #	EM-5402
Function	drive comp. slide valve
Manufacturer	RCS
Voltage	115 V
Unit #	EM-5417
Function	Drive pump P-5417
Manufacturer	Franklin
Power	3/4 hp,115 V

Skid #55 CCWP COMPRESSOR

Drawing #	SCl-0-54-001
Operating Procedure Unit	31
Location	MTL compressor building
Function	Compress helium recieved from CCWP return header.
Skid Dimensions:	
Length	3.35 m (11 ft)
Width 1.52 m (5 ft)	
Process Conditions:	
Pressure In	2 bar (29 psi)
Pressure Out	7 bar (102 psi)
Temperature In	300 K
Temperature Out	300 K
Flow Required	55 g/s
Flow Max.	110 g/s
Brake Horsepower @Req'd Flow	
Brake horsepower @Max. Flow	
Oil Type:	Ucon LB-170
Vapor Pressure After Processing	51 mbar @ 373-393 K (200-250°F)
Viscosity:	170 SUS @ 311 K (100°F)
Characteristics:	water-white to light yellow color; no odor.
	SEE MSD
Compressor	C-5501
Manufacturer	Sullair
Type	Rotary Screw
Model	C16LA
Oil Separator	V-5501
National Board	488154
Year	1991
Manufacturer	Manchester
Volume	348 liter (92 gal)
MAWP @ 394 K (250°F)	10.3 bar (150 psi)
Min. Design Temp. @ 10.3 bar (150 psi)	244 K (-20°F)
Type	Three Stage w/ Oil Heater
Carryover	<10 ppm (By Weight)

Skid #55 CCWP COMPRESSOR, cont.

Aftercooler	HX-5501
National Board #	34616
Manufacturer	Basco
Oil Cooler	HX-5502
National Board #	3461.4
Manufacturer	Basco
Heater	HTR-5506
Function	Oil Heater
Manufacturer	HOTWATT
Power	500 W Heater / 60HZ / 120V
Oil Pump	P-5517
Manufacturer	TUTHILL
Pressure Flow	
Electric Motors:	
Unit #	EM-5501
Function	drive compressor
Manufacturer	Reliance Electric Co.
Power	125 hp, 3570 rpm, 460 V, 137 amp,60Hz, 3ø
Service Factor	1.2
Unit #	EM-5502
Function	drive comp. slide valve
Manufacturer	RCS
Voltage	115 V
Unit #	EM-5517
Function	drive pump P-5517
Manufacturer	Franklin
Power	3/4 hp,115 V

Skid #56 CCWP OIL REMOVAL

Drawing #	SC1-0-56-001
Operating Procedure Unit	31
Location	Outside compressor building
Function	Remove 98-99% of oil in helium.
Skid Dimensions	
Length	3.46 m (11 ft - 4 in)
Width	2.36 m (7 ft - 9 in)
Coalescers	
Unit #	CLS-5600 / 5601 / 5602 / 5603
National Board	879 (0), 882 (1), 885 (2), 888 (3)
Year	1991
Manufacturer	Process Systems International Inc.
Type:	Single Coalescing Element.
Face Velocity:	< 5 cm/s
MAWP @ 339 K (150°F)	22 bar (300 psig)
MAWP @ 339 K (150°F)	21.7 bar (300 psig)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	339 K (150°F)
Operating Pressure	17.2 bar (235 psig)
Adsorber	ADS-5600 A / B
National Board	861 (A), 864 (B)
Year	1991
Manufacturer	Process Systems International Inc.
Type	Carbon Bed
MAWP @ 422 K (300°F)	21.7 bar (300 psig)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	339 K (150°F)
Operating Pressure	17.2 bar (235 psig)
Operating Life @ Full Flow Rate	Two Year
Adsorbent	Charcoal
Number Of Stages	1
Impurities At Outlet	<1ppb oil
Filter	F-5601-5604
Manufacturer	Koch
Type	Coalsecer SCI-4-002
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	339 K (150°F)
Nominal Retention	40 micron
Filter	F-5600 A / B
National Board	41532 (A), 41535 (B)
Year	1991
Manufacturer	Dollinger
Type	Element Polyester-99
Nominal Retention	5 micron
MAWP @ 339 K (150°F)	20.7 bar (300 psi)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	339 K (150°F)

System #57 CCWP HELIUM GAS STORAGE

Drawing #	SCl-0-57-002
Operating Procedure Unit	32
Location	
Function	Provide gaseous helium storage for CCWP.
Gas Storage	V-5701 (impure)
Nat. Board	23039
Year	1991
Location	Tank Farm
Manufacturer	Trinity Industries Inc.
Material	SA-612
Length	13.7 m (542 in)
Diameter	2.13 m(84 in)
Volume	45,420 liters (12,000 U.S. gal)
MAWP @ 328 K (131°F)	20 bar (275 psig)
Design Press.	20 bar (275 psig) / Full Vac.
Design Temp.	339 K (150°F)
Operating Press.	3-7 bar
Mechanical Safety Relief	19.6 bar (270 psig)
Suction Filter	STR-5715
Manufacturer	Process Systems International Inc.
Design Press.	9.6 bar (125 psig)
Design Temp.	339 K (150°F)
Size	30 mesh (137 micron)

Skid #60 REF. REC. Cold Box

Drawing #	SCl-0-60-001
Operating Procedure Unit	41
Location	MTL Service Building
Function	Provides a means of taking cold subatmospheric helium return flow from the magnet test stand recovering the available refrigeration.
Vacuum Vessel	V-6001
Manufacturer	Process Systems International Inc.
Material	Carbon Steel
Design Temp.	339 K (150°F)
Design Press.	2.1 bar (15 psig) Full Vac.
Heat Exchangers	
Unit #	HX-6002 / 6003
National Board	2264
Manufacturer	Sumitomo
Type	Brazed Aluminum Plate-Finned
# Of Streams	3 Stream
Unit #	HX-6001
National Board	2263
Manufacturer	Sumitomo
Type	Brazed Aluminum Plate-Finned
# Of Streams.	3-Stream
Getter	
Unit #	G-6001
Manufacturer	Ergenics, Inc.
Material Type	St 507 Zirconium
Unit #	G-6002
Manufacturer	Ergenics, Inc.
Material Type	Activated Charcoal

Skid #61 & 62 VACUUM SYSTEM (Kinney Vacuum)

Drawing #	SCl-0-61-001
Operating Procedure Unit	40
Location	Compressor Building
Function	To lower the vapor pressure in the distribution boxes's subcooler bath.
Skid Dimensions:	
Length	14'-0 "
Height	11"-1 "
Width	8'-4 "
Kinney drw#	574257 1 of 2
Normal Operating @ 12.35 g/s	Pressure: Vac I 47 mbar
Normal Operating @ 31.08 g/s	Perssure: Vac II 310 mbar
Liquid Ring Pump Motor	EM-6103/6203
RPM	1750
Manufacturer	Baldor
Power	125-hp, 46OV, 3ø
Blower Motors	EM-6101 / 6201, EM-6104 / 6204
RPM	1750
Function	Drive Blower Pump- P-6101 / 6201, 6104 / 6204
Manufacturer	Baldor
Power	10 hp, 46OV, 3ø
Unit #	EM-6102 / 6202
Function	Drive Blower pump P-6102 / 6202
Manufacturer	Baldor
Power	20 hp, 46OV, 3ø
Unit #	EM-6105 / 6205
Function	Drive oil pump #6105 / 6205
Manufacturer	Baldor
Power	2 hp, 46OV, 3ø
Bulk Oil Separator	V-6104 / 6204
Manufacturer	Kinney
Pumps	
Unit	P-6103 / 6203
Function	Liquid ring pump. Provides Vac II and backup for Vac I
Manufacturer	Kinney
Flow Rate	43.34 g/s
Ultimate Pressure	VAC I 47 mbar / VAC II 310 mbar

Skid #61&62 VACUUM SYSTEM (Kinney Vacuum) cont.

Unit #	P-6101 / 6201, 6104 / 6204
Function	Mechanical Booster pump to provide evacuation for Vac I.
Manufacturer	Kinney
Flow Rate	12.35 g/s
Ultimate Pressure	47 mbar
Unit #	P-6102 / 6202
Function	Mechanical Booster pump. Provides backing evacuation for Vac I pumps P-6101 / 6201, and 6104 / 6204
Manufacturer	Kinney
Flow Rate	31.08 g/s
Ultimate Pressure	310 mbar
Unit #	P-6105 / 6205
Function	Oil Pump provides oil injection to liquid ring pump and mechanical booster pumps
Manufacturer	Crane Deming
Flow Rate	40-50 gpm Liquid ring pump 2 gpm per blower

Electric Heater

Unit #	HTR-6104 / 6204
Function	Heat oil in oil separator
Power	115 V

Heat Exchangers:

Unit #	HX-6108 / 6208
Function	Aftercooler
National Board	35394 / 37339
Manufacturer	Basco
Type	tube / shell
# of Streams	1
Unit #	HX-6106 / 6206
Function	Heat Exchanger
National Board	35401/35400
Manufacturer	Basco
Type	tube / shell
# of Streams	1
Unit #	HX-6107 / 6207
Function	Heat Exchanger
National Board #	35398 / 35399
Manufacturer	Basco
Type	tube / shell
# of Stream	1

Skid #63 REF. REC. Coalescer

Drawing #	SCl-0-63-001
Operating Procedure Unit	
Location	Compressor Building
Function	Removes oil from Kinney skid discharge returning to compressor suction.
Coalescer	CLS-6302 / 6303
National Board	936 / 935
Manufacturer	Process Systems International
Material	Carbon Steel
Design Temp.	339 K (150°F)
Design Press.	21.7 bar (300 psig) / Full Vac.
Electric Heaters	
Unit #	HTR-6302
Manufacturer	Watlow
Function	Heats returning gas in Vac II piping.
Power	480 V, 3ø, 7.5kW, 9 A.
Unit #	HTR-6301
Manufacturer	Watlow
Function	Heats returning gas in Vac I piping.
Power	480 V, 3ø, 5kW, 6 A.

Skid #64 VACUUM SYSTEM - PORTABLE

Drawing	SCI-0-64-001
Location	Portable
Function	Perform evacuation, repressurization and pressure monitoring of various systems.
Normal Operating Pressure:	<lxl0-7 mbar
Max. Helium Leak Rate:	lxl0-6 scc/sec
Roughing Pump	P-6402
Manufacturer	Leybold
Type	Rotary Vane
Pump Speed	24.9 liter/s (53cfm)
Turbomolecular Pump	P-6401
Manufacturer	Leybold
Pump Speed	110 liter/s
Mist Eliminator	CLS-6402
Manufacturer	Leybold
Filter	F-6401
Manufacturer	Leybold
Nominal Filtration	
Electric Motor	EM-6402
Function	Drive rotary vane roughing pump P-6402
Manufacturer	GE Motor
Power	3 hp, 1725 rpm, 460 V, 3 ø, 60 Hz

Skid #70 NITROGEN DEWAR

Drawing #	SCl-0-70-001
Operating Procedure Unit	35
Location	Outside MTL
Function	Storage of liquid nitrogen.
LN2 Vaporizer Skid	
Inlet	LN2 @ 3.7 bar (54 psi
Outlet	GN2 @ 3 bar (44 psi) & 300 K (80°F)
Flow	195 g/s
Electric Trim Heater	HTR-7004
Manufacturer	Thermax
Power	20 kwatts, 480 V, 3ø, 60 Hz, 24 amp
Design Pressure	13.1 bar (175 psig)
Design Temp.	227 / 339 K (-50 / 150°F)
Ambient Air Vaporizers	HTR-7003 A/B
Type	Ambient Air Fin
Manufacturer	Thermax
Material	Aluminum
Design Pressure	13.1 bar (175 psig)
Design Temp.	77 / 339 K (-320 / 150°F)
LN2 Storage Assembly	S-7001
Strainers	STR-7031 / 7032
Manufacturer	Process Engineering Inc.
Size	100 mesh
Pressure Building Vaporizer	HTR-7002
Type	Ambient Air Fin
Manufacturer	Process Engineering Inc.
Design Press.	13.1 bar (175 psig)
Design Temp.	77 / 339 K (-320 / 150°F)
Pressure Vessel	V-7001
National Board	9667
Year	1991
Material	N/A
Volume	75,000 liter (19812 gal)
Max. Weight of Contents	60,633 kg (133,672 lb)
MAWP @ 311K (100°F)	w / ext.vac 5 bar (58 psig)
Design Temp.	77 / 339 K (-320 / 150°F)
Design Press.	5 bar (57.8 psig)
Refrigeration	905 g/s LN2
Vaporized	195 g/s LN2
Mechanical Safety Relief	5 bar (57.8 psig)

Skid #84 INSTRUMENT AIR

Drawing #	SCl-0-84-001
Operating Procedure Unit	37
Location	MTL Service Building
Function	Provide clean dry air for operation of all plant pneumatic instruments and valves.
Skid Dimensions	
Length	5.5 m (18ft)
Height	1.37 m (4ft - 6in)
Operating Pressure	8.6 bar (110 psig)
Compressors 1, 2	C-8100,C-8200
Manufacturer	Ingersoll Rand
Type	Rotary Screw SSR XP25U
Mode	Parallel Lead Lag
Flow rate	129 am3 / hr (76 acfm)
Pressure	13 bar (175 psig)
Aftercoolers:	HX-8400,HX-8401
Manufacturer	Basco
Coalescing Prefilters:	CLS-8400 A / B
Type	Coalescing with Automatic Drain
Manufacturer	Ingersoll Rand
Max. Inlet Press.	18.2 bar (250 psig)
Max. Inlet Temp.	322 K (1200°F)
Max. Flow	300 scfm
D.O.P. Efficiency	99.9999%
Compressed Air Dryer:	ADS-8300 A / B
National Board	8911 / 8911
Type	Dual Bed, Pressure Swing, and Regenerative.
Year	1992
MAWP @ 339 K (150°F)	17.2 bar (250 psi)
Min Design Temp. @ 17.2 bar (250 psi)	244 K (-20°F)
Manufacturer	Brunner Engr. and Mfg. Inc.
Particulate After Filters:	F-8401 A / B
Type	Particulate
Manufacturer	Ingersoll Rand
Max. Inlet Press.	18.2 bar (250 psig)
Max. Inlet Temp.	322 K (120°F)
Max. Flow	300 scfm
D.O.P. Efficiency	99.95%

Skid #84 INSTRUMENT AIR, cont.

Carbon Adsorbers:	F-8402 A / B
Type	Charcoal
Manufacturer	Ingersoll Rand
Max. Inlet Press.	18.2 bar (250 psig)
Max. Inlet Temp.	339 K (150°F)
Max. Flow	220 scfm
Air Receiver Tank:	V-8401
Nat. B.D.#	17346G
Year	1991
Manufacturer	Brunner Engr. and Mfg. Inc.
Material	Carbon Steel
MAWP @ 505 K (450°F)	13.8 bar (200 psi)
Design Press.	14.8 bar (200 psig)
Design Temp.	339 K (150°F)
Volume	

Skid #91 OIL PROCESSING SYSTEM

Drawing #	SC1-0-91 -001
Operating Procedure Unit	
Location	Compressor building
Function	Remove water and light hydrocarbon impurities from synthetic oil (UCON LB 170X).
Skid Dimensions:	
Length	3.66 m (12 ft)
Width	2.44 m (8 ft)
Oil Processing Vessel:	V-9102
National Board	none
Year	1991
Manufacturer	Process Systems International Inc.
Material	Carbon Steel
MAWP @ 422 K (300°F)	1.7 bar (10 psig)
Design Press.	Full Vac. / 1.7 bar (10 psig)
Design Temp.	422 K (300°F)
Operating Pressure	Full Vac.
Capacity	422 liter (110 gal)
Clean Oil Storage Vessel:	V-9106
National Board	none
Year	1991
Manufacturer	Process Systems International
Material	Carbon Steel
MAWP @ 422 K (300°F)	1.7 bar (10 psig)
Design Press.	Full Vac. / 1.7 bar (10 psig)
Design Temp.	422 K (300°F)
Operating Pressure	1.4 bar (5 psig)
Capacity	960 liter (250 gal)
Pumps	
Unit #	P-9101
Function	Recirculate and atomize oil
Manufacturer	U.S. Electrical Motors
Flow Rate	1.26 liter/s (20 gal/min)
Pressure	4.5 bar (50 psig)
Unit #	P-9107
Function	Discharge oil to remote storage or equipment.
Manufacturer	Magnetek
Flow Rate	0.32 liter/s (5 gal/min)
Pressure	15 bar (200 psig)

Skid #91 OIL PROCESSING SYSTEM, cont.

Roughing Pump	P-9105
Manufacturer	Leybold
Type	2 Stage Rotary Piston
Rate	100m3/h (68 cfm)
Ultimate Pressure	< 1.5xlo-4 mmhg
Carbon Adsorber	ADS-9104
Manufacturer	Balston
Maximum Pressure	18 bar (250 psig)
Molecular Sieve	ADS-9105
Manufacturer	Balston
Maximum Pressure	18 bar (250 psig)
Electric Motors	
Unit #	EM-9101
Function	Drive pump P-9101
Manufacturer	U.S. Electrical Motors
Power	1 1/2 hp, 1160 rpm, 230 / 460 V, 3ø, 60hz Hz
Unit #	EM-9105
Function	Drive roughing pump P-9105
Manufacturer	U.S. Electrical Motors
Power	5 hp, 1430 / 1745 rpm, 200 / 230 / 460V, 3ø, 50/60 Hz
Unit #	EM-9107
Function	Drive pump P-9107
Manufacturer	Magnetek Century Electric
Power	2 hp, 1750 rpm, 480 V, 3ø, 60 Hz
Electric Heaters	
Unit #	HTR-9102
Function	Heat oil in processing drum
Manufacturer	Watlow Industries
Power	10 kw, 480 V, 3ø, 60 Hz
Unit #	HTR-9106
Function	Keep oil viscosity low for availability to
Manufacturer	Watlow Industries
Power	1.1 kw, 480 V, 3ø, 60 Hz

Skid #91 OIL PROCESSING SYSTEM, cont.

Spray Nozzle	SP-9102
Orifice Size	1/2
Level Control	LS-9102 / 9106
Manufacturer	Magnetrol International
Power	120 / 240 AC / 115 / 230 DCV, 7/6.5/7/5 Amps, 350 / 360 VA, 1/4, 1/2, 1/2, 1/2hp
Pressure	20 bar (285 psi) @ 311 K (100,F)
Min.Sp.Gr.	0.90
LN2 Cold Trap	E-9104
Manufacturer	Process Systems International

Inner Vessel

National Board	none
Year	19 91
MAWP @ 339 K (150°F)	2 bar (14 psig)
Min. Design Temp. @ 2 bar (14 psig)	78 K (-320°F)
Operating Pressure @ 78 K (-320°F)	1.4 bar (5 psig)

Outer Vessel

National Board	none
Year	1.991
MAWP @ 339 K (150°F)	2 bar (14 psig)
Min. Design Temp. @ 2 bar (14 psig)	258 K (50°F)
Operating Pressure @ 294 K (70°F)	Full Vac.

Skid #92 GAS ANALYZER

Drawing #	SCl-0-92-001
Operating Procedure Unit	1
Location	Compressor Building
Function	Measure different samples points for impurities within the plant and associated equipment.

Analyzer

Manufacturer	Sulzer
Type	Arc Cell
Modes	N2, H20, Hydro-Carbons
Min. Design Press.	2 bar (29 psi)

Teflon Membrane Pump C-9200 A,B,C,D

Manufacturer:	Sulzer
# Of Heads	4
Min. Flow Rate	0.010 g/s @ 3.5 bar (50.8 psi) diff.

Electric Motor EM-9200

Power	120 V, 60 Hz, 1/2 hp

ASST
CRYO PLANT

Data Sheets

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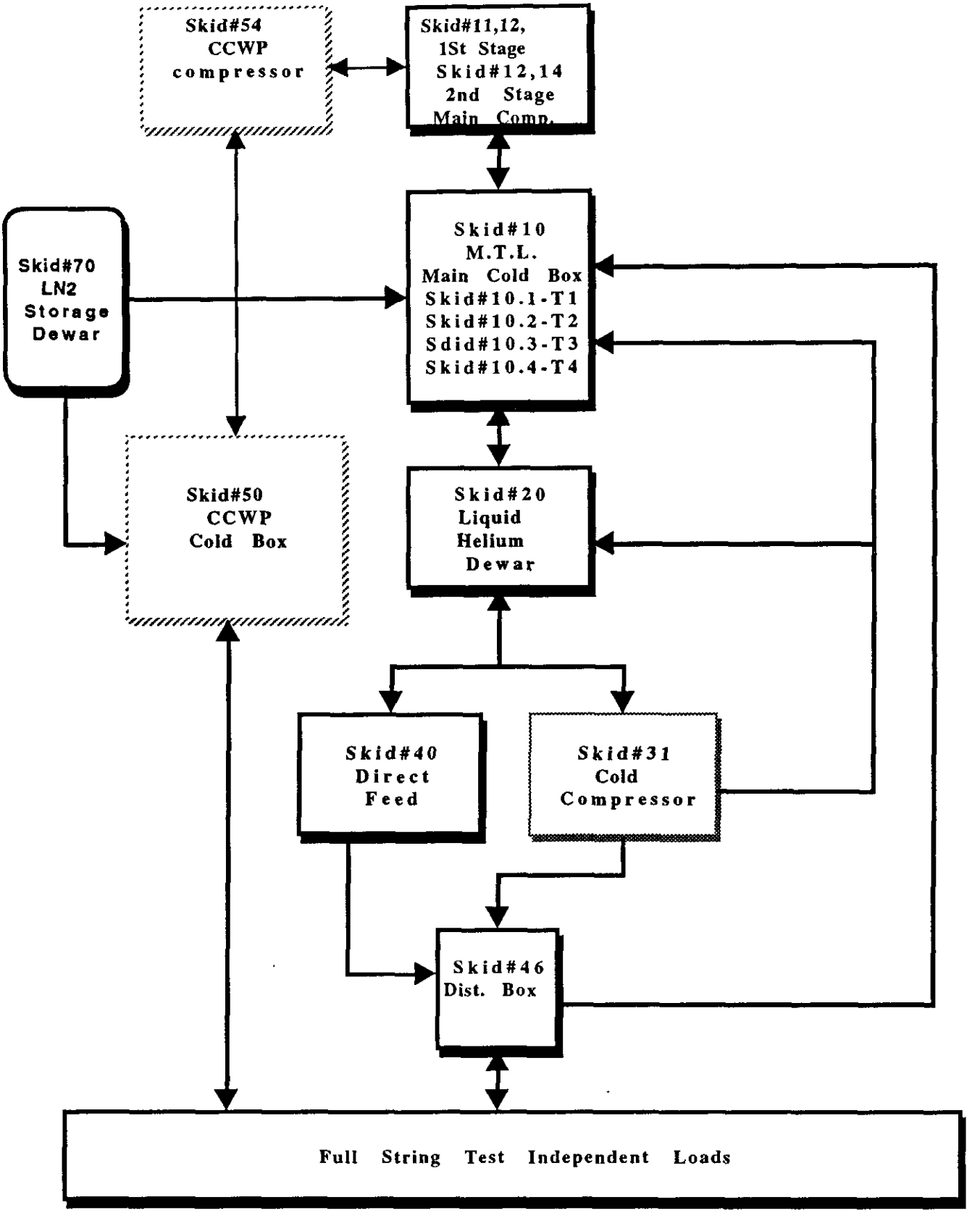
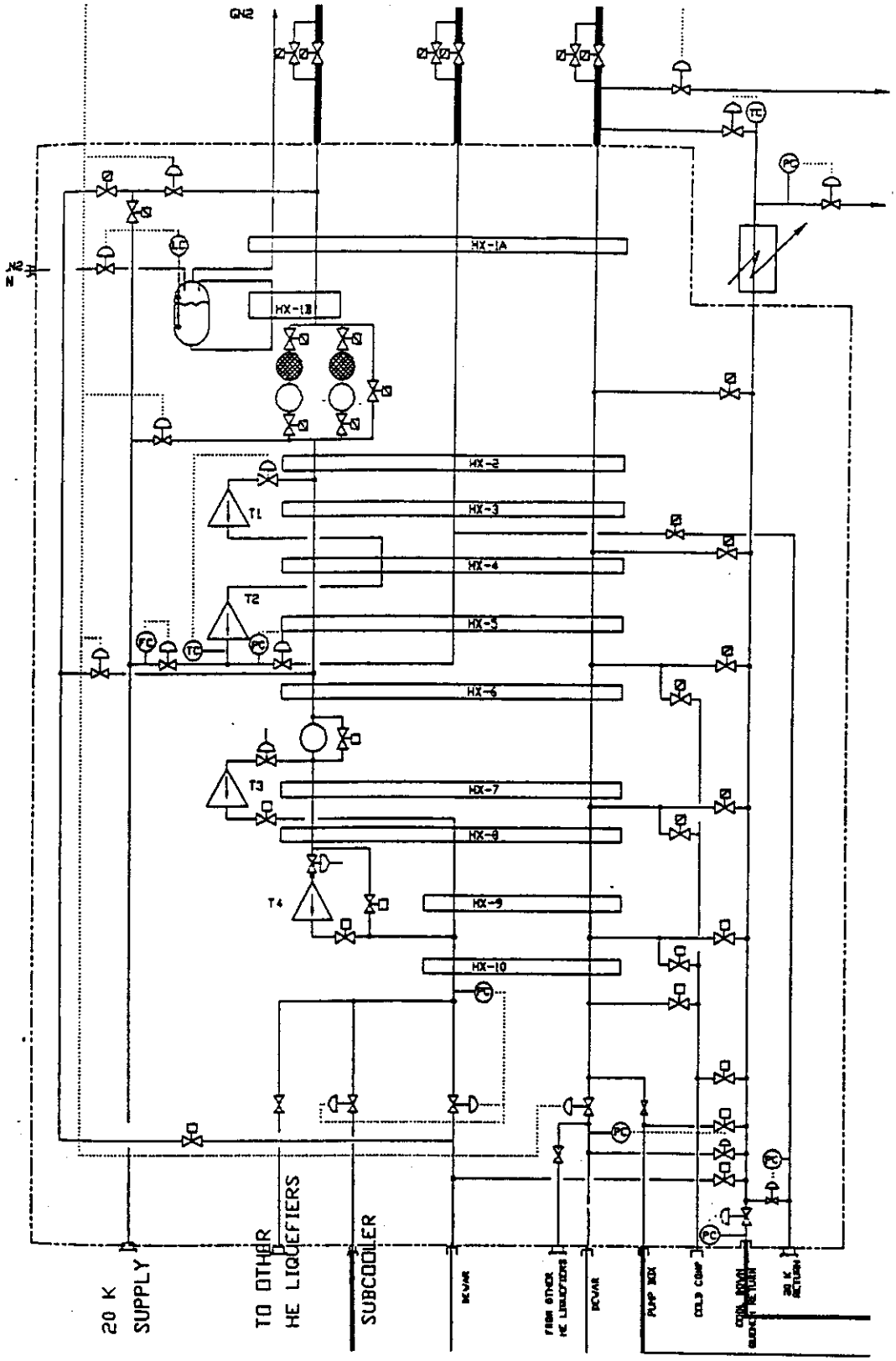


ASST cryogenic plant block diagram



ASST / MTL / N15 cold box

Skid #10 COLD BOX (main)

Drawing #	SCI-0-10-002 thru 009
Operating Procedure Unit	5, 7, and 8
Location	ASST. Service Building
Function	Supply Helium Refrigeration and Liquefaction
Skid Dimensions	13'-6" Square
Type:	Vertical Cylinder
Capacity:	4000 W or 2000 W + 20 g/s
Flow:	400 g/s
Carnot Efficiency:	>25%
80 K Carbon Adsorbers:	ADS-1001A / B
National Board	929 (A) / 932 (B)
Year	1991
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Length	2057 mm (81 in)
Outside Diameter	457 mm (18 in)
Flow	400 g/s
Adsorber	Charcoal 108 kg (238 lb)
Designed Removal	100 ppm N2, 40 ppm 02
On-line Oper. Before Regen.	12 hr
Regeneration Cycle	<12 hr
MAWP @ 339 K (150°F)	21.7 bar (300 psig)
Design Press.	21.7 bar(300 psig) / Full Vac.
Design Temp.	77 / 339K (-320 / 150°F)
Operating Pressure	16.9 bar (230 psig)
Safety Relief	20 bar (275 psig)
ACTIVATION	
Design Press.	4 bar (45 psig) / Full Vac.
Design Temp.	422 K (300°F)
20 K Carbon Adsorber (non-regen.)	ADS-1002
National Board	937
Year	1991
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Length	1930 mm (76 in)
Outside Diameter	324 mm (12.75 in)
Flow	117.25 g/s
Adsorber	Charcoal 60 kg (132 lb)
Designed Removal	Trace amount of Neon
MAWP @ 339 K (150°F)	21.7 bar (300 psig)
Design Press	21.7 bar (300 psig) / Full Vac.
Design Temp.	4.5 / 339 K (-451 / 150°F)
Operating Pressure	16.9 bar (230 psig)
Safety Relief	20 bar (275 psig)
ACTIVATION	
Design Press.	4 bar (45 psig)
Design Temp.	422 K (300°F)

Skid #10 COLD BOX, cont.

Carbon Ads. Outlet Filters:

Unit #	F-1001A/B
Filtration	5 micron
Type	Bayonet
Manufacturer	CPC
Material	304 Stainless Steel
Design Temp.	77 / 339 K (-320 / 150°F)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	422 K (300°F)
Design Press.	4 bar (45 psig) / Full Vac.

Unit #	F-1002
Filtration	5 micron
Type	Bayonet
Manufacturer	CPC
Material	304 Stainless Steel
Design Temp.	4.5 / 339 K (-451 / 150°F)
Design Press.	21.7 bar (300 psig) / Full Vac
Design Temp.	422 K (300°F)
Design Press.	4 bar (45 psig)

Getters

Unit #	G-1001
Type	ST 507 Zirconium
Manufacturer	Ergenics, Inc.

Unit #	G-1002
Type	Activated Charcoal
Manufacturer	Ergenics, Inc.

Unit #	G-1003
Type	Activated Charcoal
Manufacturer	Ergenics, Inc.

Warmup Heater:	HTR-1001
Type	Ambient Vaporize Model# TF488HF-DH
Manufacturer	Thermax Inc.
Material	Aluminum
Design Temp.	77 / 339 K (-320 / 150°F)
Design Press.	11.4 bar 150 psig)

Skid #10 COLD BOX, cont.

Heat Exchangers:	HX-1000 thru HX-1010
Type	Br. Alum. Plate-Fin
Manufacturer	Sumitomo Precision Products Co. Ltd.
HX-1000	2 Stream
National Board #	2186
HX-1001	4 Stream
National Board #	2185
HX-1002/1003	3 Stream
National Board #	2187
HX-1004 / 1005	4 Stream
National Board #	2188
HX-1006 / 1007 / 1008	4 Stream
National Board #	2189
HX-1009 / 1010	2 Stream
National Board #	2190
Nitrogen Phase Separator:	V-1004
National Board	923
Year	1991
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Length	0.61 m (24 in)
Outside Diameter	0.406 m (16 in)
MAWP @ 339 K (150°F)	11.4 bar (150 psig)
Design Press.	6.2 bar (75 psig) / Full Vac.
Design Temp.	77 / 339 K (-320 / 150°F)
Operating Pressure	4.5 bar (50 psig)
Water Separator:	V-1001
National Board	848
Year	1991
Manufacturer	Process Systems International Inc.
MAWP @ 339 K (150°F)	21.7 bar (300 psig)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	77 / 339 K (-320 / 150°F)
Operating Pressure	16.9 bar (230 psig)
Helium Supply Strainer:	STR-1001
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Mesh	100
Design Temp.	339 K (150°F)
Design Press.	21.7 bar (300 psig) / Full Vac.
Turbo Expanders (4)	See 10.1-10.4

Skid #10 COLD BOX, cont.

Vacuum Vessel	V-1000
Manufacturer	Process Systems International Inc.
Material	Carbon Steel
Length	7.62 m (25ft)
Diameter	3.81 m (12ft - 6")
Design Temp.	339 K (150°F)
Design Press.	Full Vac. / 2.1 bar (15 psig)

10.1 TURBINE ASSEMBLY #T1

Drawing #	SCI-0-10-006
Operating Procedure Unit	9
Location	Cold Box Turbine Pod
Function	Turboexpander runs in series with #T2 expander.
Turbine Speed:	
Norm. Oper. (Temp. <50 K)	2500 rps
Cooldown (Temp. >55 K)	2000 rps
High Temp. Alarm/Trip:	363K (194°F)
High Speed Alarm:	2550 rps
High Speed Trip:	2600 rps
Low Speed Alarm/Trip:	500 rps
Software Switchpoint	50 rps
Turbo Expander/Brake:	T-1001
Type	Gas Bearing TGL 32-28 B50
Manufacturer	Sulzer
Brake Cooler:	HX-1011
National Board	18603
Year	1991
Manufacturer	Graham Manufacturing Co. Inc.
MAWP (Shell) @ 422 K (300°F)	11.4 bar (150 psig)
MAWP (Tube) @ 422 K (300°F)	FV/ 21.7 bar (300 psig)
Min. Design Temp.@ MAWP (both)	244 K (-20°F)
Heat Load	8.83 kw (30,130 Btu / h)
Cooling Water	15 liter/m (4.0 gal/m)
Inlet Filters	F-1003 A/B
Manufacturer	CPC
Design Temp.	4.5 / 339 K (-451 / 150°F)
Design Press.	21.7 bar (300 psig) / Full Vac.
Nominal Retention	10 micron
Brake Filter	F-1006
Manufacturer	CPC
Design Temp.	-451/ 150°F
Design Press.	21.7 bar (300 psig)
Nominal Retention	10 micron

10.2 TURBINE ASSEMBLY #T2

Drawing #	SC1-0-10-007
Operating Procedure Unit	9
Location	Coldbox Turbine Pod #1&2
Function	Turboexpander runs in series with #Tl.
Turbine Speed:	
Norm. Oper. (Temp. <30 K)	2200 rps
Cooldown (Temp. >35 K)	2500 rps
High Temp. Alarm/Trip:	363 K (194°F)
High Speed Alarm:	2550 rps
High Speed Trip:	2600 rps
Low Speed Alarm/Trip:	500 rps
Software Switchpoint	50 rps
Turbo Expander/Brake:	T-1002
Type	Gas Bearing TGL 32-28 A56
Manufacturer	Sulzer
Brake Cooler:	HX-1012
National Board	18606
Year	1991
Manufacturer	Graham Manufacturing Co. Inc.
MAWP (Shell) @ 422 K (300°F)	11.4 bar (150 psig)
MAWP (Tube) @ 422 K(300°F)	FV/ 21.7 bar (300 psig)
Min. Design Temp. @ MAWP (both)	244 K (-20°F)
Heat Load	6.97 kW (23,800 Btu/h)
Cooling Water	12 liter/m (3.2 gal/m)
Brake Filter	F-1007
Manufacturer	CPC
Design Temp.	4.5 / 339 K (-451 / 150°F)
Design Press.	21.7 bar (300 psig)
Nominal Retention	10 micron

10.3 TURBINE ASSEMBLY #T3

Drawing #	SCl-0-10-008
Operating Procedure Unit	10
Location	Coldbox Turbine Pod
Function	Turbine expander arranged parallel w/T4 37% of stream flow through #T3.
Turbine Speed:	
Cartridge TGL22 12 B32	3600 rps
Cartridge TGL22 12 B32	3200 rps
High Temp. Alarm/Trip:	90°C
High Speed Alarm:	3700 rps
High Speed Trip:	3800 rps
Low Speed Alarm/Trip:	500 rps
Software Switchpoint	50 rps
Turbo Expander/Brake:	T-1003
Type	Gas Bearing TGL 22-12 B32
Manufacturer	Sulzer
Brake Cooler:	HX-1013
National Board	18610
Year	1991
Manufacturer	Graham Manufacturing Co. Inc.
MAWP (Shell) @ 422 K (300°F)	11.4 bar (150 psig)
MAWP (Tube) @ 422 K (300°F)	FV/ 21.7 bar (300 psig)
Min. Design Temp. @ MAWP (both)	244 K (-20°F)
Heat Load	1.17 kW (4,000 Btu/h)
Cooling Water	1.9 liter/m (0.5 gal/m)
Inlet Filters	F-1004 A/B
Manufacturer	CPC
Design Temp.	4.5 / 339 K (-451 / 150°F)
Design Press.	21.7 bar (300 psig) / Full Vac.
Nominal Retention	10 micron
Brake Filter	F-1008
Manufacturer	CPC
Design Temp.	4.5 / 339 K (-451 / 150°F)
Design Press.	21.7 bar (300 psig)
Nominal Retention	10 micron

10.4 TURBINE ASSEMBLY #T4

Drawing #	SC1-0-10-009
Operating Procedure Unit	11
Location	Coldbox Turbine Pod
Function	Turboexpander arranged in parallel with # T3.
Turbine Speed:	2800 rps (any mode)
High Temp. Alarm/Trip:	363 K (194°F)
High Speed Alarm:	3700 rps
High Speed Trip:	3800 rps
Low Speed Alarm/Trip:	500 rps
Software Switchpoint	50 rps
Turbo Expander/Brake:	T-1004
Type	Gas Bearing TGL 22-12 B40
Manufacturer	Sulzer
Brake Cooler:	HX-1014
National Board	18612
Year	1991
Manufacturer	Graham Manufacturing Co. Inc.
MAWP (Shell) @ 422 K (300°F)	11.4 bar (150 psig)
MAWP (Tube) @ 422 K (300°F)	FV/ 21.7 bar (300 psig)
Min. Design Temp. @ MAWP (both)	244 K (-20°F)
Heat Load	1.52 kW (5,200 Btu/h)
Cooling Water	2.6 liter/m (0.7 gal/m)
Inlet Filters	F-1005 A/B
Manufacturer	CPC
Design Temp.	4.5 K (-451°F)
Design Press.	21.7 bar (300 psig) / Full Vac.
Nominal Retention	10 micron
Brake Filter	F-1009
Manufacturer	CPC
Design Temp.	339 K
Design Press.	21.7 bar (300 psig)
Nominal Retention	10 micron

Skid #11 FIRST STAGE COMPRESSOR

Drawing #	SC1-0-11-001
Operating Procedure Unit	3
Location	Compressor Building
Function	Compress gases helium from storage tank farm.
Skid Dimensions	1.83 m x 3.96 m (6 ft x 13 ft)
Process Conditions:	
Pressure In	1.01 bar (15.44 psia)
Pressure Out	3.45 bar (49.98 psia)
Temperature In	316.5 K (109.8°F)
Temperature Out	352.1 K (174°F)
Flow Required	108.5 g/s each
Flow Max.	112.29 g/s -0, +5% each
Brake Horsepower @Req'd Flow	198 bhp
Brake horsepower @Max. Flow	204 bhp
Volumetric Efficiency	90 - 92 %
Isothermal Efficiency	56%
Oil Type:	Ucon LB-170
Vapor Pressure After Processing	51 mbar @ 373-393 K (200-250,F)
Viscosity:	170 SUS @ 311 K (100°F)
Characteristics:	water-white to light yellow color;
Aftercooler	HX-1101
National Board	34235
Type	Tube / Shell
Manufacturer	Basco
Compressors	C-1101
Type	Two Parallel Oil Injected Rotary Screw (50% Each)
Manufacturer	Sullair Inc.
Model #	C25 LB 704-22
Electric Heater	HTR-1106
Function	Oil Heater
Manufacturer	Hotwatt
Power	500 W, 115 V

Skid #11 FIRST STAGE COMPRESSOR cont.

Electric Motors

Unit #	EM-1101
Function	drive compressor
Manufacturer	Reliance Electric
Power	250 hp, 3560 rpm, 460 V, 3ø
Service Factor	1.2
Unit #	EM-1102
Function	drive slide valve
Manufacturer	RCS
Voltage	115 V
Unit #	EM-1117
Function	drive oil pump P-1117
Manufacturer	Franklin
Power	3/4 hp, 115 V
Oil Cooler	HX-1102
National Board	34233
Manufacturer	Amceican Precision
Oil Pump	P-1117
Manufacturer	Tuthill
Oil Separator	V-1101
National Board	486971
Year	1991
Manufacturer	Manchester
Volume	1003 liter (265 gal)
MAWP @ 394 K (250°F)	10.3 bar (150 psi)
Min. Design Temp. @10.3 bar (150 psi)	244 K (-20°F)
Type	Three Stage w/ Oil Heater
Carryover	<10 ppm (By Weight)

Skid #12 FIRST STAGE COMPRESSOR

Drawing #	SC1-O-11-OO1
Operating Procedure Unit	3
Location	Compressor Building
Function	compress helium
Skid Dimensions	1.83 m x 3.96 m (6 ft x 13 ft)
Process Conditions:	
Pressure In	1.01 bar (15.44 ps ia)
Pressure Out	3.45 bar (49.98 psia)
Temperature In	316.5 K (109.8°F)
Temperature Out	352.1 K (174°F)
Flow Required	108.5 g/s each
Flow Max.	112.29 g/s -0, +5% each
Brake Horsepower @Req'd Flow	198 bhp
Brake horsepower @Max. Flow	204 bhp
Volumetric Efficiency	90 -92 %
Isothermal Efficiency	56%
Oil Type:	Ucon LB-170
Vapor Pressure After Processing	51 mbar @ 373-393K(200-250°F)
Viscosity:	170 SUS @ 311 K (100°F)
Characteristics:	water-white to light yellow color; no odor. SEE MSD
Aftercooler	HX-1201
National Board	34234
Type	Tube / Shell
Manufacturer	Basco
Compressors	C-1201
Type	Two Parallel Oil Injected Rotary Screw (50% Each)
Manufacturer	Sullair Inc.
Model #	C25 LB 704-22
Electric Heater	HTR-1206
Function	Oil Heater
Manufacturer	Hotwatt
Model	SC62-175
Power	500 W, 115 V

Skid 12 FIRST STAGE COMPRESSOR, cont.

Electric Motors

Unit #	EM-1201
Function	drive compressor
Manufacturer	Reliance Electric
Power	250 hp, 3560 rpm, 460 V, 3ø
Service Factor	1.2
Unit #	EM-1202
Function	drive slide valve
Manufacturer	RCS
Voltage	115 V
Unit #	EM-1217
Function	drive oil pump P-1217
Manufacturer	Franklin
Power	3/4 hp, 115 V
Oil Cooler	HX-1202
National Board	34232
Manufacturer	American Percision
Oil Pump	P-1217
Manufacturer	Tuthill
Oil Separator	V-1201
National Board	486972
Year	1991
Manufacturer	Manchester
Volume	1003 liter (265 gal)
MAWP @ 394 K (250°F)	10.3 bar (150 psi)
Min. Design Temp. @10.3 bar (150psi)	244 K (-200F)
Type	Three Stage w/ Oil Heater
Carryover	<10 ppm (By Weight)

Skid #13 SECOND STAGE COMPRESSOR

Drawing #	SCl-0-13-001
Operating Procedure Unit	4
Location	Compressor Building
Function	Compress gases helium from storage tank farm.
Skid Dimensions	1.83 m x 3.96 m (6 ft x 13 ft)
Process Conditions:	
Pressure In	3.2 bar (47.04 psia)
Pressure Out	18 bar (264.6 psia)
Temperature In	312 K (101.7°F)
Temperature Out	364.3 K (196°F)
Flow Required	197.5 g/s each
Flow Max.	224.49 g/s -0, +5% each
Brake Horsepower	@ Req'd Flow 582 bhp
Brake horsepower	@ Max. Flow 625 bhp
Volumetric Efficiency	80 - 87 %
Isothermal Efficiency	53%
Oil Type:	Ucon LB-170
Vapor Pressure After Processing	51 mbar @ 373-393 K (200-250°F)
Viscosity:	170 SUS @ 311 K (1000°F)
Characteristics:	water-white to light yellow color; no odor SEE MSD
Aftercooler	HX-1301
National Board	34239
Type	Tube / Shell
Manufacturer	Baso
Compressor	C-1301
Type	Two Parallel Oil Injected Rotary Screw (50% Each)
Manufacturer	Sullair Inc.
Model #	C25MA704-26
Electric Heater	HTR-1306
Function	Oil Heater
Manufacturer	Hotwatt
Model	SC62-175
Power	500 W, 115 V

Skid #13 SECOND STAGE COMPRESSOR, cont.

Electric Motors

Unit #	EM-1301
Function	drive compressor
Manufacturer	Reliance Electric
Power	700 hp, 3600 rpm, 4160 V, 3ø
Service Factor	1.2
Unit #	EM-1302
Function	drive slide valve
Manufacturer	RCS
Voltage	115V
Unit #	EM-1317
Function	drive oil pump P-1317
Manufacturer	Franklin
Power	3/4 hp, 115 V
Oil Cooler	HX-1302
National Board	34237
Manufacturer	American Precision
Oil Pump	P-1317
Manufacturer	Tuthill
Oil Separator	V-1301
National Board	486969
Year	1991
Manufacturer	Manchester
Volume	1003 liter (265 gal)
MAWP @ 394 K (250°F)	10.3 bar (150 psi)
Min. Design Temp. @10.3 bar (150 psi)	244 K (-200F)
Type	Three Stage w/ Oil Heater
Carryover	<10 ppm (By Weight)

Skid #14 SECOND STAGE COMPRESSOR

Drawing #	SCI-0-13-001
Operating Procedure Unit	4
Location	Compressor Building
Function	Compress gases helium from storage tank farm.
Skid Dimensions	1.83 m x 3.96 m (6 ft x 13 ft)
Process Conditions:	
Pressure In	3.2 bar (47.04 psia)
Pressure Out	18 bar (264.6 psia)
Temperature In	312 K (101.7°F)
Temperature Out	364.3 K (196°F)
Flow Required	197.5 g/s each
Flow Max.	224.49 g/s -0, +5% each
Brake Horsepower @Req'd Flow	582 bhp
Brake Horsepower @Max. Flow	625 bhp
Volumetric Efficiency	80 - 87 %
Isothermal Efficiency	53%
Oil Type:	Ucon LB-170
Vapor Pressure After Processing	51 mbar @ 373-393 K (200-250°F)
Viscosity:	170 SUS @ 311 K (100°F)
Characteristics:	water-white to light yellow color; no odor. SEE MSD
Aftercooler	HX-1401
National Board	34238
Type	Tube / Shell
Manufacturer	Basco
Compressor	C-1401
Type	Two Parallel Oil Injected Rotary Screw (50% Each)
Manufacturer	Sullair Inc.
Model #	C25MA704-26
Electric Heater	HTR-1406
Function	Oil Heater
Manufacturer	Hotwatt
Model	SC62-175
Power	500 W, 115 V

Skid #14 SECOND STAGE COMPRESSOR, cont.

Electric Motors

Unit #	EM-1401
Function	drive compressor
Manufacturer	Reliance Electric
Power	700 hp, 3600 rpm, 4160 V, 3ϕ
Service Factor	1.2
Unit #	EM-1402
Function	drive slide valve
Manufacturer	RCS
Voltage	115 V
Unit #	EM-1417
Function	drive oil pump P-1417
Manufacturer	Franklin
Power	3/4 hp, 115V
Oil Cooler	HX-1402
National Board	34236
Manufacturer	American Precision
Oil Pump	P-1417
Manufacturer	Tuthill
Oil Separator	V-1401
National Board	486970
Year	1991
Manufacturer	Manchester
Volume	1003 liter (265 gal)
MAWP @ 394 K (250°F)	10.3 bar (150 psi)
Min. Design Temp. @10.3 bar (150psi)	244 K (-200F)
Type	Three Stage w/ Oil Heater
Carryover	<10 ppm (By Weight)

Skid #15 COMPRESSOR OIL REMOVAL

Drawing #	SCI-0-15-001
Operating Procedure Unit	
Location	Outside compressor building
Function	Remove oil vapor and droplett from helium gas flow
Skid Dimensions:	
Length	3.45 m (11 ft - 4 in)
Height	3.63 m (11 ft - 11 in)
Width	2.36 m (7 ft - 9 in)
Adsorber:	ADS-150OA/B
National Board	856 (A),859 (B)
Year	1991
Manufacturer:	Process Systems International Inc.
Type:	Carbon Bed
Operating Life:	Two Year @ Full Flow Rate
Adsorbent:	Charcoal
Number Of Stages:	1
Impurities At Outlet:	< 1 ppbw Oil
MAWP @ 422 K (300°F)	22 bar (300 psig)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	339 K (150"F)
Operating Pressure	17 bar (235 psig)
Coalescers:	CLS-1500,1501,1502,1503
National Board	868 (0), 871 (1), 874 (2), 877 (3)
Year	1991
Type:	Single Coalescing Element
Manufacturer:	Process Systems International Inc.
Face Velocity:	< 5 cm/s
MAWP @ 339 K (150°F)	22 bar (300 psig)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	339 K (150°F)
Operating Pressure	17 bar (235 psig)

Skid #15 COMPRESSOR OIL REMOVAL cont.

Filters

Unit #	F-150OA/B
National Board	(A) 41483 ,(B) 41482
Year	1991
Manufacturer:	Dollinger
Type:Element	Polyester-99
Nominal Retention:	5 micron
MAWP @ 339 K (150°F)	22 bar (300 psig)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp	339 K (150°F)

Unit #	F-1501-1504
Year	1991
Type	Coalsecer SCI-4-002
Manufacturer	Koch
Nominal Retention	40 micron
MAWP @ 339 K (150°F)	300 psig
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	339 K (150°F)

System #16 HELIUM GAS STORAGE

Drawing #	SCl-0-16-001 thru 004
Operating Procedure Unit	2
Location	Tank Farm
Function	Provide storage for gaseous helium @ approx. 18 bar.
Gas Storage 1, 2	V-1601, V-1602
National Board	219,220
Year	1991
Manufacturer	Trinity Industries, Inc.
Material	SA.612
Length	16.5 m (652.375 in)
Diameter	3.35 m (131.875 in)
Volume	132,475 L (35,000 U.S. gal)
MAWP @328K (131°F)	20bar (275 psig)
Design Press.	20 bar (275 psig) / Full Vac.
Design Temp.	339 K (150°F)
Mechanical Safety Relief:	19.6 bar (270 psig)
Compressor Inlet Strainer	STR-1652
Manufacturer	Process Systems International Inc.
Material	Stainless Steel
Design Press.	11.4bar (150 psig) / Full Vac.
Design Temp.	339 K (150°F)
Size	30 mesh
Filter	
Unit #	F-1601
Type	27/80
Manufacturer	Balst
Design Press.	19.6 bar (270 psig)
Design Temp.	339 K (150°F)
Nominal Retention	5 micron
Unit	F-1628 / 1630
Type	
Manufacturer	
Design Press.	415 bar (6,000 psig)
Design Temp.	339 K (150°F)
Nominal Retention	7 micron

Skid #17 COLD BOX REGENERATION

Drawing #	SCl-0-17-001
Operating Procedure Unit	15
Location	ASST. Service Building
Function	Activate and regenerate carbon adsorber beds in R/L module and recycle pure helium back to medium pressure helium gas header.
Skid Dimensions:	
Length	3.2 m (126 in)
Width	2.59 m (102 in)

Electric Motors

Unit #	EM-1700
Function	drive Lamson Blower
Manufacturer	Toshiba
Power	3 hp, 3500 rpm, 460 V, 3ø, 60 Hz
Unit #	EM-1702
Function	drive vacuum pump (Leybold)
Manufacturer	Brook Crompton Inc.
Power	3 hp, 1750 rpm, 460 V, 3ø, 60 Hz

Filter

Manufacturer	Leybold
Design Press.	Full Vac. / 3.1 bar (30 psig)
Design Temp.	339 K (150°F)
Nominal Retention	10 micron

Gas Heaters:

Unit #	HTR-1701
National Board	46
Year	1991
Type	Incoloy Elements
Manufacturer	Watlow / Process Systems Inc.
Material	304 Stainless Steel
MAWP @ 422 K (300°F)	20.7 bar (300 psi)
Design Press.	21.7 bar (300 psig) / Full Vac.
DesignTemp.	478 K (400°F)
Watts	5 KW, 480 V, 3ø, WYE
Unit #	HTR-1702
Type	Ambient Air Fin
Manufacturer	KPS Thermax
Material	Aluminum
Design Press.	12 bar (175 psig)
DesignTemp.	78 / 422 K (-320 / 300°F)
Flow rate @ design temp. and press.	53 g/s

Skid #17 COLD BOX REGENERATION, cont.

Unit #	HTR-1703
Type	Ambient Air Fin
Manufacturer	KPS Thermax
Material	Aluminum
Design Press.	21.7 bar (300 psig)
DesignTemp.	20 / 339 K (-423 / 150°F)
Flow rate @ design temp. and press.	5 g/s
Gas Blower:	C-1700
Manufacturer	Lamson
Material	Cast Iron / Ductile Iron
Design Press.	2.7 bar (25 psig)
Design Temp.	422 K (300°F)
Flow	119 m3/hr (70 acfm)
Pressure Change	138 mbar (2 psi)
Regen. Vacuum Pump:	P-1702
Manufacturer	Leybold Sogevac
Type	Rotary Vane
Mist Eliminator:	CLS-1702
Manufacturer	Leybold
Design Press.	Full Vac. / 3.1 bar (30 psig)
Design Temp.	339 K (150°F)
Strainer:	STR-1701
Design Temp.	233 / 422 K (-40 / 300°F)
National Board	none
Year	1991
Type	100 Mesh
Manufacturer	Mueller Steam Specialty
MAWP @311K (100°F)	19.7bar(285psi)
Design Press.	3.1 bar (30 psig) / Full Vac.

Skid #18 VACUUM SYSTEM

Drawing #	SCl-0-18-001
Operating Procedure Unit	16
Location	MTL service building
Function	Provide insulating vacuum for main cold box.
Normal Operating Pressure:	<lxl0-7 mbar
Max. Helium Leak Rate:	lxl0-6 ssc/sec
Chiller Motor	EM-1803
Function	Cool Turbomolecular-Pump bearing
Manufacturer	Leybold
Voltage	110 V
Electric Motors	
Unit #	EM-1801
Function	drive turbomolecular pump P-1801
Manufacturer	Leybold
Power	5 hp, 115 V, 60 Hz
Unit #	EM-1802
Function	drive roughing pump P-1802
Manufacturer	GE Motor
Power	3 hp, 1725 rpm, 460 V, 3ø, 60 Hz
Filter	F-1802
Manufacturer	Leybold
Type	AR65
Mist Eliminator	CLS-1802
Manufacturer	Leybold
Roughing Pump:	P-1802
Type	Rotary Vane
Manufacturer	Leybold
Pumping Speed	53 cfm
Turbomolecular Pump:	P-1801
Manufacturer	Leybold
Pumping Speed	110 liter/s
Vacuum System	S-1800
Manufacturer	Leybold

Skid #20 LIQUID HELIUM DEWAR

Drawing #	SCl-0-20-002
Operating Procedure Unit	12
Location	ASST. / outside
Function	Separate helium phases, store liquid helium, store energy during quench, vaporize helium during ref./ liq. performance test, and provide decant to portable dewars.
Liquid Helium Dewar	V-2001
Manufacturer	Cryenco
LN2 Shield	Yes
LHe Vessel	
Mfg Serial #	D843-1
Year	1991
Material	304 SS
Volume	40,000 / L (10567 gal)
MAWP @ 4. / 339 K (-452 / 150 °F)	60 psig
Design Temp.	4. / 339 K (-452 / 150 °F)
Design Press.	4.13 bar (45.3 psig)
Mechanical Safety Relief	4.0 bar (43 psig)
Liquid Nitrogen Tank	V-2001
Manufacturer	Minnesota Valley
National Board	45279
Pressure Vessel	
National Board	HL 190-55-50
Year	1991
Material	T304
Volume	719 liter (190 gal)
MAWP @77 / 339K (-321 / 150°F)	50 psig
Design Temp:	77 / 339K (-321 / 150°F)
Design Pressure:	4 bar (43 psig)
Mechanical Safety Relief	43 psig
Calorimeter:	HTR-2003
Type	Three 2kw Heaters
Power	240 V, 3ø, 60 Hz

Skid #31 Helium Cold Compressor

Drawing #	20114-D
Operating Procedure Unit	49
Location	ASST. Service Building
Function	Isolate helium dewar press. from magnet String test stand press. and provide continuous supply of single phase hulium to subcooler and test stand.
Total Static Heat Load:	< 145 W
Static Heat Leak:	75 W approx.
Pump Efficiency:	> 50 %
Capacity Modulation:	10-100 % of full pump output
Temp. Before and After:	< 4.3 K (-452°F)
Surge Vessels: Two Each	Temperature gradient 20K-4K
National Board	165 (V-30-8), 167 (V-30-9)
Dimensions:	
Length	Volume 11 ft3 (300 liters)
Height	90 "
Width	16 "
Subcooler	V-30-1 0
National Board	163
Intake Surge Vessels: Three Each	
National Board #	169 (Al), 170 (A2), 171 (A3)
Filter Housings: Three Each	
National Board	178 (Bl), 180 (B2), 179 (B3)
Booster Pump:	
Manufacturer	CCI
Flow Rate	<200 g/s
Density	125 g/liter
Differential Pressure	< 3 bar
Flow Bypass Rate	200 g/s
Circulation Pumps (2):	
Manufacturer	CCI
Flow Rate	<250 g/s
Density	125 g/liter
Differential Pressure	.5 bar
Flow Bypass Rate	500 g/s
Suct. & Dis. Surge Tanks (2):	
Manufacturer	CCI
Volume	> .25 m3

Skid #40 TEST STAND DISTRIBUTION BOX SYSTEM

Drawing #	SCl-0-40-002
Operating Procedure Unit	20
Location	ASST. Laydown Area
Function	Distributes helium and nitrogen flows to the one distribution boxes # 46.
4K Header Vacuum Jacket	E-4021
Manufacturer	Process Systems International
Material	Carbon Steel
Design Temp.	339 K (150°F)
Design Press.	Full Vac./2.1bar(15 psig)
80K Header Vacuum Jacket	E-4022
Manufacturer	Process Systems International
Material	Carbon Steel
Design Temp.	339 K (150°F)
Design Press.	Full Vac./2.1bar(15 psig)
Getters	
Unit #	G-4015
Manufacturer	Ergenics, Inc.
Material Type	St 507 Zirconium
Unit #	G-4020
Manufacturer	Ergenics, Inc.
Material Type	St 507 Zirconium

Skid #46 TEST STAND DISTRIBUTION BOXES

Drawing #	SC1-0-46-002
Operating Procedure Unit	
Location	ASST. Laydown area
Function	Distributes helium and nitrogen to Magnet String test stands.
Vacuum Vessel	V-4600
Manufacturer	Process Systems International
Material	Carbon Steel
Design Temp.	339 K (150°F)
Design Press.	Full Vac./ 2.1 bar(15 psig)
Subcooler Separator	V-4601
National Board	945
Manufacturer	Process Systems International
Design Press.	19 bar (261 psig)
Design Temp.	2. / 339 K (-456 / 150°F)
Heat Exchanger	HX-4601
National Board	
Manufacturer	Sumitomo
Type	Brazed Aluminum Plate-Finned
# Of Streams	3
Heat Stationing	HX-4602
Manufacturer	Process Systems International
Type	LN2 Shield w/ Valve Stationing
Material	Aluminum
Getters	
Unit #	G-4601
Manufacturer	Ergenics, Inc.
Material Type	St 507 Zirconium
Unit #	G-4602
Manufacturer	Ergenics, Inc.
Material Type	Activated Charcoal

Skid #47 TEST STAND DISTRIBUTION BOX VACUUM SYSTEM

Drawing	SCI-0-47-001
Location	Portable
Function	Perform evacuation, repressurization and pressure monitoring of distribution boxes and other systems.
Roughing Pump	P-4702
Manufacturer	Leybold
Type	Rotary Vane
Pump Speed	24.9 liters / s (53 cfm)
Turbomolecular Pump	P-4701
Manufacturer	Leybold
Pump Speed	110 f/s
Mist Eliminator	CLS-4702
Manufacturer	Leybold
Filter	F-4701
Manufacturer	Leybold
Electric Motor	EM-4702
Function	Drive rotary vane roughing pump P-4702
Manufacturer	GE Motor
Power	3 hp, 1725 rpm, 460 V, 3 ø, 60 Hz

Skid #50 CCWP

Drawing #	SC1-0-50-001
Operating Procedure Unit	27
Location	MTL Service Building
Function	Perform cleanup, cooldown, and warmup functions for magnets, and purification of circulating helium.
Skid Dimensions	
Length	3 m (9 ft - 10 in)
Height	
Width	3 m (9 ft - 10 in)
Vacuum Vessel	V-5002
Manufacturer	
Material	Carbon Steel
Length	
Diameter	
Design Temp.	339 K (150°F)
Design Press.	2.1 bar (15psig)Full Vac.
Heat Exchangers	
Unit #	HX-5000
National Board	2196
Manufacturer	Sumitomo
Type	Brazed Aluminum Plate-Finned
# Of Streams	4 Stream
Unit #	HX-5001
National Board	2229
Manufacturer	Sumitomo
Type	Brazed Aluminum Plate-Finned
# Of Streams	2-Stream
LN2 Separator	V-5000
National Board	899
Year	1991
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Length	1.016 m (40 in)
Diameter	.660 m (26 in)
MAWP @ 339 K (150°F)	11.4 bar (150 psig)
Design Press.	11.3 bar (150 psig) Full Vac.
Design Temp.	77 / 339 K (-320 / 150°F)
Operating Pressure	4.5 bar (50 psig)

skid #50 CCWP, cont.

Water Separator	V-5001
National Board	851
Year	1991
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Length	.609 m (24 in)
Diameter	.203 m (8 in)
MAWP @ 339 K (150°F)	13.1 bar (175 psig)
Design Press.	11.3 bar (150 psig) / Full Vac.
Design Temp.	77 / 339 K (-320 / 150°F)
Operating Pressure	9.0 bar (116psig)
Carbon Adsorber	ADS-5000
National Board	940
Year	1991
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Length	2057 mm (8 ft 10 in)
Diameter	457 mm (18 in)
MAWP @ 339 K (150°F)	21.7 bar (300 psig)
Design Press.	11.3 bar (150 psig) / Full Vac.
Design Temp.	77 / 400 K(-320 / 260°F)
Operating Pressure	16.9 bar (230 psig)
Flow	110 g/s
On-line Oper.Before Regen.	24 hr
Regeneration Cycle	< 12 hr
Inlet Press.	7 bar (102 psi)
Outlet Press.	6 bar (87 psi)
Adsorber	Charcoal 102 kg (225 lb)
Getter	
Unit #	G-5000
Manufacturer	Ergenics, Inc.
Material Type	St 502 Zirconium
Unit #	G-5001
Manufacturer	Ergenics, Inc.
Material Type	Activated Charcoal
Filter	
Unit #	F-5000
Manufacturer	CPC
Design Temp.	77 / 339 K (-320 / 150°F)
Design Press.	11.3 bar (150 psig) / Full Vac.
Nominal Filtration	10 micron
Unit #	F-5001
Manufacturer	CPC
Design Temp.	77 / 400 K (-320 / 260°F)
Design Press.	11.3 bar (150 psig) / Full Vac.
Nominal Filtration	5 micron

Skid #50 CCWP, cont.

Unit #	F-5002
Manufacturer	CPC
Design Temp.	77 / 339 K (-320 / 150°F)
Design Press.	139 bar (2,000 psig) / Full Vac.
Nominal Filtration	2 micron

Skid #52 CCWP REGENERATION

Drawing #	SCI-0-52-001
Operating Procedure Unit	29
Location	ASST. Service Building
Function	Warmup and cooldown of CCWP adsorber bed and activation of carbon in adsorber bed.
Skid Dimensions	
Length	3.2 m (126 in)
Width	2.59 m (102 in)
Gas Heaters	
Unit #	HTR-5201
National Board	47
Year	1991
Manufacturer	Watlow / Process System Inc.
Manuf. Serial	T7O6-lAlD4-1
Type	Incoloy Elements
Material	304 Stainless Steel
MAWP @ 422 K (300°F)	13 bar (175 psig)
Design Press.	13 bar (175 psig) / Full Vac.
DesignTemp.	422 K (300°F)
Power	5 kill, 480 V, 3 ø, wye
Unit #	HTR-5202
Manufacturer	Thermax Inc.
Manuf.Model	TF208HF-P8-V ser. C-16-1
Type	Ambient Air Fin
Material	Aluminum
Design Press.	13 bar (175 psig)
Design Temp.	77 / 422 K (-320 / 300°F)
Gas Blower	C-5200
Manufacturer	Lamson
Material	Cast Iron / Ductile Iron
Design Temp.	422 K (300°F)
Design Press.	2.7 bar (25 psig)
Flow	119 m3/ hr (70 acmf)
Pressure Change	138 mbar (2 psi)
Strainer	STR-5201
Manufacturer	Mueller Stream Specialty
Type	100 Mesh
Year	1991
MAWP @ 311 K (100°F)	19.7 bar (285 psi)
Design Press.	13 bar (175 psig)
Design Temp.	233 / 339 K (-40 / 150°F)
Electric Motor	EM-5200
Manufacturer	Toshiba
Power	3 hp, 460 V,3ø

Skid #53 CCWP DEHYDRATION

Drawing #	SC1-0-53-001
Operating Procedure Unit	30
Location	ASST. Service Building
Function	Dehydrate helium stream returning from CCWP to compressors.
Skid Dimensions	
Length	4.88 m (16 ft)
Width	1.68 m (66 in)
Mol.Sieve Adsorber	ADS-530OA/B
National Board	909(A) 912 (B)
Year	1991
Manufacturer	Process Systems International Inc.
Material	Stainless Steel
Length	2133 mm (7 ft)
Diameter	609 mm (24 in)
MAWP @ 600 K (620°F)	9.6 bar (125 psig)
Design Press.	9.6 bar (125 psig) / Full Vac.
Design Temp.	600 K (620°F)
Capacity	
Coalescer	CLS-5301A/B
National Board	915 (A) 918 (B)
Year	1991
Manufacturer	Process Systems International Inc.
Type	Water Droplet Separator
Material	Stainless Steel
MAWP @ 339 K (150°F)	11.3 bar (150 psig)
Design Press.	13 bar (175 psig) / Full Vac.
Design Temp.	339 K (150°F)
Face Velocity	
Efficiency	
Filter	F-5301 A/B
National Board	41590 (A) 41595 (B)
Year	1991
Manufacturer	Dollinger
Material	Stainless Steel
MAWP @ 339 K (150°F)	12 bar (175 psi)
Design Press.	13 bar (175 psig) / Full Vac.
Design Temp.	339 K (150°F)
Components Limit Temp.	291 K (650°F)
Nominal Filtration	3 micron

Skid #53 CCWP DEHYDRATION, cont.

GN2 Heater	HTR-5306
National Board	43
Year	1991
Manufacturer	Watlow / Process Systems Inc.
MAWP @ 616 K (650°F)	8.6 bar (125 psi)
Design Press.	9.6 bar (125 psig)
Design Temp.	617 K (650°F)
Power	5 kW, 480 V, 3ø, 60 Hz
Heater	HTR-5300
National Board	41
Year	1991
Manufacturer	Watlow / Process Systems Inc.
Material	340 Stainless Steel
MAWP@	12 bar (175 psi) @ 477 K (400°F)
Design Press.	13 bar (175 psig) / Full Vac.
Design Temp.	77 / 477 K (-320 / 400°F)
Power	145 kW, 480 V, 3ø, 60 Hz
Strainer	STR-5300
Manufacturer	Mueller Stream Specialty
Year	1991
MAWP @ 311 K (100°F)	19.7 bar (285 psi)
Design Press.	11.4 bar (150 psig)
Design Temp.	339 K (150°F)
Type	30 Mesh

Skid #54 CCWP COMPRESSOR

Drawing #	SCl-0-54-001
Operating Procedure Unit	31
Location	ASST. / N-15 compressor building
Function	Compress helium recieved from CCWP return header.
Skid Dimensions:	
Length	3.35 m (11 ft)
Width	1.52 m (5 ft)
Process Conditions:	
Pressure In	2 bar (29 psi)
Pressure Out	7 bar (102 psi)
Temperature In	300 K
Temperature Out	300 K
Flow Required	55 g/s
Flow Max.	110 g/s
Brake Horsepower @Req'd Flow	
Brake horsepower @Max. Flow	
Oil Type:	Ucon LB-170
Vapor Pressure After Processing	51 mbar @ 373-393 K (200-250°F)
Viscosity:	170 SUS @ 311 K (100°F)
Characteristics:	water-white to light yellow color; no odor.
	SEE MSD
Compressor	C-5401
Manufacturer	Sullair
Type	Rotary Screw
Model	C16LA
Oil Separator	V-5401
National Board	486973
Year	1991
Manufacturer	Manchester
Volume	348 liter (92 gal)
MAWP @ 394 K (250°F)	10.3 bar (150 psi)
Min. Design Temp. @10.3 bar (150psi)	244 K (-200F)
Type	Three Stage w/ Oil Heater
Carryover	<10 ppm (By Weight)

Skid #54 CCWP COMPRESSOR, cont.

Aftercooler	HX-5401
National Board #	34242
Manufacturer	Basco
Oil Cooler	HX-5402
National Board #	34241
Manufacturer	American Precision
Watts	
Heater	HTR-5406
Function	Oil Heater
Manufacturer	HOTWATT
Power	500 W Heater 60HZ / 120V
Oil Pump	P-5417
Manufacturer	TUTHILL
Pressure Flow	
Electric Motors:	
Unit #	EM-5401
Function	drive compressor
Manufacturer	Reliance Electric Co.
Power	125 hp, 3570 rpm, 460 V, 1.37 amp, 60 Hz, 3ø
Service Factor	1.2
Unit #	EM-5402
Function	drive comp. slide valve
Manufacturer	RCS
Voltage	115 V
Unit #	EM-5417
Function	drive pump P-5417
Manufacturer	Franklin
Power	3/4 hp, 115 V

Skid #56 CCWP OIL REMOVAL

Drawing #	SC1-0-56-001
Operating Procedure Unit	31
Location	Outside compressor building
Function	Remove 98-99% of oil in helium.
Skid Dimensions	
Length	3.46 m (11 ft - 4 in)
Width 2.36 m (7 ft - 9 in)	
Coalescers	
Units #	CLS-5600/5601/5602/5603
National Board	880 (0), 883 (1), 886 (2), 889 (3)
Year	1991
Manufacturer	Process Systems International Inc.
Type:	Single Coalescing Element.
Face Velocity:	< 5 cm/s
MAWP @ 339 K (150°F)	22 bar (300 psig)
MAWP @ 339 K (150°F)	21.7 bar (300 psig)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	339 K (150°F)
Operating Pressure	17.2 bar (235 psig)
Adsorber	ADS-5600A/B
National Board	862 (A), 865 (B)
Year	1991
Manufacturer	Process Systems International Inc.
Type	Carbon Bed
MAWP @ 422 K (300°F)	21.7 bar (300 psig)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	339 K (150°F)
Operating Pressure	17.2 bar (235 psig)
Operating Life @ Full Flow Rate	Two Year
Adsorbent	Charcoal
Number Of Stages	1
Impurities At Outlet	<1ppb oil
Filter	F-5601-5604
Manufacturer	Koch
Type	Coalsecer SCI-4-002
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	339 K (150°F)
Nominal Retention	40 micron
Filter	F-5600A/B
National Board	41530(A), 41534 (B)
Year	1991
Manufacturer	Dollinger
Type	Element Polyester-99
Nominal Retention	5 micron
MAWP @ 339 K (150°F)	20.7 bar (300 psi)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	339 K (150°F)

System #57 CCWP HELIUM GAS STORAGE

Drawing #	SCl-0-57-002
Operating Procedure Unit	32
Location	Tank Farm
Function	Provide gaseous helium storage for CCWP
Gas Storage	V-5701 (impure) / V-5751 (pure)
Nat. Board	23041 (impure) / 23135 (pure)
Year	1991
Location	Tank Fram
Manufacturer	Trinity Industries Inc.
Material	SA-612
Length	13.7 m (542 in)
Diameter	2.13 m(84 in)
Volume	45,420 liters (12,000 U.S. gal)
MAWP @ 328 K (131°F)	20 bar (275 psig)
Design Press.	20 bar (275 psig) / Full Vac.
Design Temp.	339 K (150°F)
Operating Press.	3-7 bar
Mechanical Safety Relief	**19.6 bar (270 psig)**
Suction Filter	STR-5715
Manufacturer	Process Systems International Inc.
Design Press.	9.6 bar (125 psig)
Design Temp.	339 K(150°F)
Size	30 mesh (137 micron)

Skid #64 VACUUM SYSTEM - PORTABLE

Drawing	SCI-0-64-001
Location	Portable
Function	Perform evacuation, repressurization and pressure monitoring of various systems.
Normal Operating Pressure:	<lxl0-7 mbar
Max. Helium Leak Rate:	lxl0-6 ssc/sec
Roughing Pump	P-6402
Manufacturer	Leybold
Type	Rotary Vane
Pump Speed	24.9 liters / s (53 cfm)
Turbomolecular Pump	P-6401
Manufacturer	Leybold
Pump Speed	110 liter / s
Mist Eliminator	CLS-6402
Manufacturer	Leybold
Filter	F-6401
Manufacturer	Leybold
Nominal Filtration	
Electric Motor	EM-6402
Function	Drive rotary vane roughing pump P-6402
Manufacturer	GE Motor
Power	3 hp, 1725 rpm, 460 V, 3 ø, 60 Hz

Skid #70 NITROGEN DEWAR

Drawing #	SCl-0-70-001
Operating Procedure Unit	35
Location	ASST. outside R/L building
Function	Storage of liquid nitrogen.
LN2 Vaporizer Skid	S-7000
Inlet	LN2 @ 3.7 bar (54 psi
Outlet	GN2 @ 3 bar (44 psi) & 300 K (80°F)
Flow	195 g/s
Electric Trim Heater	HTR-7004
Manufacturer	Thermax
Power	20 kW 480 V, 3ø, 60 Hz, 24 amp
Design Pressure	13.1 bar (175 psig)
Design Temp.	227 / 339 K (-50 / 150°F)
Ambient Air Vaporizers	HTR-7003 A/B
Type	Ambient Air Fin
Manufacturer	Thermax
Material	Aluminum
Design Pressure	13.1 bar (175 psig)
Design Temp.	77 / 339 K (-320 / 150°F)
LN2 Storage Assembly	S-7001
Strainers	STR-7031 / 7032
Manufacturer	Process Engineering Inc.
Size	100 mesh
Pressure Building Vaporizer	HTR-7002
Type	Ambient Air Fin
Manufacturer	Process Engineering Inc.
Design Press.	13.1 bar (175 psig)
Design Temp.	77 / 339 K (-320 / 150°F)
Pressure Vessel	V-7001
National Board	9610
Year	1991
Material	N/A
Volume	75,000 liter (19812 gal)
Max. Weight of Contents	60,633 kg (133,672 lb)
MAWP @ 311K(100°F)	w / ext.vac @ 5 bar (58 psig)
Design Temp.	77 / 339 K (-320 / 150°F)
Design Press.	5 bar (57.8 psig)
Refrigeration	905 g/s LN2
Vaporized	195 g/s LN2
Mechanical Safety Relief	5 bar (57.8 psig)

Skid #84 INSTRUMENT AIR

Drawing #	SCI-0-84-001
Operating Procedure Unit	37
Location	ASST. Service Building
Function	Provide clean dry air for operation of all plant pneumatic instruments and valves.
Skid Dimensions	
Length	5.5 m (18ft)
Height	1.37 m (4ft - 6in)
Operating Pressure	8.6 bar (110 psig)
Compressors 1, 2	C-8100,C-8200
Manufacturer	Ingersoll Rand
Type	Rotary Screw SSR XP25U
Mode	Parallel Lead Lag
FlowRate	129 m3/hr (76 acfm)
Pressure	13 bar (175 psig)
Aftercoolers:	HX-8400,HX-8401
Manufacturer	Basco
Coalescing Prefilters:	CLS-8400 A/B
Type	Coalescing with Automatic Drain
Manufacturer	Ingersoll Rand
Max. Inlet Press.	18.2 bar (250 psig)
Max. Inlet Temp.	322 K (1200°F)
Max. Flow	300 scfm
D.O.P. Efficiency	99.9999%
Compressed Air Dryer:	ADS-8300 A/B
National Board	87420F / 87414F
Type	Dual Bed, Pressure Swing, and Regenerative
Year	1992
MAWP @ 339 K (150°F)	17.2 bar (250 psi)
Min Design Temp.@17.2 bar (250 psi)	244 K (-20°F)
Manufacturer	Brunner Engr. and Mfg. Inc.
Particulate After Filters:	F-8401 A/B
Type	Particulate
Manufacturer	Ingersoll Rand
Max. Inlet Press.	18.2 bar (250 psig)
Max. Inlet Temp.	322 K (120°F)
Max. Flow	300 scfm
D.O.P. Efficiency	99.95%

Skid #84 INSTRUMENT AIR, cont.

Carbon Adsorbers:	F-8402 A/B
Type	Charcoal
Manufacturer	Ingersoll Rand
Max. Inlet Press.	18.2 bar (250 psig)
Max. Inlet Temp.	339 K (150°F)
Max. Flow	220 scfm
Air Receiver Tank:	V-8401
Nat. B.D.#	25786G
Year	1991
Manufacturer	Brunner Engr. and Mfg. Inc.
Material	Carbon Steel
MAWP @ 505 K (450°F)	13.8 bar (200 psi)
Design Press.	14.8 bar (200 psig)
Design Temp.	339 K (150°F)
Volume	

Skid #91 OIL PROCESSING SYSTEM

Drawing #	SC1-0-91 -001
Operating Procedure Unit	
Location	Compressor building
Function	Remove water and light hydrocarbon impurities from synthetic oil (UCON LB 170X).
Skid Dimensions:	
Length	3.66 m (12 ft)
Width	2.44 m (8 ft)
Oil Processing Vessel:	V-9102
National Board	none
Year	1991
Manufacturer	Process Systems International Inc.
Material	Carbon Steel
MAWP @ 422 K (300°F)	1.7 bar (10 psig)
Design Press.	Full Vac. / 1.7 bar (10 psig)
Design Temp.	422 K (300°F)
Operating Pressure	Full Vac.
Capacity	422 liter (110 gal)
Clean Oil Storage Vessel:	V-9106
National Board	none
Year	1991
Manufacturer	Process Systems International
Material	Carbon Steel
MAWP @ 422 K (300°F)	1.7 bar (10 psig)
Design Press.	Full Vac. / 1.7 bar (10 psig)
Design Temp.	422 K (300°F)
Operating Pressure	1.4 bar (5 psig)
Capacity	960 liter (250 gal)
Pumps	
Unit #	P-9101
Function	Recirculate and atomize oil
Manufacturer	U.S. Electrical Motors
Flow Rate	1.26 liter / s (20 gal/m)
Pressure	4.5 bar (50 psig)
Unit #	P-9107
Function	Discharge oil to remote storage or equipment.
Manufacturer	Magnetek
Flow Rate	0.32 liter/s (5 gal/m)
Pressure	15 bar (200 psig)

Skid #91 OIL PROCESSING SYSTEM, cont.

Roughing Pump	P-9105
Manufacturer	Leybold
Type	2 Stage Rotary Piston
Flow Rate	100 m3/h (68 cfm)
Ultimate Pressure	< 1.5xlo-4 mmhg
Carbon Adsorber	ADS-9104
Manufacturer	Balston
Maximum Pressure	18 bar (250 psig)
Molecular Sieve	ADS-9105
Manufacturer	Balston
Maximum Pressure	18 bar (250 psig)
Electric Motors	
Unit #	EM-9101
Function	Drive pump P-9101
Manufacturer	U.S. Electrical Motors
Power	1 1/2 hp, 1160 rpm, 230 / 460 V, 3ø, 60Hz
Unit #	EM-9105
Function	Drive roughing pump P-9105
Manufacturer	U.S. Electrical Motors
Power	5 hp, 1430 / 1745 rpm, 200 / 230 / 460 V, 3ø,50/60 Hz
Unit #	EM-9107
Function	Drive pump P-9107
Manufacturer	Magnetek Century Electric
Power	2 hp, 1750 rpm, 480 V, 3ø, 60 Hz
Electric Heaters	
Unit #	HTR-9102
Function	Heat oil in processing drum
Manufacturer	Watlow Industries
Power	10 kw, 480 V, 3ø, 60 Hz
Unit #	HTR-9106
Function	Keep oil viscosity low for availability to
Manufacturer	Watlow Industries
Power	1.1 kw, 480 V, 3ø, 60 Hz

Skid #91 OIL PROCESSING SYSTEM, cont.

Spray Nozzle	SP-9102
Orifice Size	1/2
Level Control	LS-91 02/91 06
Manufacturer	Magnetrol International
Power	120 / 240 AC / 115 / 230 DC V, 7/6.5/7/5 Amps, 350 / 360 VA, 1/4, 1/2,1/2,1/2hp
Pressure	20 bar (285 psi) @ 311 K (100,F)
Min. Sp. Gr.	0.90
LN2 Cold Trap	E-9104
Manufacturer	Process Systems International

Inner Vessel

National Board	none
Year	19 91
MAWP @ 339 K (150°F)	2 bar (14 psig)
Min. Design Temp.@ 2 bar (14 psig)	78 K (-320°F)
Operating Pressure @ 78 K (-320°F)	1.4 bar (5 psig)

Outer Vessel

National Board	none
Year	1.991
MAWP @ 339 K (150°F)	2 bar (14 psig)
Min. Design Temp.@ 2 bar (14 psig)	258 K (50°F)
Operating Pressure @ 294 K (70°F)	Full Vac.

Skid #92 GAS ANALYZER

Drawing #	SCl-0-92-001
Operating Procedure Unit	1
Location	ASST. / N-15 compressor building
Function	Measure different samples points for impurities within the plant and associated equipment.
Analyzer	
Manufacturer	Sulzer
Type	Arc Cell
Modes	N2, H20, Hydro-Carbons
Min. Design Press.	2 bar (29 psi)
Teflon Membrane Pump	C-9200 A,B,C,D
Manufacturer:	Sulzer
# Of Heads	4
Min. Rate	0.010 g/s @ 3.5 bar (50.8 psi) diff.
Electric Motor	EM-9200
Power	120 V, 60 Hz, 1/2 hp

N-15B
CRYO PLANT
Data Sheets

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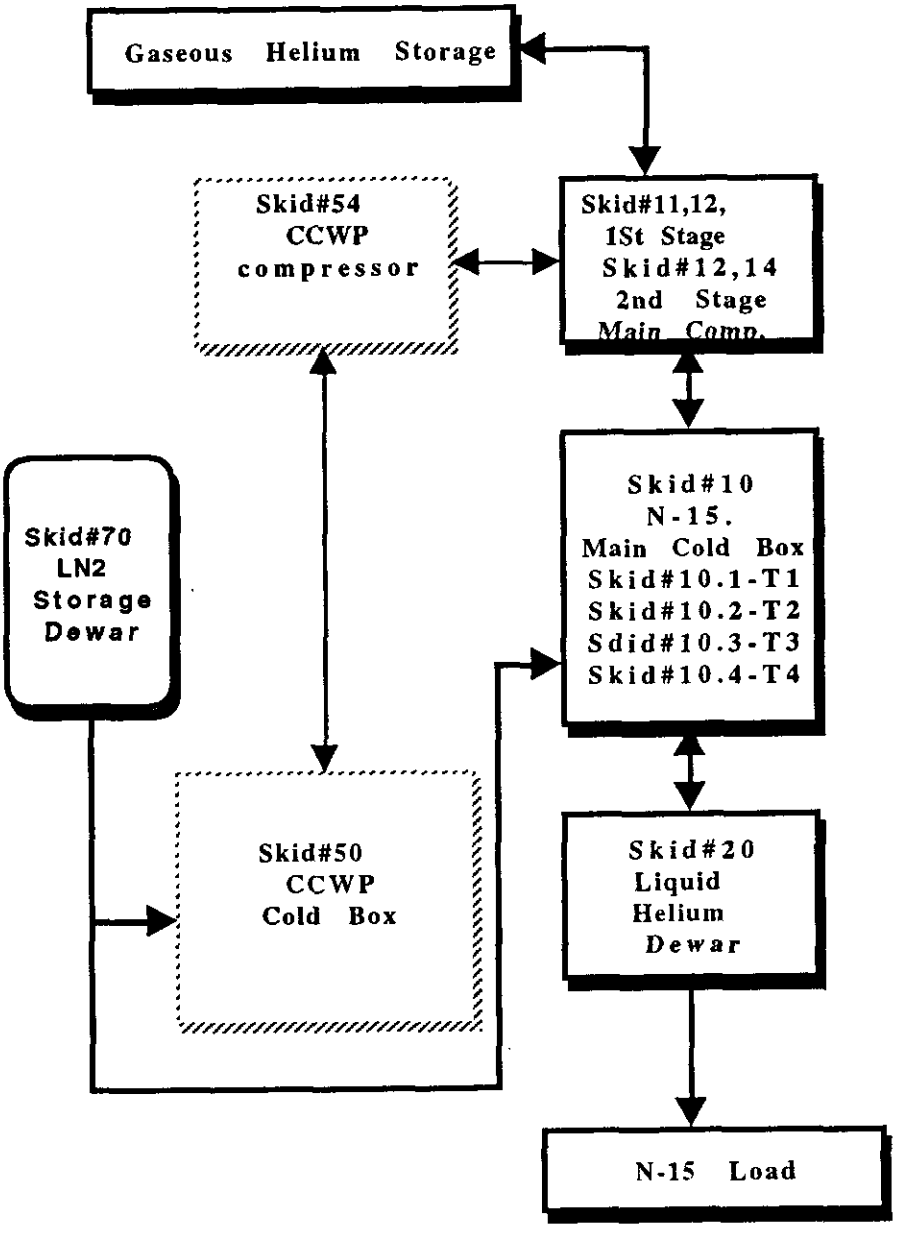
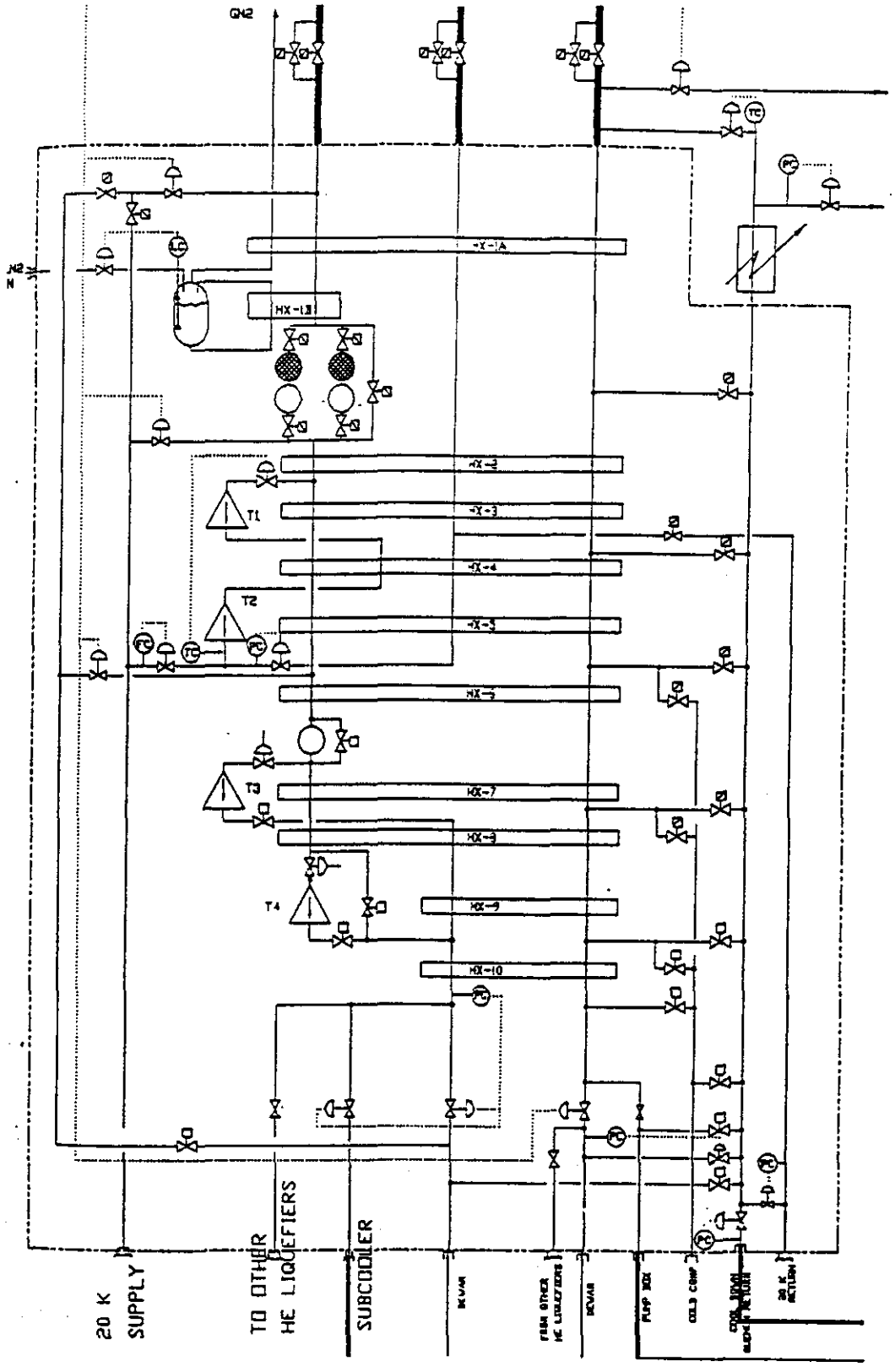


N-15 cryogenic plant block diagram



ASST / MTL / N15 cold box

Skid #10 COLD BOX (main)

Drawing #	SCl-0-10-002 thru 009
Operating Procedure Unit	5, 7, and 8
Location	ASST. Service Building
Function	Supply Helium Refrigeration and Liquefaction
Skid Dimensions	13'-6" Square
Type:	Vertical Cylinder
Capacity:	4000 W or 2000 W + 20 g/s
Flow:	400 g/s
Carnot Efficiency:	>25%
80 K Carbon Adsorbers:	ADS-1001A / B
National Board	930 (A) / 933 (B)
Year	1991
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Length	2057 mm (81 in)
Outside Diameter	457 mm (18 in)
Flow	400 g/s
Adsorber	Charcoal 108 kg (238 lb)
Designed Removal	100 ppm N2, 40 ppm 02
On-line Oper. Before Regen.	12 hr
Regeneration Cycle	<12 hr
MAWP @ 339 K (150°F)	21.7 bar (300 psig)
Design Press.	21.7 bar(300 psig) / Full Vac.
Design Temp.	77 / 339K (-320 / 150°F)
Operating Pressure	16.9 bar (230 psig)
Safety Relief	20 bar (275 psig)
ACTIVATION	
Design Press.	4 bar (45 psig) / Full Vac.
Design Temp.	422 K (300°F)
20 K Carbon Adsorber (non-regen.)	ADS-1002
National Board	938
Year	1991
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Length	1930 mm (76 in)
Outside Diameter	324 mm (12.75 in)
Flow	117.25 g/s
Adsorber	Charcoal 60 kg (132 lb)
Designed Removal	Trace amount of Neon
MAWP @ 339 K (150°F)	21.7 bar (300 psig)
Design Press	21.7 bar (300 psig) / Full Vac.
Design Temp.	4.5 / 339 K (-451 / 150°F)
Operating Pressure	16.9 bar (230 psig)
Safety Relief	20 bar (275 psig)
ACTIVATION	
Design Press.	4 bar (45 psig)
Design Temp.	422 K (300°F)

Carbon Ads. Outlet Filters:

Unit #	F-1001A/B
Filtration	5 micron
Type	Bayonet
Manufacturer	CPC
Material	304 Stainless Steel
Design Temp.	77 / 339 K (-320 / 150°F)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	422 K (300°F)
Design Press.	4 bar (45 psig) / Full Vac.

Unit #	F-1002
Filtration	5 micron
Type	Bayonet
Manufacturer	CPC
Material	304 Stainless Steel
Design Temp.	4.5 / 339 K (-451 / 150°F)
Design Press.	21.7 bar (300 psig) / Full Vac
Design Temp.	422 K (300°F)
Design Press.	4 bar (45 psig)

Getters

Unit #	G-1001
Type	ST 507 Zirconium
Manufacturer	Ergenics, Inc.

Unit #	G-1002
Type	Activated Charcoal
Manufacturer	Ergenics, Inc.

Unit #	G-1003
Type	Activated Charcoal
Manufacturer	Ergenics, Inc.

Warmup Heater:	HTR-1001
Type	Ambient Vaporize Model# TF488HF-DH
Manufacturer	Thermax Inc.
Material	Aluminum
Design Temp.	77 / 339 K (-320 / 150°F)
Design Press.	11.4 bar 150 psig)

Skid #10 COLD BOX, cont.

Heat Exchangers:	HX-1000 thru HX-1010
Type	Br. Alum. Plate-Fin
Manufacturer	Sumitomo Precision Products Co. Ltd.
HX-1000	2 Stream
National Board #	2192
HX-1001	4 Stream
National Board #	2191
HX-1002/1003	3 Stream
National Board #	2193
HX-1004 / 1005	4 Stream
National Board #	2197
HX-1006 / 1007 / 1008	4 Stream
National Board #	2194
HX-1009 / 1010	2 Stream
National Board #	2198
Nitrogen Phase Separator:	V-1004
National Board	924
Year	1991
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Length	0.61 m (24 in)
Outside Diameter	0.406 m (16 in)
MAWP @ 339 K (150°F)	11.4 bar (150 psig)
Design Press.	6.2 bar (75 psig) / Full Vac.
Design Temp.	77 / 339 K (-320 / 150°F)
Operating Pressure	4.5 bar (50 psig)
Water Separator:	V-1001
National Board	849
Year	1991
Manufacturer	Process Systems International Inc.
MAWP @ 339 K (150°F)	21.7 bar (300 psig)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	77 / 339 K (-320 / 150°F)
Operating Pressure	16.9 bar (230 psig)
Helium Supply Strainer:	STR-1001
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Mesh	100
Design Temp.	339 K (150°F)
Design Press.	21.7 bar (300 psig) / Full Vac.
Turbo Expanders (4)	See 10.1-10.4

Skid #10 COLD BOX, cont.

Vacuum Vessel	V-1000
Manufacturer	Process Systems International Inc.
Material	Carbon Steel
Length	7.62 m (25ft)
Diameter	3.81 m (12ft - 6")
Design Temp.	339 K (150°F)
Design Press.	Full Vac. / 2.1 bar (15 psig)

10.1 TURBINE ASSEMBLY #T1

Drawing #	SCl-0-10-006
Operating Procedure Unit	9
Location	Cold Box Turbine Pod
Function	Turboexpander runs in series with #T2 expander.
Turbine Speed:	
Norm. Oper. (Temp.<50 K)	2500 rps
Cooldown (Temp. >55 K)	2000 rps
High Temp. Alarm/Trip:	363K (194°F)
High Speed Alarm:	2550 rps
High Speed Trip:	2600 rps
Low Speed Alarm/Trip:	500 rps
Software Switchpoint	50 rps
Turbo Expander/Brake:	T-1001
Type	Gas Bearing TGL 32-28 B50
Manufacturer	Sulzer
Brake Cooler:	HX-1011
National Board	18602
Year	1991
Manufacturer	Graham Manufacturing Co. Inc.
MAWP (Shell) @ 422 K (300°F)	11.4 bar (150 psig)
MAWP (Tube) @ 422 K (300°F)	FV/ 21.7 bar (300 psig)
Min. Design Temp.@ MAWP (both)	244 K (-20°F)
Heat Load	8.83 kw (30,130 Btu / h)
Cooling Water	15 liter/m (4.0 gal/m)
Inlet Filters	F-1003 A/B
Manufacturer	CPC
Design Temp.	4.5 / 339 K (-451 / 150°F)
Design Press.	21.7 bar (300 psig) / Full Vac.
Nominal Retention	10 micron
Brake Filter	F-1006
Manufacturer	CPC
Design Temp.	-451/ 150°F
Design Press.	21.7 bar (300 psig)
Nominal Retention	10 micron

10.2 TURBINE ASSEMBLY #T2

Drawing #	SC1-0-10-007
Operating Procedure Unit	9
Location	Coldbox Turbine Pod #1&2
Function	Turboexpander runs in series with #Tl.
Turbine Speed:	
Norm. Oper. (Temp. <30 K)	2200 rps
Cooldown (Temp. >35 K)	2500 rps
High Temp. Alarm/Trip:	363 K (194°F)
High Speed Alarm:	2550 rps
High Speed Trip:	2600 rps
Low Speed Alarm/Trip:	500 rps
Software Switchpoint	50 rps
Turbo Expander/Brake:	T-1002
Type	Gas Bearing TGL 32-28 A56
Manufacturer	Sulzer
Brake Cooler:	HX-1012
National Board	18605
Year	1991
Manufacturer	Graham Manufacturing Co. Inc.
MAWP (Shell) @ 422 K (300°F)	11.4 bar (150 psig)
MAWP (Tube) @ 422 K(300°F)	FV/ 21.7 bar (300 psig)
Min. Design Temp. @ MAWP (both)	244 K (-20°F)
Heat Load	6.97 kW (23,800 Btu/h)
Cooling Water	12 liter/m (3.2 gal/m)
Brake Filter	F-1007
Manufacturer	CPC
Design Temp.	4.5 / 339 K (-451 / 150°F)
Design Press.	21.7 bar (300 psig)
Nominal Retention	10 micron

10.3 TURBINE ASSEMBLY #T3

Drawing #	SCl-0-10-008
Operating Procedure Unit	10
Location	Coldbox Turbine Pod
Function	Turbine expander arranged parallel w/T4 37% of stream flow through #T3.
Turbine Speed:	
Cartridge TGL22 12 B32	3600 rps
Cartridge TGL22 12 B32	3200 rps
High Temp. Alarm/Trip:	90°C
High Speed Alarm:	3700 rps
High Speed Trip:	3800 rps
Low Speed Alarm/Trip:	500 rps
Software Switchpoint	50 rps
Turbo Expander/Brake:	T-1003
Type	Gas Bearing TGL 22-12 B32
Manufacturer	Sulzer
Brake Cooler:	HX-1013
National Board	18608
Year	1991
Manufacturer	Graham Manufacturing Co. Inc.
MAWP (Shell) @ 422 K (300°F)	11.4 bar (150 psig)
MAWP (Tube) @ 422 K (300°F)	FV/ 21.7 bar (300 psig)
Min. Design Temp. @ MAWP (both)	244 K (-20°F)
Heat Load	1.17 kW (4,000 Btu/h)
Cooling Water	1.9 liter/m (0.5 gal/m)
Inlet Filters	F-1004 A/B
Manufacturer	CPC
Design Temp.	4.5 / 339 K (-451 / 150°F)
Design Press.	21.7 bar (300 psig) / Full Vac.
Nominal Retention	10 micron
Brake Filter	F-1008
Manufacturer	CPC
Design Temp.	4.5 / 339 K (-451 / 150°F)
Design Press.	21.7 bar (300 psig)
Nominal Retention	10 micron

10.4 TURBINE ASSEMBLY #T4

Drawing #	SC1-0-10-009
Operating Procedure Unit	11
Location	Coldbox Turbine Pod
Function	Turboexpander arranged in parallel with # T3.
Turbine Speed:	2800 rps (any mode)
High Temp. Alarm/Trip:	363 K (194°F)
High Speed Alarm:	3700 rps
High Speed Trip:	3800 rps
Low Speed Alarm/Trip:	500 rps
Software Switchpoint	50 rps
Turbo Expander/Brake:	T-1004
Type	Gas Bearing TGL 22-12 B40
Manufacturer	Sulzer
Brake Cooler:	HX-1014
National Board	18613
Year	1991
Manufacturer	Graham Manufacturing Co. Inc.
MAWP (Shell) @ 422 K (300°F)	11.4 bar (150 psig)
MAWP (Tube) @ 422 K (300°F)	FV/ 21.7 bar (300 psig)
Min. Design Temp. @ MAWP (both)	244 K (-20°F)
Heat Load	1.52 kW (5,200 Btu/h)
Cooling Water	2.6 liter/m (0.7 gal/m)
Inlet Filters	F-1005 A/B
Manufacturer	CPC
Design Temp.	4.5 K (-451°F)
Design Press.	21.7 bar (300 psig) / Full Vac.
Nominal Retention	10 micron
Brake Filter	F-1009
Manufacturer	CPC
Design Temp.	339 K
Design Press.	21.7 bar (300 psig)
Nominal Retention	10 micron

Skid #11 FIRST STAGE COMPRESSOR

Drawing #	SC1-0-11-001
Operating Procedure Unit	3
Location	Compressor Building
Function	Compress gases helium from storage tank farm.
Skid Dimensions	1.83 m x 3.96 m (6 ft x 13 ft)
Process Conditions:	
Pressure In	1.01 bar (15.44 psia)
Pressure Out	3.45 bar (49.98 psia)
Temperature In	316.5 K (109.8°F)
Temperature Out	352.1 K (174°F)
Flow Required	108.5 g/s each
Flow Max.	112.29 g/s -0, +5% each
Brake Horsepower @Req'd Flow	198 bhp
Brake horsepower @Max. Flow	204 bhp
Volumetric Efficiency	90 - 92 %
Isothermal Efficiency	56%
Oil Type:	Ucon LB-170
Vapor Pressure After Processing	51 mbar @ 373-393 K (200-250,F)
Viscosity:	170 SUS @ 311 K (100°F)
Characteristics:	water-white to light yellow color;
Aftercooler	HX-1101
National Board	34745
Type	Tube / Shell
Manufacturer	Basco
Compressors	C-1101
Type	Two Parallel Oil Injected Rotary Screw (50% Each)
Manufacturer	Sullair Inc.
Model #	C25 LB 704-22
Electric Heater	HTR-1106
Function	Oil Heater
Manufacturer	Hotwatt
Power	500 W, 115 V

Electric Motors

Unit #	EM-1101
Function	drive compressor
Manufacturer	Reliance Electric
Power	250 hp, 3560 rpm, 460 V, 3ø
Service Factor	1.2
Unit #	EM-1102
Function	drive slide valve
Manufacturer	RCS
Voltage	115 V
Unit #	EM-1117
Function	drive oil pump P-1117
Manufacturer	Franklin
Power	3/4 hp, 115 V
Oil Cooler	HX-1102
National Board	34701
Manufacturer	Amceican Precision
Oil Pump	P-1117
Manufacturer	Tuthill
Oil Separator	V-1101
National Board	489358
Year	1991
Manufacturer	Manchester
Volume	1003 liter (265 gal)
MAWP @ 394 K (250°F)	10.3 bar (150 psi)
Min. Design Temp. @10.3 bar (150 psi)	244 K (-20°F)
Type	Three Stage w/ Oil Heater
Carryover	<10 ppm (By Weight)

Skid #12 FIRST STAGE COMPRESSOR

Drawing #	SC1-O-11-OO1
Operating Procedure Unit	3
Location	Compressor Building
Function	compress helium
Skid Dimensions	1.83 m x 3.96 m (6 ft x 13 ft)
Process Conditions:	
Pressure In	1.01 bar (15.44 ps ia)
Pressure Out	3.45 bar (49.98 psia)
Temperature In	316.5 K (109.8°F)
Temperature Out	352.1 K (174°F)
Flow Required	108.5 g/s each
Flow Max.	112.29 g/s -0, +5% each
Brake Horsepower @Req'd Flow	198 bhp
Brake horsepower @Max. Flow	204 bhp
Volumetric Efficiency	90 -92 %
Isothermal Efficiency	56%
Oil Type:	Ucon LB-170
Vapor Pressure After Processing	51 mbar @ 373-393K(200-250°F)
Viscosity:	170 SUS @ 311 K (100°F)
Characteristics:	water-white to light yellow color; no odor. SEE MSD
Aftercooler	HX-1201
National Board	34744
Type	Tube / Shell
Manufacturer	Basco
Compressors	C-1201
Type	Two Parallel Oil Injected Rotary Screw (50% Each)
Manufacturer	Sullair Inc.
Model #	C25 LB 704-22
Electric Heater	HTR-1206
Function	Oil Heater
Manufacturer	Hotwatt
Model	SC62-175
Power	500 W, 115 V

Skid 12 FIRST STAGE COMPRESSOR, cont.

Electric Motors

Unit #	EM-1201
Function	drive compressor
Manufacturer	Reliance Electric
Power	250 hp, 3560 rpm, 460 V, 3ø
Service Factor	1.2
Unit #	EM-1202
Function	drive slide valve
Manufacturer	RCS
Voltage	115 V
Unit #	EM-1217
Function	drive oil pump P-1217
Manufacturer	Franklin
Power	3/4 hp, 115 V
Oil Cooler	HX-1202
National Board	34700
Manufacturer	American Percision
Oil Pump	P-1217
Manufacturer	Tuthill
Oil Separator	V-1201
National Board	489357
Year	1991
Manufacturer	Manchester
Volume	1003 liter (265 gal)
MAWP @ 394 K (250°F)	10.3 bar (150 psi)
Min. Design Temp. @10.3 bar (150psi)	244 K (-200F)
Type	Three Stage w/ Oil Heater
Carryover	<10 ppm (By Weight)

Skid #13 SECOND STAGE COMPRESSOR

Drawing #	SCl-0-13-001
Operating Procedure Unit	4
Location	Compressor Building
Function	Compress gases helium from storage tank farm.
Skid Dimensions	1.83 m x 3.96 m (6 ft x 13 ft)
Process Conditions:	
Pressure In	3.2 bar (47.04 psia)
Pressure Out	18 bar (264.6 psia)
Temperature In	312 K (101.7°F)
Temperature Out	364.3 K (196°F)
Flow Required	197.5 g/s each
Flow Max.	224.49 g/s -0, +5% each
Brake Horsepower	@ Req'd Flow 582 bhp
Brake horsepower	@ Max. Flow 625 bhp
Volumetric Efficiency	80 - 87 %
Isothermal Efficiency	53%
Oil Type:	Ucon LB-170
Vapor Pressure After Processing	51 mbar @ 373-393 K (200-250°F)
Viscosity:	170 SUS @ 311 K (1000°F)
Characteristics:	water-white to light yellow color; no odor SEE MSD
Aftercooler	HX-1301
National Board	34757
Type	Tube / Shell
Manufacturer	Baso
Compressor	C-1301
Type	Two Parallel Oil Injected Rotary Screw (50% Each)
Manufacturer	Sullair Inc.
Model #	C25MA704-26
Electric Heater	HTR-1306
Function	Oil Heater
Manufacturer	Hotwatt
Model	SC62-175
Power	500 W, 115 V

Skid #13 SECOND STAGE COMPRESSOR, cont.

Electric Motors

Unit #	EM-1301
Function	drive compressor
Manufacturer	Reliance Electric
Power	700 hp, 3600 rpm, 4160 V, 3ø
Service Factor	1.2
Unit #	EM-1302
Function	drive slide valve
Manufacturer	RCS
Voltage	115V
Unit #	EM-1317
Function	drive oil pump P-1317
Manufacturer	Franklin
Power	3/4 hp, 115 V
Oil Cooler	HX-1302
National Board	34699
Manufacturer	American Precision
Oil Pump	P-1317
Manufacturer	Tuthill
Oil Separator	V-1301
National Board	489355
Year	1991
Manufacturer	Manchester
Volume	1003 liter (265 gal)
MAWP @ 394 K (250°F)	10.3 bar (150 psi)
Min. Design Temp. @10.3 bar (150 psi)	244 K (-200F)
Type	Three Stage w/ Oil Heater
Carryover	<10 ppm (By Weight)

Skid #14 SECOND STAGE COMPRESSOR

Drawing #	SCl-0-13-001
Operating Procedure Unit	4
Location	Compressor Building
Function	Compress gases helium from storage tank farm.
Skid Dimensions	1.83 m x 3.96 m (6 ft x 13 ft)
Process Conditions:	
Pressure In	3.2 bar (47.04 psia)
Pressure Out	18 bar (264.6 psia)
Temperature In	312 K (101.7°F)
Temperature Out	364.3 K (196°F)
Flow Required	197.5 g/s each
Flow Max.	224.49 g/s -0, +5% each
Brake Horsepower @Req'd Flow	582 bhp
Brake Horsepower @Max. Flow	625 bhp
Volumetric Efficiency	80 - 87 %
Isothermal Efficiency	53%
Oil Type:	Ucon LB-170
Vapor Pressure After Processing	51 mbar @ 373-393 K (200-250°F)
Viscosity:	170 SUS @ 311 K (100°F)
Characteristics:	water-white to light yellow color; no odor. SEE MSD
Aftercooler	HX-1401
National Board	34753
Type	Tube / Shell
Manufacturer	Basco
Compressor	C-1401
Type	Two Parallel Oil Injected Rotary Screw (50% Each)
Manufacturer	Sullair Inc.
Model #	C25MA704-26
Electric Heater	HTR-1406
Function	Oil Heater
Manufacturer	Hotwatt
Model	SC62-175
Power	500 W, 115 V

Skid #14 SECOND STAGE COMPRESSOR, cont.

Electric Motors

Unit #	EM-1401
Function	drive compressor
Manufacturer	Reliance Electric
Power	700 hp, 3600 rpm, 4160 V, 3ϕ
Service Factor	1.2
Unit #	EM-1402
Function	drive slide valve
Manufacturer	RCS
Voltage	115 V
Unit #	EM-1417
Function	drive oil pump P-1417
Manufacturer	Franklin
Power	3/4 hp, 115V
Oil Cooler	HX-1402
National Board	34698
Manufacturer	American Precision
Oil Pump	P-1417
Manufacturer	Tuthill
Oil Separator	V-1401
National Board	489354
Year	1991
Manufacturer	Manchester
Volume	1003 liter (265 gal)
MAWP @ 394 K (250°F)	10.3 bar (150 psi)
Min. Design Temp. @10.3 bar (150psi)	244 K (-200F)
Type	Three Stage w/ Oil Heater
Carryover	<10 ppm (By Weight)

Skid #15 COMPRESSOR OIL REMOVAL

Drawing #	SCI-0-15-001
Operating Procedure Unit	
Location	Outside compressor building
Function	Remove oil vapor and droplett from helium gas flow.
Skid Dimensions:	
Length	3.45 m (11 ft - 4 in)
Height	3.63 m (11 ft - 11 in)
Width	2.36 m (7 ft - 9 in)
Adsorber:	ADS-150OA/B
National Board	857 (A),860 (B)
Year	1991
Manufacturer:	Process Systems International Inc.
Type:	Carbon Bed
Operating Life:	Two Year @ Full Flow Rate
Adsorbent:	Charcoal
Number Of Stages:	1
Impurities At Outlet:	< 1 ppbw Oil
MAWP @ 422 K (300°F)	22 bar (300 psig)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	339 K (150"F)
Operating Pressure	17 bar (235 psig)
Coalescers:	CLS-1500,1501,1502,1503
National Board	869 (0), 872 (1), 875 (2), 878 (3)
Year	1991
Type:	Single Coalescing Element
Manufacturer:	Process Systems International Inc.
Face Velocity:	< 5 cm/s
MAWP @ 339 K (150°F)	22 bar (300 psig)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	339 K (150°F)
Operating Pressure	17 bar (235 psig)

Skid #15 COMPRESSOR OIL REMOVAL cont.

Filters

Unit #	F-150OA/B
National Board	(A) 41478 ,(B) 41480
Year	1991
Manufacturer:	Dollinger
Type:Element	Polyester-99
Nominal Retention:	5 micron
MAWP @ 339 K (150°F)	22 bar (300 psig)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp	339 K (150°F)

Unit #	F-1501-1504
Year	1991
Type	Coalsecer SCI-4-002
Manufacturer	Koch
Nominal Retention	40 micron
MAWP @ 339 K (150°F)	300 psig
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	339 K (150°F)

System #16 HELIUM GAS STORAGE

Drawing #	SCl-0-16-001 thru 004
Operating Procedure Unit	2
Location	Tank Farm
Function	Provide storage for gaseous helium @ approx. 18 bar.
Gas Storage 1, 2	V-1601, V-1602
National Board	222,221
Year	1991
Manufacturer	Trinity Industries, Inc.
Material	SA.612
Length	16.5 m (652.375 in)
Diameter	3.35 m (131.875 in)
Volume	132,475 L (35,000 U.S. gal)
MAWP @328K (131°F)	20bar (275 psig)
Design Press.	20 bar (275 psig) / Full Vac.
Design Temp.	339 K (150°F)
Mechanical Safety Relief:	19.6 bar (270 psig)
Compressor Inlet Strainer	STR-1652
Manufacturer	Process Systems International Inc.
Material	Stainless Steel
Design Press.	11.4bar (150 psig) / Full Vac.
Design Temp.	339 K (150°F)
Size	30 mesh
Filter	
Unit #	F-1601
Type	27/80
Manufacturer	Balst
Design Press.	19.6 bar (270 psig)
Design Temp.	339 K (150°F)
Nominal Retention	5 micron
Unit #	F-1628 / 1630
Type	
Manufacturer	
Design Press.	415 bar (6,000 psig)
Design Temp.	339 K (150°F)
Nominal Retention	7 micron

Skid #17 COLD BOX REGENERATION

Drawing #	SCl-0-17-001
Operating Procedure Unit	15
Location	ASST. Service Building
Function	Activate and regenerate carbon adsorber beds in R/L module and recycle pure helium back to medium pressure helium gas header.
Skid Dimensions:	
Length	3.2 m (126 in)
Width	2.59 m (102 in)

Electric Motors

Unit #	EM-1700
Function	drive Lamson Blower
Manufacturer	Toshiba
Power	3 hp, 3500 rpm, 460 V, 3ø, 60 Hz
Unit #	EM-1702
Function	drive vacuum pump (Leybold)
Manufacturer	Brook Crompton Inc.
Power	3 hp, 1750 rpm, 460 V, 3ø, 60 Hz

Filter

Manufacturer	Leybold
Design Press.	Full Vac. / 3.1 bar (30 psig)
Design Temp.	339 K (150°F)
Nominal Retention	10 micron

Gas Heaters:

Unit #	HTR-1701
National Board	48
Year	1991
Type	Incoloy Elements
Manufacturer	Watlow / Process Systems Inc.
Material	304 Stainless Steel
MAWP @ 422 K (300°F)	20.7 bar (300 psi)
Design Press.	21.7 bar (300 psig) / Full Vac.
DesignTemp.	478 K (400°F)
Watts	5 KW, 480 V, 3ø, WYE
Unit #	HTR-1702
Type	Ambient Air Fin
Manufacturer	KPS Thermax
Material	Aluminum
Design Press.	12 bar (175 psig)
DesignTemp.	78 / 422 K (-320 / 300°F)
Flow rate @ design temp. and press.	53 g/s

Skid #17 COLD BOX REGENERATION, cont.

Unit #	HTR-1703
Type	Ambient Air Fin
Manufacturer	KPS Thermax
Material	Aluminum
Design Press.	21.7 bar (300 psig)
DesignTemp.	20 / 339 K (-423 / 150°F)
Flow rate @ design temp. and press.	5 g/s
Gas Blower:	C-1700
Manufacturer	Lamson
Material	Cast Iron / Ductile Iron
Design Press.	2.7 bar (25 psig)
Design Temp.	422 K (300°F)
Flow	119 m3/hr (70 acfm)
Pressure Change	138 mbar (2 psi)
Regen. Vacuum Pump:	P-1702
Manufacturer	Leybold Sogevac
Type	Rotary Vane
Mist Eliminator:	CLS-1702
Manufacturer	Leybold
Design Press.	Full Vac. / 3.1 bar (30 psig)
Design Temp.	339 K (150°F)
Strainer:	STR-1701
Design Temp.	233 / 422 K (-40 / 300°F)
National Board	none
Year	1991
Type	100 Mesh
Manufacturer	Mueller Steam Specialty
MAWP @311K (100°F)	19.7bar(285psi)
Design Press.	3.1 bar (30 psig) / Full Vac.

Skid #18 VACUUM SYSTEM

Drawing #	SCI-0-18-001
Operating Procedure Unit	16
Location	MTL service building
Function	Provide insulating vacuum for main cold box.
Normal Operating Pressure:	<lxl0-7 mbar
Max. Helium Leak Rate:	lxl0-6 ssc/sec
Chiller Motor	EM-1803
Function	Cool Turbomolecular-Pump bearing
Manufacturer	Leybold
Voltage	110 V
Electric Motors	
Unit #	EM-1801
Function	drive turbomolecular pump P-1801
Manufacturer	Leybold
Power	5 hp, 115 V, 60 Hz
Unit #	EM-1802
Function	drive roughing pump P-1802
Manufacturer	GE Motor
Power	3 hp, 1725 rpm, 460 V, 3ø, 60 Hz
Filter	F-1802
Manufacturer	Leybold
Type	AR65
Mist Eliminator	CLS-1802
Manufacturer	Leybold
Roughing Pump:	P-1802
Type	Rotary Vane
Manufacturer	Leybold
Pumping Speed	53 cfm
Turbomolecular Pump:	P-1801
Manufacturer	Leybold
Pumping Speed	110 liter/s
Vacuum System	S-1800
Manufacturer	Leybold

Skid #20 LIQUID HELIUM DEWAR

Drawing #	SCI-0-20-002
Operating Procedure Unit	12
Location	ASST. / outside
Function	Separate helium phases, store liquid helium, store energy during quench, vaporize helium during ref./ liq. performance test, and provide decant to portable dewars.
Liquid Helium Dewar	V-2001
Manufacturer	Cryenco
LN2 Shield	Yes
LHe Vessel	
Mfg Serial #	D-843-1
Year	1991
Material	304 SS
Volume	40,000 / L (10567 gal)
MAWP @ 4. / 339 K (-452 / 150 °F)	60 psig
Design Temp.	4. / 339 K (-452 / 150 °F)
Design Press.	4.13 bar (45.3 psig)
Mechanical Safety Relief	4.0 bar (43 psig)
Liquid Nitrogen Tank	V-2001
Manufacturer	Minnesota Valley
National Board	45281
Pressure Vessel	
National Board	HL 190-55-50
Year	1991
Material	T304
Volume	719 liter (190 gal)
MAWP @77 / 339K (-321 / 150°F)	50 psig
Design Temp:	77 / 339K (-321 / 150°F)
Design Pressure:	4 bar (43 psig)
Mechanical Safety Relief	43 psig
Calorimeter:	HTR-2003
Type	Three 2kw Heaters
Power	240 V, 3ø, 60 Hz

Skid #50 CCWP

Drawing #	SC1-0-50-001
Operating Procedure Unit	27
Location	MTL Service Building
Function	Perform cleanup, cooldown, and warmup functions for magnets, and purification of circulating helium.
Skid Dimensions	
Length	3 m (9 ft - 10 in)
Height	
Width	3 m (9 ft - 10 in)
Vacuum Vessel	V-5002
Manufacturer	
Material	Carbon Steel
Length	
Diameter	
Design Temp.	339 K (150°F)
Design Press.	2.1 bar (15psig)Full Vac.
Heat Exchangers	
Unit #	HX-5000
National Board	2225
Manufacturer	Sumitomo
Type	Brazed Aluminum Plate-Finned
# Of Streams	4 Stream
Unit #	HX-5001
National Board	2243
Manufacturer	Sumitomo
Type	Brazed Aluminum Plate-Finned
# Of Streams	2-Stream
LN2 Separator	V-5000
National Board	900
Year	1991
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Length	1.016 m (40 in)
Diameter	.660 m (26 in)
MAWP @ 339 K (150°F)	11.4 bar (150 psig)
Design Press.	11.3 bar (150 psig) Full Vac.
Design Temp.	77 / 339 K (-320 / 150°F)
Operating Pressure	4.5 bar (50 psig)

skid #50 CCWP, cont.

Water Separator	V-5001
National Board	852
Year	1991
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Length	.609 m (24 in)
Diameter	.203 m (8 in)
MAWP @ 339 K (150°F)	13.1 bar (175 psig)
Design Press.	11.3 bar (150 psig) / Full Vac.
Design Temp.	77 / 339 K (-320 / 150°F)
Operating Pressure	9.0 bar (116psig)
Carbon Adsorber	ADS-5000
National Board	941
Year	1991
Manufacturer	Process Systems International Inc.
Material	304 Stainless Steel
Length	2057 mm (8 ft 10 in)
Diameter	457 mm (18 in)
MAWP @ 339 K (150°F)	21.7 bar (300 psig)
Design Press.	11.3 bar (150 psig) / Full Vac.
Design Temp.	77 / 400 K(-320 / 260°F)
Operating Pressure	16.9 bar (230 psig)
Flow	110 g/s
On-line Oper.Before Regen.	24 hr
Regeneration Cycle	< 12 hr
Inlet Press.	7 bar (102 psi)
Outlet Press.	6 bar (87 psi)
Adsorber	Charcoal 102 kg (225 lb)
Getter	
Unit #	G-5000
Manufacturer	Ergenics, Inc.
Material Type	St 502 Zirconium
Unit #	G-5001
Manufacturer	Ergenics, Inc.
Material Type	Activated Charcoal
Filter	
Unit #	F-5000
Manufacturer	CPC
Design Temp.	77 / 339 K (-320 / 150°F)
Design Press.	11.3 bar (150 psig) / Full Vac.
Nominal Filtration	10 micron
Unit #	F-5001
Manufacturer	CPC
Design Temp.	77 / 400 K (-320 / 260°F)
Design Press.	11.3 bar (150 psig) / Full Vac.
Nominal Filtration	5 micron

Skid #50 CCWP, cont.

Unit #	F-5002
Manufacturer	CPC
Design Temp.	77 / 339 K (-320 / 150°F)
Design Press.	139 bar (2,000 psig) / Full Vac.
Nominal Filtration	2 micron

Skid #52 CCWP REGENERATION

Drawing #	SCI-0-52-001
Operating Procedure Unit	29
Location	ASST. Service Building
Function	Warmup and cooldown of CCWP adsorber bed and activation of carbon in adsorber bed.
Skid Dimensions	
Length	3.2 m (126 in)
Width	2.59 m (102 in)
Gas Heaters	
Unit #	HTR-5201
National Board	48
Year	1991
Manufacturer	Watlow / Process System Inc.
Manuf. Serial	T7O6-lAlD4-1
Type	Incoloy Elements
Material	304 Stainless Steel
MAWP @ 422 K (300°F)	13 bar (175 psig)
Design Press.	13 bar (175 psig) / Full Vac.
DesignTemp.	422 K (300°F)
Power	5 kill, 480 V, 3 ø, wye
Unit #	HTR-5202
Manufacturer.	Thermax Inc.
Manuf.Model	TF208HF-P8-V ser. C-16-1
Type	Ambient Air Fin
Material	Aluminum
Design Press.	13 bar (175 psig)
Design Temp.	77 / 422 K (-320 / 300°F)
Gas Blower	C-5200
Manufacturer	Lamson
Material	Cast Iron / Ductile Iron
Design Temp.	422 K (300°F)
Design Press.	2.7 bar (25 psig)
Flow	119 m3/ hr (70 acmf)
Pressure Change	138 mbar (2 psi)
Strainer	STR-5201
Manufacturer	Mueller Stream Specialty
Type	100 Mesh
Year	1991
MAWP @ 311 K (100°F)	19.7 bar (285 psi)
Design Press.	13 bar (175 psig)
Design Temp.	233 / 339 K (-40 / 150°F)
Electric Motor	EM-5200
Manufacturer	Toshiba
Power	3 hp, 460 V,3ø

Skid #53 CCWP DEHYDRATION

Drawing #	SC1-0-53-001
Operating Procedure Unit	30
Location	ASST. Service Building
Function	Dehydrate helium stream returning from CCWP to compressors.
Skid Dimensions	
Length	4.88 m (16 ft)
Width	1.68 m (66 in)
Mol.Sieve Adsorber	ADS-530OA/B
National Board	907(A) 910 (B)
Year	1991
Manufacturer	Process Systems International Inc.
Material	Stainless Steel
Length	2133 mm (7 ft)
Diameter	609 mm (24 in)
MAWP @ 600 K (620°F)	9.6 bar (125 psig)
Design Press.	9.6 bar (125 psig) / Full Vac.
Design Temp.	600 K (620°F)
Capacity	
Coalescer	CLS-5301A/B
National Board	916 (A) 913 (B)
Year	1991
Manufacturer	Process Systems International Inc.
Type	Water Droplet Separator
Material	Stainless Steel
MAWP @ 339 K (150°F)	11.3 bar (150 psig)
Design Press.	13 bar (175 psig) / Full Vac.
Design Temp.	339 K (150°F)
Face Velocity	
Efficiency	
Filter	F-5301 A/B
National Board	41591 (A) 41593 (B)
Year	1991
Manufacturer	Dollinger
Material	Stainless Steel
MAWP @ 339 K (150°F)	12 bar (175 psi)
Design Press.	13 bar (175 psig) / Full Vac.
Design Temp.	339 K (150°F)
Components Limit Temp.	291 K (650°F)
Nominal Filtration	3 micron

Skid #53 CCWP DEHYDRATION, cont.

GN2 Heater	HTR-5306
National Board	35
Year	1991
Manufacturer	Watlow / Process Systems Inc.
MAWP @ 616 K (650°F)	8.6 bar (125 psi)
Design Press.	9.6 bar (125 psig)
Design Temp.	617 K (650°F)
Power	5 kW, 480 V, 3ø, 60 Hz
Heater	HTR-5300
National Board	32
Year	1991
Manufacturer	Watlow / Process Systems Inc.
Material	340 Stainless Steel
MAWP@	12 bar (175 psi) @ 477 K (400°F)
Design Press.	13 bar (175 psig) / Full Vac.
Design Temp.	77 / 477 K (-320 / 400°F)
Power	145 kW, 480 V, 3ø, 60 Hz
Strainer	STR-5300
Manufacturer	Mueller Stream Specialty
Year	1991
MAWP @ 311 K (100°F)	19.7 bar (285 psi)
Design Press.	11.4 bar (150 psig)
Design Temp.	339 K (150°F)
Type	30 Mesh

Skid #54 CCWP COMPRESSOR

Drawing #	SCl-0-54-001
Operating Procedure Unit	31
Location	ASST. / N-15 compressor building
Function	Compress helium recieved from CCWP return header.
Skid Dimensions:	
Length	3.35 m (11 ft)
Width	1.52 m (5 ft)
Process Conditions:	
Pressure In	2 bar (29 psi)
Pressure Out	7 bar (102 psi)
Temperature In	300 K
Temperature Out	300 K
Flow Required	55 g/s
Flow Max.	110 g/s
Brake Horsepower @Req'd Flow	
Brake horsepower @Max. Flow	
Oil Type:	Ucon LB-170
Vapor Pressure After Processing	51 mbar @ 373-393 K (200-250°F)
Viscosity:	170 SUS @ 311 K (100°F)
Characteristics:	water-white to light yellow color; no odor. SEE MSD
Compressor	C-5401
Manufacturer	Sullair
Type	Rotary Screw
Model	C16LA
Oil Separator	V-5401
National Board	489356
Year	1991
Manufacturer	Manchester
Volume	348 liter (92 gal)
MAWP @ 394 K (250°F)	10.3 bar (150 psi)
Min. Design Temp. @10.3 bar (150psi)	244 K (-200F)
Type	Three Stage w/ Oil Heater
Carryover	<10 ppm (By Weight)

Skid #54 CCWP COMPRESSOR, cont.

Aftercooler	HX-5401
National Board #	34615
Manufacturer	Basco
Oil Cooler	HX-5402
National Board #	34613
Manufacturer	American Precision
Watts	
Heater	HTR-5406
Function	Oil Heater
Manufacturer	HOTWATT
Power	500 W Heater 60HZ / 120V
Oil Pump	P-5417
Manufacturer	TUTHILL
Pressure Flow	
Electric Motors:	
Unit #	EM-5401
Function	drive compressor
Manufacturer	Reliance Electric Co.
Power	125 hp, 3570 rpm, 460 V, 1.37 amp, 60 Hz, 3ø
Service Factor	1.2
Unit #	EM-5402
Function	drive comp. slide valve
Manufacturer	RCS
Voltage	115 V
Unit #	EM-5417
Function	drive pump P-5417
Manufacturer	Franklin
Power	3/4 hp, 115 V

Skid #56 CCWP OIL REMOVAL

Drawing #	SC1-0-56-001
Operating Procedure Unit	31
Location	Outside compressor building
Function	Remove 98-99% of oil in helium.
Skid Dimensions	
Length	3.46 m (11 ft - 4 in)
Width 2.36 m (7 ft - 9 in)	

Coalescers

Units #	CLS-5600/5601/5602/5603
National Board	881 (0), 884 (1), 887 (2), 890 (3)
Year	1991
Manufacturer	Process Systems International Inc.
Type:	Single Coalescing Element.
Face Velocity:	< 5 cm/s
MAWP @ 339 K (150°F)	22 bar (300 psig)
MAWP @ 339 K (150°F)	21.7 bar (300 psig)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	339 K (150°F)
Operating Pressure	17.2 bar (235 psig)

Adsorber

	ADS-560OA/B
National Board	863 (A), 866 (B)
Year	1991
Manufacturer	Process Systems International Inc.
Type	Carbon Bed
MAWP @ 422 K (300°F)	21.7 bar (300 psig)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	339 K (150°F)
Operating Pressure	17.2 bar (235 psig)
Operating Life @ Full Flow Rate	Two Year
Adsorbent	Charcoal
Number Of Stages	1
Impurities At Outlet	<1ppb oil

Filter

	F-5601-5604
Manufacturer	Koch
Type	Coalsecer SCI-4-002
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	339 K (150°F)
Nominal Retention	40 micron

Filter

	F-560OA/B
National Board	41531(A), 41533 (B)
Year	1991
Manufacturer	Dollinger
Type	Element Polyester-99
Nominal Retention	5 micron
MAWP @ 339 K (150°F)	20.7 bar (300 psi)
Design Press.	21.7 bar (300 psig) / Full Vac.
Design Temp.	339 K (150°F)

Skid #70 NITROGEN DEWAR

Drawing #	SCl-0-70-001
Operating Procedure Unit	35
Location	ASST. outside R/L building
Function	Storage of liquid nitrogen.
LN2 Vaporizer Skid	S-7000
Inlet	LN2 @ 3.7 bar (54 psi
Outlet	GN2 @ 3 bar (44 psi) & 300 K (80°F)
Flow	195 g/s
Electric Trim Heater	HTR-7004
Manufacturer	Thermax
Power	20 kW 480 V, 3ø, 60 Hz, 24 amp
Design Pressure	13.1 bar (175 psig)
Design Temp.	227 / 339 K (-50 / 150°F)
Ambient Air Vaporizers	HTR-7003 A/B
Type	Ambient Air Fin
Manufacturer	Thermax
Material	Aluminum
Design Pressure	13.1 bar (175 psig)
Design Temp.	77 / 339 K (-320 / 150°F)
LN2 Storage Assembly	S-7001
Strainers	STR-7031 / 7032
Manufacturer.	Process Engineering Inc.
Size	100 mesh
Pressure Building Vaporizer	HTR-7002
Type	Ambient Air Fin
Manufacturer	Process Engineering Inc.
Design Press.	13.1 bar (175 psig)
Design Temp.	77 / 339 K (-320 / 150°F)
Pressure Vessel	V-7001
National Board	9617
Year	1991
Material	N/A
Volume	75,000 liter (19812 gal)
Max. Weight of Contents	60,633 kg (133,672 lb)
MAWP @ 311K(100°F)	w / ext.vac @ 5 bar (58 psig)
Design Temp.	77 / 339 K (-320 / 150°F)
Design Press.	5 bar (57.8 psig)
Refrigeration	905 g/s LN2
Vaporized	195 g/s LN2
Mechanical Safety Relief	5 bar (57.8 psig)

Skid #84 INSTRUMENT AIR

Drawing #	SCl-0-84-001
Operating Procedure Unit	37
Location	ASST. Service Building
Function	Provide clean dry air for operation of all plant pneumatic instruments and valves.
Skid Dimensions	
Length	5.5 m (18ft)
Height	1.37 m (4ft - 6in)
Operating Pressure	8.6 bar (110 psig)
Compressors 1, 2	C-8100,C-8200
Manufacturer	Ingersoll Rand
Type	Rotary Screw SSR XP25U
Mode	Parallel Lead Lag
FlowRate	129 m3/hr (76 acfm)
Pressure	13 bar (175 psig)
Aftercoolers:	HX-8400,HX-8401
Manufacturer	Basco
Coalescing Prefilters:	CLS-8400 A/B
Type	Coalescing with Automatic Drain
Manufacturer	Ingersoll Rand
Max. Inlet Press.	18.2 bar (250 psig)
Max. Inlet Temp.	322 K (1200°F)
Max. Flow	300 scfm
D.O.P. Efficiency	99.9999%
Compressed Air Dryer:	ADS-8300 A/B
National Board	87415F / 87416F
Type	Dual Bed, Pressure Swing, and Regenerative
Year	1992
MAWP @ 339 K (150°F)	17.2 bar (250 psi)
Min Design Temp.@17.2 bar (250 psi)	244 K (-20°F)
Manufacturer	Brunner Engr. and Mfg. Inc.
Particulate After Filters:	F-8401 A/B
Type	Particulate
Manufacturer	Ingersoll Rand
Max. Inlet Press.	18.2 bar (250 psig)
Max. Inlet Temp.	322 K (120°F)
Max. Flow	300 scfm
D.O.P. Efficiency	99.95%

Skid #84 INSTRUMENT AIR, cont.

Carbon Adsorbers:	F-8402 A/B
Type	Charcoal
Manufacturer	Ingersoll Rand
Max. Inlet Press.	18.2 bar (250 psig)
Max. Inlet Temp.	339 K (150°F)
Max. Flow	220 scfm
Air Receiver Tank:	V-8401
Nat. B.D.#	2788-G
Year	1991
Manufacturer	Brunner Engr. and Mfg. Inc.
Material	Carbon Steel
MAWP @ 505 K (450°F)	13.8 bar (200 psi)
Design Press.	14.8 bar (200 psig)
Design Temp.	339 K (150°F)
Volume	

Skid #91 OIL PROCESSING SYSTEM

Drawing #	SC1-0-91 -001
Operating Procedure Unit	
Location	Compressor building
Function	Remove water and light hydrocarbon impurities from synthetic oil (UCON LB 170X).
Skid Dimensions:	
Length	3.66 m (12 ft)
Width	2.44 m (8 ft)
Oil Processing Vessel:	V-9102
National Board	none
Year	1991
Manufacturer	Process Systems International Inc.
Material	Carbon Steel
MAWP @ 422 K (300°F)	1.7 bar (10 psig)
Design Press.	Full Vac. / 1.7 bar (10 psig)
Design Temp.	422 K (300°F)
Operating Pressure	Full Vac.
Capacity	422 liter (110 gal)
Clean Oil Storage Vessel:	V-9106
National Board	none
Year	1991
Manufacturer	Process Systems International
Material	Carbon Steel
MAWP @ 422 K (300°F)	1.7 bar (10 psig)
Design Press.	Full Vac. / 1.7 bar (10 psig)
Design Temp.	422 K (300°F)
Operating Pressure	1.4 bar (5 psig)
Capacity	960 liter (250 gal)
Pumps	
Unit #	P-9101
Function	Recirculate and atomize oil
Manufacturer	U.S. Electrical Motors
Flow Rate	1.26 liter / s (20 gal/m)
Pressure	4.5 bar (50 psig)
Unit #	P-9107
Function	Discharge oil to remote storage or equipment.
Manufacturer	Magnetek
Flow Rate	0.32 liter/s (5 gal/m)
Pressure	15 bar (200 psig)

Skid #91 OIL PROCESSING SYSTEM, cont.

Roughing Pump	P-9105
Manufacturer	Leybold
Type	2 Stage Rotary Piston
Flow Rate	100 m3/h (68 cfm)
Ultimate Pressure	< 1.5xlo-4 mmhg
Carbon Adsorber	ADS-9104
Manufacturer	Balston
Maximum Pressure	18 bar (250 psig)
Molecular Sieve	ADS-9105
Manufacturer	Balston
Maximum Pressure	18 bar (250 psig)
Electric Motors	
Unit #	EM-9101
Function	Drive pump P-9101
Manufacturer	U.S. Electrical Motors
Power	1 1/2 hp, 1160 rpm, 230 / 460 V, 3ø, 60Hz
Unit #	EM-9105
Function	Drive roughing pump P-9105
Manufacturer	U.S. Electrical Motors
Power	5 hp, 1430 / 1745 rpm, 200 / 230 / 460 V, 3ø,50/60 Hz
Unit #	EM-9107
Function	Drive pump P-9107
Manufacturer	Magnetek Century Electric
Power	2 hp, 1750 rpm, 480 V, 3ø, 60 Hz
Electric Heaters	
Unit #	HTR-9102
Function	Heat oil in processing drum
Manufacturer	Watlow Industries
Power	10 kw, 480 V, 3ø, 60 Hz
Unit #	HTR-9106
Function	Keep oil viscosity low for availability to
Manufacturer	Watlow Industries
Power	1.1 kw, 480 V, 3ø, 60 Hz

Skid #91 OIL PROCESSING SYSTEM, cont.

Spray Nozzle	SP-9102
Orifice Size	1/2
Level Control	LS-91 02/91 06
Manufacturer	Magnetrol International
Power	120 / 240 AC / 115 / 230 DC V, 7/6.5/7/5 Amps, 350 / 360 VA, 1/4, 1/2,1/2,1/2hp
Pressure	20 bar (285 psi) @ 311 K (100,F)
Min. Sp. Gr.	0.90
LN2 Cold Trap	E-9104
Manufacturer	Process Systems International

Inner Vessel

National Board	none
Year	19 91
MAWP @ 339 K (150°F)	2 bar (14 psig)
Min. Design Temp.@ 2 bar (14 psig)	78 K (-320°F)
Operating Pressure @ 78 K (-320°F)	1.4 bar (5 psig)

Outer Vessel

National Board	none
Year	1.991
MAWP @ 339 K (150°F)	2 bar (14 psig)
Min. Design Temp.@ 2 bar (14 psig)	258 K (50°F)
Operating Pressure @ 294 K (70°F)	Full Vac.

Skid #92 GAS ANALYZER

Drawing #	SCl-0-92-001
Operating Procedure Unit	1
Location	ASST. / N-15 compressor building
Function	Measure different samples points for impurities within the plant and associated equipment.
Analyzer	
Manufacturer	Sulzer
Type	Arc Cell
Modes	N2, H20, Hydro-Carbons
Min. Design Press.	2 bar (29 psi)
Teflon Membrane Pump	C-9200 A,B,C,D
Manufacturer:	Sulzer
# Of Heads	4
Min. Rate	0.010 g/s @ 3.5 bar (50.8 psi) diff.
Electric Motor	EM-9200
Power	120 V, 60 Hz, 1/2 hp

PLAN "B"
Data Sheets

Prepared by CCI as part of the system documentation

Edited by
S. Abramovich

1.0 COMPRESSOR MODULE

Manufacturer	Sullair
Model No.	C25MA704-48-500
Type	Oil-Flooded Rotary Screw
Mounting	Structural Steel Skid
Dimensions	306.25" L * 61.50"W * 121.25" H

Auxiliaries:

Oil Separator
Oil Cooler
Gas Aftercooler

Oil	UCON Type
Vapor Pressure @ 100 F°	$<10^{-4}$ torr
Viscosity	SSU
Characteristics	Moderately Hygroscropic

Process Conditions:

Pressure In	14.7 psia (1 ata)
Pressure Out	264.7 psia (18 ata)
Temperature In	70F°
Temperature Out	90F°
Flow Required g/s	70
Flow Actual g/s	73.6 -0% +3%
Brake Horsepower, @ 70 g/s	461
Brake Horsepower, @ 73.6 g/s	475

Driver:

Horsepower	500
Electric	4160 volts, 3 phase, 60 hz
Service Factor	1.15

2.0 OIL REMOVAL AND GAS MANAGEMENT MODULE

Reference Drawing 20203-D

Oil Particulate Coalescer:	
Manufacturer	CCI
No. of Stages	2
Stage #1 Elements:	5
Type	Balston DX
Efficiency	90% of particles larger than 0.6 micron
Stage #2 Elements:	5
Type	Balston BX
Efficiency	99.99% of particles larger than 0.6 micron
Oil Vapor Adsorber:	
Manufacturer	CCI
No. of Stages	One
Adsorber	Activated Carbon
Nominal Size	3mm * 3mm
Type	Sorba-norit
Dust Filter:	
Manufacturer	
Model	IFM-335108
Nominal Retention	3 Micron

3.0 REFRIGERATOR COLD BOX

Manufacturer:	CCI
Type:	Horizontal Cylinder Single Wall Vacuum Insulated
Material:	Carbon Steel
Dimensions:	
	Length - 11' - 10" Width - 4' - 6" Height - 11' - 2"
Internal Equipment:	
Heat Exchangers	Nine wound finned-tube heat exchangers in three columns. a. I, IA, and II b. III, IV, and V c. VI, VII, and VIII
80K Adsorber:	
Diameter	6"
Adsorbent	Activated Carbon
Capacity	45 lbs.
20K Adsorber:	
Diameter	4"
Adsorbent	Activated Carbon
Capacity	15 lbs.
Warm Expander:	See 4.0
Cold Expander:	See 4.0

4.0 RECIPROCATING HELIUM EXPANSION ENGINE

Model	CCI-308X300
Pressure:	20 ata (294 psia)
Bore:	3.5 in. (8.89 cm)
Stroke:	3.0 in. (7.62 cm)
Displacement	28.86 $in.^3$ (473 cc)
Cylinders:	1
Engine Speed:	440 rpm max.
Valve Tappet Clearance :	Inlet - .006 in. (cold) Exhaust - .006 in. (cold)
Rotation:	Counter-Clockwise facing engine flywheel
Valve Timing :	Inlet starts to open 1 after TDC; Exhaust starts to open 1° before BDC
Inlet Cam*:	90°
Exhaust Cam :	170°

*The inlet cam is easily removed and may be exchanged with cams of varing profiles to suit operating conditions.

Top dead center (TDC) is defined as that position when the piston is closest to the cylinder head.

Bottom dead center (BDC) is 180 degrees opposite of TDC.

High Speed Alarm / Trip	418 rpm (10 min. delay)
High Speed Trip	440 rpm
Low Speed Alarm / Trip	22 rpm

5.0 SPECIFICATIONS COLD GAS PUMP

Model	CO. CCI-CGP406X300
Bore:	4.375 IN (11.113 cm)
Stroke:	3.000 in. (7.62 cm)
Cylinder:	One (1)
Piston Area:	15.03 in-2 (97 cm^2)
Displacement:	45.1 $in.^3$ (739 cc)
Suction Pressure:	0.3 ata (min.)
Discharge Pressure:	1.3 ata
Pump Speed:	Variable as Follows:
	50 to 470 rpm with 3.1 in. P.D. Pulley (3.71: 1 pulley ratio)
Motor:	3 HP DC TEFC motor, 180 VDC armature, permanent magnet field, 1750 rpm
Speed Controller:	240 V, 60 Hz, 1 Phase (input) for 3 HP DC motor run, stop, variable speed, local control

6.0 AUXILIARY COLD BOX

Manufacturer:	CCI
Type:	Vertical cylindrical single wall evacuated
Diameter:	34"
Flange Diameter:	60"
Height (shipping)	100 1/2"
LN_2 Shield	copper, 48" diameter 84" high

Internal:

Pre-cooler
Sub-cooler
Cold Vacuum Pump (see 5.0)

7.0 Ambient Heater "A"

Service	Reheat helium returning to compressor suction during cooldown or defrost.
Manufacturer	Cryogenic Experts, Inc.
Model	A12A - GH
Type	Ambient Gas Heater
Fluid	Gaseous Helium
Flow	200 lbs per hour (19343 scfh)
Inlet Connection	3" 150 lb ansi flange
Outlet Connection	Same
Fluid Passages	6063 Aluminum
Inlet Temperature	-320 degrees F
Outlet Temperature	70 degrees F
MAWP	275 psig
Pressure Drop	Less than .2 psig - Calculated is .13 psig
Air Temperature	90 degrees F
Heat Transfer Rate	
Clean	4 btu / sq ft / degree F
Corroded	2 btu / sq ft / degree F
Surface Area	
Internal	28.14 sq. ft.
External	436.8 sq. ft.
MAWP	275 psig
Cleaning	For Oxygen service per GS28
Shipping Weight	480 Lbs. - Approx.
Dimensions	28.5" * 37.75" * 108" tall

8.0 Ambient Heater "B"

Service	Reheat helium returning to compressor suction from dewar.
Manufacturer	Cryogenic Experts, Inc.
Model	A4A - GH
Type	Ambient Gas Heater
Fluid	Gaseous Helium
Flow	46.7 lbs. per hour (4516 scfh)
Inlet Connection	1.5" 150 lb ansi flange
Outlet Connection	Same
Fluid Passages	6063 Aluminum
Inlet Temperature	-450 degrees F
Outlet Temperature	70 degrees F
MAWP	275 psig
Pressure Drop	Less than .2 psig - Calculated is .04 psig
Air Temperature	90 degrees F
Heat Transfer Rate	
Clean	4 btu / sq ft / degree F
Corroded	2 btu / sq ft / degree F
Surface Area	
Internal	9.38 sq. ft.
External	145.6 sq. ft.
MAWP	275 psig
Cleaning	For Oxygen service per GS38
Shipping Weight	480 Lbs - Approx
Dimensions	20" x 20" x 108" tall

9.0 Liquid Helium Storage Tank

Number required	One
Manufacturer	Cryofab, Inc.
Model	CMSH-5000
Type	Vertical, Top Flange
Dimensions	94" dia. x 101" OAH
Capacity	5000 liters liquid
Approx.Weight	
empty	6000 lbs. (2700 kg)
full	7300 lbs. (3100 kg)
Insulation	Vacuum, Super-insulation, heat-stationed neck
Heat Leak	1.0% of total liquid capacity per dry (250 g/hr. or 1.2 watts)
Normal Operating Press.	(1.30 bara)
Maximum Operating Press.	15 psig (2.03 bara)
Gas Ullage (full)	10%
Heater	400 watts - at 120V, 1 ph 60 hz.
Heater Model	CIR -3020
Manufacturer	Chromolox

10.0 GASEOUS NITROGEN GENERATOR

Manufacturer:	International Cryogenics, Inc.
Type:	Vertical Vacuum-Jacketed, Super-Insulated LN2 Dewar
Model:	IC Model No. 22-8929 (NGG-250)
Dimensions:	69.22 cm O.D. x 185.42 cm High[1] (27.25" O.D. X 73 " High[2])
Capacity	250 Liters
Materials of construction	
Inner Vessel	Type 304 Stainless Steel
Outer Vessel	Type 304 Stainless Steel
MAWP[3]	4 Bar (58 psig)
Relief Valves:	
Primary	ASME Coded 58 psig setpoint
Secondary	5.1 atm burst disk (75 psig)
Connections:	
LN2 Inlet	CVI 1/2 " pipe female bayonet
GN2 Outlet	CVI 1 1/2 " pipe female bayonet
LN2 Outlet	CVI 1/2 " pipe female bayonet
Vent Valve	Manual 1/2" ball valve
Electrical:	Two (2) 2400 Watt, 240 VAC Heaters One remote mounted control panel
Instrumentation:	One High Liquid Level Probe
	One Low Liquid Level Probe
	One Low Liquid Level Alarm Probe
	One 2 1/2" Dia. Pressure Gauge (0-100 psig range)

1 To top of bayonet flanges
2 To top of bayonet flanges
3 Maximum Allowable Working Pressure

11.0 Liquid Nitrogen Dewar

Manufacturer	Taylor-Wharton
Model	TL- 11000
Type	Vertical Vacuum-Powder Insulated Dewar
Nationasl Board NO.	305229
Dimensions	309.88 cm Dia. x 963 cm High (10' 2" Dia. x 3l' 7" High)
Capacity	41,639 l (11,000 gal)
Weight:	
Empty	151,239 N (34,000 lb)
Full	491,528 N (110,500 lb)
Working Pressure	2 atm (30 psig)
$MAWP_1$ @ 232"C (200 psig @ 4500F)	13.6 atm
$MDMT_2$ @ 13.6 atm (-4"F @ 200 psig)	-200C
Gages	
DIFF. Pressure Indicator	Barton Model 227
Range	0-747 mm Hg (0-400 in H20)

1 Maximum Allowable Working Pressure
2 Minimum Design Metal Temperature

12.0 1,000 Gallon Helium Gas Buffer Tank

Manufacturer	Trinity Industries Inc.
Type	Horizontal Non-Corrosive Service Tank
Manf. Serial NO.	68430-68436
National Board NO.	68430-68436
Dimensions	104 cm 0D x 491.5 cm OAL (40.96" 0D x 193.5" OAL)
Capacity	3,785 1 (1,000 Gal)
Empty Weight	10,230 N (2,300 lb)
$MAWP_1$	17 atm @ 52"C (250 psi @ 125"F)
$MDMT_2$	-200C @ 17 psi (-4"F @ 250 psi)
Test Pressure	34 atm Hydrostatic (500 psi)
Relief Valve Pressure	17 atm (250 psig)
Shell Thickness	6.8834 mm (0.271")
Head Thickness	5.842 mm (0.230")
Material Spec. NO.	SA285C

'Maximum Allowable Working Pressure
2Minimum Design Metal Temperature

13.0 18,000 Gallon Helium Gas Storage Tank

Manufacturer	Trinity Industries Inc.
Type	Horizontal Non-Corrosive Service Tank
Manf. Serial No.	Not Available
National Board No.	Not Available
Dimensions	277.74 cm 0D x 12.48 cm OAL (109.346" 0D x 491.375" OAL)
Capacity	68,137 l (18,000 Gal)
Empty Weight	145,812 N (32,780 lb)
$MAWP_1$ @ 550°C (275 Psig @ 131°F)	18.7 Atm
$MDMT_2$ @ 18.7 atm (5°F @ 275 psig)	-15 °C
$MDMT_2$ External @ 1 atm Extemal (5°F @ 15 psig)	- 15 °C
Test Pressure	34 atm Hydrostatic (500 psi)
Relief Valve Pressure	18.7 atm (275 psig)
Shell Thickness	18.82 mm (0.741")
Head Thickness	10.78 mm (0.425")
Material Spec. No.	SA612 Nominal (Shell and Heads)

1 Maximum Allowable Working Pressure
2 Minimum Design Working Pressure

14.0 35,000 Gallon Helium Gas Storage Tank

Manufacturer	Trinity Industries Inc.
Type	Horizontal Non-Corrosive Service Tank
Manf. Serlal No.	118869
National Board No.	221
Dimensions	334.92 cm OD x 1657 cm OAL
	(131.875" OD x 652.375" OAL
Capacity	132,489 1 (35,000 gal)
Empty Weight	287,355 N (64,600 lb)
$MAWP_1$ @ 55 °C (275 Psig @ 131 °F)	18.7 atm
$MDMT_2$ @ 18.7 atm (5 °F @ 275 Psig)	-15 °C
$MDMT_2$ External @ 1 atm Extemal (5 °F @ 15 Psig)	-15 °C
Test Pressure	28 atm Hydrostatic (413 psi)
Relief Valve Pressure	18.7 atm (275 psig)
Shell Thickness	22.68 mm (0.893")
Head Thickness	11.84 mm (0.466")
Material Spec. No.	SA612 Normal (Shell and Heads)

1 Maximum Allowable Working Pressure
2 Minimum Design Metal Temperature

15.0 Cooling Tower

Manufacturer		Heatcraft Inc.
Model		GPT-115
Overall Drensions:		
	Width:	251.5 cm (99")
	Length:	137.2 cm (54")
	Height:	251.5 cm (99")
Weight:		
	Shipping:	7,184 N (1,615 lb)
	Wet:	16,658 N (3,745 lb)
Fan Motor:	Type	TEFC
	Hp	7.5
	Rpm	1750
	Amps	22/21/10.5
	Phase	3
	Volts	200-230/460
Nominal Coolant Flowrate		1306 l/min (345 Gpm)
Min Reqd Coolant Flowrate		473 l/min (125 Gpm)
Inlet Temp		40 °c (104 °F)
Outlet Temp		30 °c (85 °F)
Makeup Water Approx.		9.5 l/min (2.5 gpm)
Blowdown Rate Approx.		3.75 l/min (1.0 gpm)
Total Makeup Rate Approx.		13.25 l/min (3.5 gpm)
Flowrate		963 m3/min (34,000 cfm)

16.0 Water Pump

Manufacturer:	Ben & Gosset
Type	Frame Mounted Centrifugal
Model	1510-2AC
Serial No.	1699737
Nema[1] Frame Designation	182T
Dimensions[2]	
Length	78.75 cm (31")
Width	37.1475 cm (14.625")
Height	41.275 cm (16.25")
Shipping Weight[2]	756 N (170 lb)
Rotation	Clockwise[3]
Nominal RPM	3500
Nominal Hp	7.5
Expected Flow Rate	757 l/min (200 gpm)
Total Head[4,5]	34 m (110 Ft)
MAWP[6]	18.7 Atm (175 psi)
NPSHR[7]	3 m (10 ft)
Lubrication Schedule	Every 2500 Hrs. or Six Months
Lubricant	#2 Lithium Base Petroleum Grease

1 National Electrical Manufacturing Association
2 Complete Pump and Motor assembly
3 When viewed from back of the motor
4 According to an expected flow of 757 l/min (200 gpm)
5 Pump curves provided in figure 1 for reference
6 Maximum Allowable Working Pressure
7 Net Positive Suction Head Required

17.0 Water Pump Motor

Manufacturer	Baldor Industries
Catalog No.	M3616T
$NEMA_1$ Designation	184T
Dimensions	See Pump Data Sheet for complete pump and motor assembly dimensions
Dimensions	See Pump Data Sheet for complete pump and motor assembly weight
Horsepower	7.5 Hp
Rpm	3450
Volts	208-230/460
Amps	19-17.2/8.6
Hertz	60
Phase	3
Class	F
Service Factor	1.0
$NEMA_1$ Nominal Efficiency	87.5 %
$NEMA_1$ Power Factor	94 %
Temperature Rise Rating	40C AMB-CONT (40 °C Above Ambient)

1 National Electrical Manufacturing Association

18.0 Duplex Filter

Manufacturer	Tate Andale Canada Inc.
Manf. Serial No.	4829
Dimensions:	
Height	121.92 cm (48")
Width	60.96 cm (24")
Length	137.16 cm (54")
MAWP	
@ 66 °C (150 psi @ 150 °F)	10.2 atm
Minimum Design Metal Temp	
@ 10.2 atm (20 °F @ 150 psi)	-7 °C

19.0 Instrument Air Compressor

Manufacturer		Speedaire
Type		Two Stage, Four cylinder Air compressor
Model / Serial NO.		5Z402 / 03139IL- 650134
Overall Dimensions		190.5 cm x 66 cm x 145 cm tall (75" x 26" x 57")
Pressure:		
	Cut-in point	9.2 atm (135 psi)--(Factory Set)
	Cut-out point	12 atm (175 psi)--(Factory Set)
	$MAWP_1$	12 atm (175 psi)
Delivery Rate		
	@ Low Pressure	1.217 m3/min (43 cfm)
	@ 12 atm (175 psi)	0.962 m3/min (34.0 cfm)
ASME Air Tank Capacity		454 1 (120 gal)
Horsepower		10
Number Of Cylinders		4
Stage 1 Cyl. Dimensions		4 3/4" Bore, 3" Stroke
Stage 2 Cyl. Drmensions		2 1/2" Bore, 3" Stroke
Rotation		Counterclockwise2
Maintenance:		
	Daily	Check oil level. Drain water from air tank.
	WEEKLY	Check inlet filters. Check drive belts. Check safety valve manually for sticking.
	90 DAY/500 HR3	Change oil in crankcase. Clean and dust foreign material form compressor.
Lubricant:	32 TO 120°F	(SAE 30) ISO 100_4
	Below 32°F	(SAE 20) ISO 68
	Capacity	4.75 1 (5 Quarts)
	$Type_{5,6}$	Non-Detergent Napthenic Oil with foam, rust, and with foam, rust, and oxidation inhibitors
Belts:	Tension	3/8 to 1/2" deflection with normal thumb pressure
	Reorder Part #	6A157 Speedaire
Cmpressor Location		Minimum flywheel clearance of 30-35cm(12-14").7 Surrounding Air Temperature of <380C (1000F)
Service Precaution		Run for two hours without load to set rings. Check oil level before operating.

1 Maximum Allowable Working Pressure
2 While Facing Flywheel side of the pump (as shown by the arrow on the flywheel
3 90 days or 500 hrs of operation--whichever comes first.
4 Available as Model 4Z988 SAE 30 Industrial Grade Air Compressor Oil through Speedaire
5 Use of Automotive Type Engine Oil will cause carbon buildup deposits on valves and shorten the life expectancy.
6 Do not use ATF, Hydraulic Fluid, Two Cycle, Synthetic Oil, or any oil treatment products.
7 Between flywheel and wall or other airflow obstructing object.

20.0 Instrument Air Dryer

Manufacturer	Norgren
Type	Heatless Twin Desiccant Packed Towers Timer Altemation Controlled Compressed Air Dryer D50-100-0025
Model Weight	94 N (21 lb)
Overall Drensions	25.4 cm x 13.34 cm x 56.5 cm tall (10" x 5.25" x 22.25" tall)
Outlet Pressure Dewpoint	-40°C (-40°F)
Maximum Inlet Air Pressure	10.2 atm (150 psig)
Minimum Inlet Air Pressure	4.1 atm (60 psig)
Ambient Temperature Range	2 °C to 38 °C (35 °F to 100 °F)
Nominal Capacity	0.708 m3/min (25 scfm)
Instrumentation Level	6 ft power cord, purge muffler, inlet pressure gage, moisture indicators and tower pressure indicators
Electrical	60 Hz, 120V, 1 Phase, 9 watts

Tower Pressure Indicator Color Code:

Green	Toweris at line pressure in drying cycle
Black	Tower is slightly above atmospheric pressure and in regenerative cycle

Sound Level	56 dBa Running 74 dBa Switching

Materials of Construction:

Tower & Body	Aluminum
Elastomers	Nitrile & Polyurethane
Desiccant	Activated Alumina

Shuitte Valve Default	Normally Open

Air Flow Rating[1]

Inlet Flow Range	0.227 to 0.708 m3/min (8 to 25 scfm)
Outlet Flow Range	0. 173 m3/min to .263 m3/min (6.1 to 19.3 scfm)

1 Air flow ratings are determined at the conditions listed below.

Inlet Air Pressure	6.8 atm (100 psig)
Inlet Air Temperature	38°C (100°F)
Ambient Air Temp	38°C (100°F)

21 Transformer

Manufacturer		Westinghouse
Type		Single Phase
Model / Serial No.		DS-3 / J92-A0381
Overall Dimensions		57.15 cm x 50.8 cm x 111. 125 cm tall (22 1/2" x 20" x 43 3/4" tall)
Weight		1890 N (425 lb)
Enclosure		Type 2
Frame		811
Voltage:	High Low kVa	480 240/120 50
Min. Installation Clearance		15 cm (6") from any obstructions
Sound Level		50
Max Operating Ambient Temp.		400 °C (104 °F)
Temperature Rise Rating		150 °C (270 °F) AMB-CONT (150 °C Above Ambient)

22.0 Motor Control Center

Manefacturer	Westinghouse
Model	2100
Serial NO.	568711848
Overall Dimensions	40.64 cm x 101.6 cm x 228.6 cm tall (16" x 40" x 90" tall)
Weight	1112 N (250 lb)
Enclosure	Type 2
NEMA Class Type Wiring	1B
Service Voltage	480
Control Voltage	120
Amperage	600
Hertz	60
Phase	3
Motor Overload Reset Type	Manual
Service Factor	1.00
MIN. Installation Clearance	15 cm (6") rear clearance from outside walls 1.25 cm (1/2") rear clearance from inside walls 76 cm (30") front clearance from obstructions
MAX OPerating Amb Eent Temp.	40°C (104°F)
Temperature Rise Rating	50°C (90°F) AMB-CONT (50°C Above Ambient)