

# 40m Vacuum System States and Sequences

Last updated 10/24/01

## Recognized States

(Note: devices in brackets may be either open/on or closed/off in the given state)

State: All Off

Open: None

On: None

State: Chamber Open

Open: V4, V5, VM3, [VABSSCI], [VABSSCO]

On: TP1, TP2, TP3, [IPEE], [IPEV], [IPSV], [IPSE]

State: Vacuum Normal (maglev/annulus only)

Open: V1, V4, V5, VA6, VAEE, VAEV, VABS, VASV, VASE, VABSSCI,  
VABSSCO, [VM1]

On: TP1, TP2, TP3, [IPEE], [IPEV], [IPSV], [IPSE]

State: Turbopumps + Cryopump

Open: V1, V4, V5, VC1, VA6, VAEE, VAEV, VABS, VASV, VASE, VABSSCI,  
VABSSCO, [VM1]

On: TP1, TP2, TP3, CP1, [IPEE], [IPEV], [IPSV], [IPSE]

State: Turbopumps + Ion Pumps

Open: V1, V4, V5, VC1, VA6, VAEE, VAEV, VABS, VASV, VASE, VABSSCI,  
VABSSCO, VM1, VIPEE, VIPEV, VIPSV, VIPSE

On: TP1, TP2, TP3, IPEE, IPEV, IPSV, IPSE

State: Maximum Pumping Speed (all pumps running)

Open: V1, V4, V5, VC1, VA6, VAEE, VAEV, VABS, VASV, VASE, VABSSCI,  
VABSSCO, VM1, VIPEE, VIPEV, VIPSV, VIPSE

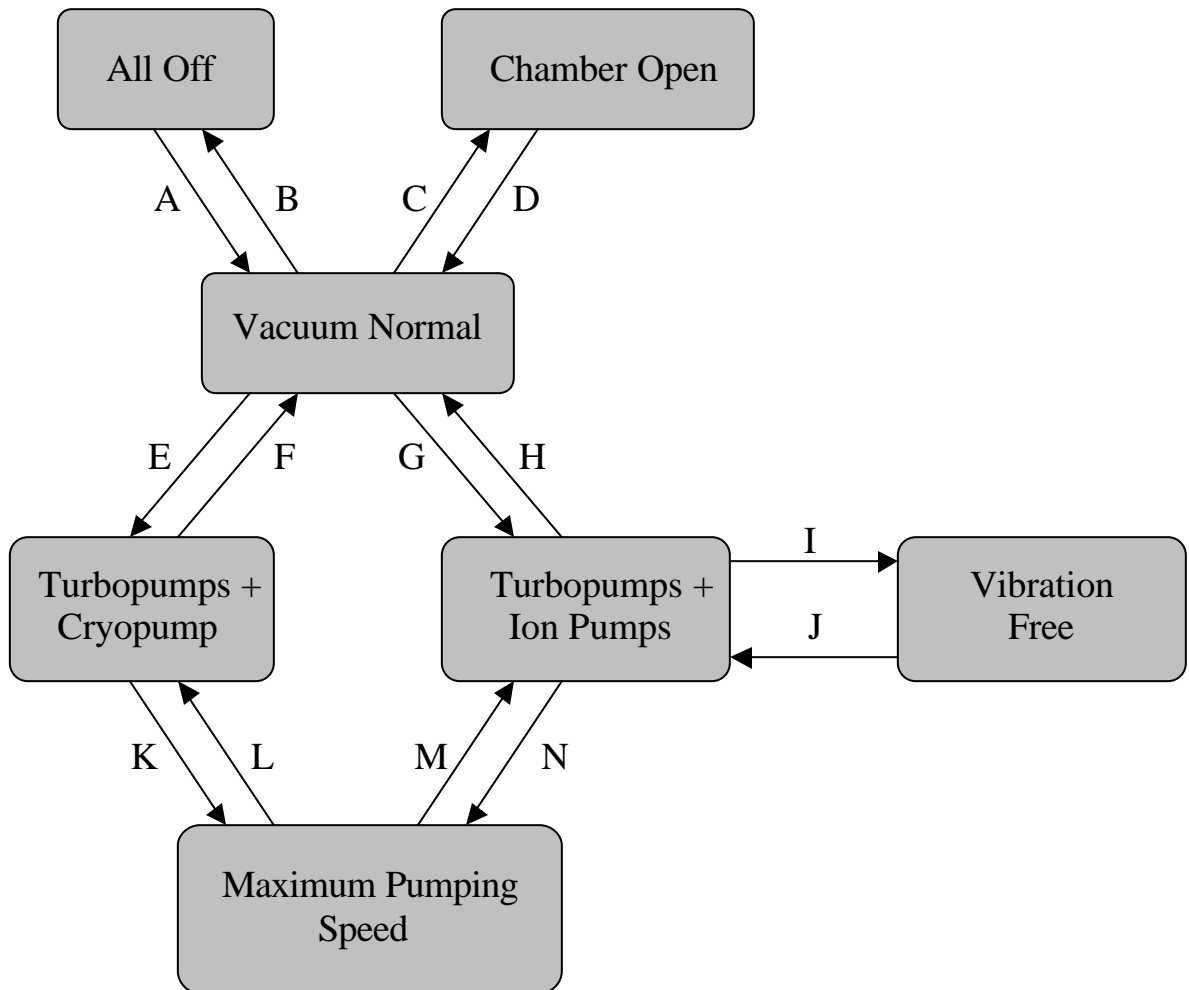
On: TP1, TP2, TP3, CP1, IPEE, IPEV, IPSV, IPSE

State: Vibration-Free (ion pumps only)

Open: VM1, VIPEE, VIPEV, VIPSV, VIPSE

On: IPEE, IPEV, IPSV, IPSE

# State Transition Diagram



## **A: ALL OFF ® VACUUM NORMAL**

A001 IPEE ON  
A002 IPEV ON  
A003 IPSV ON  
A004 IPSE ON  
A005 OPERATOR: Connect N2 cylinder to vent line  
A006 VV1 OPEN  
A007 CONDITION: Wait until P1 > 25 torr  
A008 OPERATOR: Close N2 cylinder, replace with dry air cylinder  
A009 CONDITION: Repeat until P1 = atmospheric pressure  
A010 VV1 CLOSE  
A011 V7 OPEN  
A012 CONDITION: RGA filament must be OFF.  
A013 VM3 OPEN  
A014 VA6 OPEN  
A015 TP2 ON  
A016 OPERATOR: Switch TP2 controller to STANDBY  
A017 CONDITION: Wait until TP2 rotation frequency > 950 Hz  
A018 TP3 ON  
A019 OPERATOR: Switch TP3 controller to STANDBY  
A020 CONDITION: Wait until TP3 rotation frequency > 950 Hz  
A021 V7 CLOSE  
A022 VA6 CLOSE  
A023 VM3 CLOSE  
A024 OPERATOR: Connect roughing pump line  
A025 RP1 ON  
A026 RP2 ON  
A027 RP3 ON  
A028 CONDITION: Wait until PRP < 0.35 torr  
A029 VC2 OPEN  
A030 V6 OPEN  
A031 CONDITION: Wait until P3 < 0.5 torr  
A032 V6 CLOSE  
A033 V5 OPEN  
A034 CONDITION: Wait until CC3 < 10<sup>-4</sup> torr  
A035 VC2 CLOSE  
A036 V5 CLOSE  
A037 V7 OPEN  
A038 V6 OPEN  
A039 CONDITION: Wait until P2 < 0.5 torr  
A040 V6 CLOSE  
A041 V7 CLOSE  
A042 V4 OPEN  
A043 TP1 ON  
A044 VM3 OPEN

A045 V6 OPEN  
A046 CONDITION: Wait until P3 < 0.5 torr  
A047 V6 CLOSE  
A048 VM3 CLOSE  
A049 VA6 OPEN  
A050 V6 OPEN  
A051 CONDITION: Wait until PAN < 0.5 torr  
A052 V6 CLOSE  
A053 V5 OPEN  
A054 V3 OPEN  
A055 RV1 OPEN  
A056 CONDITION: Wait until P1 < 0.5 torr (about 3 hours)  
A057 V3 CLOSE  
A058 RV1 CLOSE  
A059 VA6 CLOSE  
A060 V7 OPEN  
A061 V1 OPEN  
A062 VM1 OPEN  
A063 RP1 OFF  
A064 RP2 OFF  
A065 RP3 OFF  
A066 OPERATOR: Disconnect roughing pump line  
A067 CONDITION: Wait until P2 < 0.05 torr (about 1 hour)  
A068 V7 CLOSE  
A069 VA6 OPEN  
A070 VAEV OPEN  
A071 CONDITION: Wait until PAN < 1 torr  
A072 VAEV OPEN  
A073 CONDITION: Wait until PAN < 1 torr  
A074 VABS OPEN  
A075 CONDITION: Wait until PAN < 1 torr  
A076 VABSSCI OPEN  
A077 CONDITION: Wait until PAN < 1 torr  
A078 VABSSCO OPEN  
A079 CONDITION: Wait until PAN < 1 torr  
A080 VASV OPEN  
A081 CONDITION: Wait until PAN < 1 torr  
A082 VASE OPEN  
A083 CONDITION: If CC3 < 10<sup>-5</sup> torr, turn RGA filament ON

## **B: VACUUM NORMAL ® ALL OFF**

B001 OPERATOR: Turn RGA filament OFF  
B002 V1 CLOSE  
B003 VM1 CLOSE  
B004 V4 CLOSE  
B005 V5 CLOSE  
B006 TP1 OFF  
B007 OPERATOR: Wait until TP1 indicates "OFF" (about 8 minutes)  
B008 VA6 CLOSE  
B009 VAEE CLOSE  
B010 VAEV CLOSE  
B011 VABSSCO CLOSE  
B012 VABSSCI CLOSE  
B013 VABS CLOSE  
B014 VASV CLOSE  
B015 VASE CLOSE  
B016 TP2 OFF  
B017 TP3 OFF  
B018 OPERATOR: Make sure calibrated leaks are closed  
B019 IPEE OFF  
B020 IPEV OFF  
B021 IPSV OFF  
B022 IPSE OFF

## **C: VACUUM NORMAL ® CHAMBER OPEN**

C001 VM1 CLOSE  
C002 VM3 OPEN  
C003 V1 CLOSE  
C004 OPERATOR: Connect N2 cylinder to vent line  
C005 OPERATOR: Set regulator to 30 psi  
C006 OPERATOR: Make sure interferometer high voltages are off  
C007 VV1 OPEN  
C008 CONDITION: Wait until P1 > 25 torr  
C009 OPERATOR: Replace N2 cylinder with dry air cylinder  
C010 CONDITION: Add air cylinders until P1 = atmospheric pressure  
C011 VAEE CLOSE  
C012 VAEV CLOSE  
C013 VABS CLOSE  
C014 VASV CLOSE  
C015 VASE CLOSE  
C016 VAV\*\* OPEN (\*\* corresponds to chamber you wish to open)  
C017 CONDITION: Wait until PA\*\* = atmospheric pressure  
C018 VAV\*\* CLOSE  
C019 OPERATOR: Repeat C016-C018 for each chamber to be opened

## **D: CHAMBER OPEN ® VACUUM NORMAL**

D001 OPERATOR: Turn RGA filament OFF  
D002 VM3 CLOSE  
D003 VABSSCI CLOSE  
D004 VABSSCO CLOSE  
D005 VAEV OPEN  
D006 CONDITION: Wait until PAN < 1 torr  
D007 VAEV OPEN  
D008 CONDITION: Wait until PAN < 1 torr  
D009 VABS OPEN  
D010 CONDITION: Wait until PAN < 1 torr  
D011 VABSSCI OPEN  
D012 CONDITION: Wait until PAN < 1 torr  
D013 VABSSCO OPEN  
D014 CONDITION: Wait until PAN < 1 torr  
D015 VASV OPEN  
D016 CONDITION: Wait until PAN < 1 torr  
D017 VASE OPEN  
D018 CONDITION: Wait until PAN < 1 torr  
D019 VV1 CLOSE  
D020 OPERATOR: Connect roughing pump line  
D021 RP1 ON  
D022 RP2 ON  
D023 RP3 ON  
D024 CONDITION: Wait until PRP < 0.35 torr  
D025 V3 OPEN  
D026 RV1 OPEN  
D027 CONDITION: Wait until P1 < 0.5 torr (about 3 hours)  
D028 V3 CLOSE  
D029 RV1 CLOSE  
D030 VA6 CLOSE  
D031 V7 OPEN  
D032 V1 OPEN  
D033 RP1 OFF  
D034 RP2 OFF  
D035 RP3 OFF  
D036 OPERATOR: Disconnect roughing pump line  
D037 CONDITION: Wait until P2 < 0.05 torr (about 1 hour)  
D038 V7 CLOSE  
D039 VA6 OPEN  
D040 CONDITION: If CC3 < 10<sup>-5</sup> torr, turn RGA filament ON

## **E: VACUUM NORMAL ® TURBOPUMPS + CRYOPUMP**

E001 OPERATOR: Switch cryopump compressor and controller ON  
E002 CONDITION: Wait until CP1 reads COLD  
E003 OPERATOR: Reset CP1 interlock to turn CP1 ON  
E004 VC1 OPEN

## **F: TURBOPUMPS + CRYOPUMP ® VACUUM NORMAL**

F001 VC1 CLOSE  
F002 VC2 OPEN  
F003 OPERATOR: Switch cryopump compressor and controller OFF  
F004 CONDITION: Wait until cryopump fully warms up  
F005 CONDITION: Wait until CC3 <  $10^{-4}$  torr  
F006 VC2 CLOSE

## **G: VACUUM NORMAL ® TURBOPUMPS + ION PUMPS**

G001 CONDITION: Wait until CC1 <  $4 \cdot 10^{-6}$  torr  
G002 VIPEE OPEN  
G003 VIPEV OPEN  
G004 VIPSV OPEN  
G005 VIPSE OPEN

## **H: TURBOPUMPS + ION PUMPS ® VACUUM NORMAL**

H001 VIPEE CLOSE  
H002 VIPEV CLOSE  
H003 VIPSV CLOSE  
H004 VIPSE CLOSE

## **I: TURBOPUMPS + ION PUMPS ® VIBRATION FREE**

I001 V1 CLOSE  
I002 TP1 OFF  
I003 CONDITION: Wait until TP1 indicates OFF (about 8 minutes)  
I004 V4 CLOSE  
I005 TP2 OFF  
I006 V5 CLOSE  
I007 TP3 OFF

## **J: VIBRATION FREE ® TURBOPUMPS + ION PUMPS**

J001 TP2 OFF  
J002 OPERATOR: Switch TP2 controller to standby  
J003 CONDITION: Wait until TP2 rotation frequency > 950 Hz  
J004 TP3 ON  
J005 OPERATOR: Switch TP3 controller to standby  
J006 CONDITION: Wait until TP3 rotation frequency > 950 Hz  
J007 V4 OPEN  
J008 TP1 ON  
J009 CONDITION: Wait until TP1 indicates ON  
J010 V5 OPEN  
J011 V1 OPEN

## **K: TURBOPUMPS + CRYOPUMP ® MAXIMUM PUMPING SPEED**

K001 CONDITION: Wait until CC1 <  $4 \times 10^{-6}$  torr  
K002 VIPEE OPEN  
K003 VIPEV OPEN  
K004 VIPSV OPEN  
K005 VIPSE OPEN

## **L: MAXIMUM PUMPING SPEED ® TURBOPUMPS + CRYOPUMP**

L001 VIPEE CLOSE  
L002 VIPEV CLOSE  
L003 VIPSV CLOSE  
L004 VIPSE CLOSE

## **M: MAXIMUM PUMPING SPEED ® TURBOPUMPS + ION PUMPS**

M001 VC1 CLOSE  
M002 VC2 OPEN  
M003 OPERATOR: Switch cryopump compressor and controller OFF  
M004 CONDITION: Wait until cryopump fully warms up  
M005 CONDITION: Wait until CC3 <  $10^{-4}$  torr  
M006 VC2 CLOSE

## **N: TURBOPUMPS + ION PUMPS ® MAXIMUM PUMPING SPEED**

N001 OPERATOR: Switch cryopump compressor and controller ON  
N002 CONDITION: Wait until CP1 reads COLD  
N003 OPERATOR: Reset CP1 interlock to turn CP1 ON  
N004 VC1 OPEN

# Mark III Vacuum Schematic

