

<p>ARCS PROCEDURE</p> <p>Author: L. Jones</p>	<p>TWP/AMF INSTRUMENT CHANGEOUT/CHECKING/CALIBRATION PROCEDURE</p>	<p>PRO(CAL)-003.000</p> <p>6 June 2008 Page 1 of 20</p>
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TWP/AMF Instrument Changeout/Checking/Calibration Procedure

I. Purpose:

To describe the actions performed by the TWP/AMF technicians and the ARM support organizations in changing out and calibrating TWP and AMF equipment.

II. Cautions and Hazards:

- Follow guidelines outlined in appropriate Site Safety Plan.

III. Requirements:

- Replacement instruments
- List cal equipment

IV. Procedures – for sensors:

A. PSP (Swap out and calibration on hold until further notice)

1. TWP(Manus, Nauru, Darwin) Requirements:
 - a) 18 PSPs for swapping out 2 deployed and 1 spare for each of 3 sites.
 - b) Process:
 - ⇒ Annually – after borcal season SGP send newly calibrated PSPs back to each site.
 - ⇒ Annually – replace SKY, GRND, and spare PSPs w/calibrated units at each site and **notify mentor**.
 - ⇒ Annually – send old PSPs to SGP for calibration.
2. AMF(Main Site) Requirements:
 - a) 6 PSPs for swapping out 2 deployed and 1 spare.
 - b) Process:
 - ⇒ After calibration and before end of each deployment SGP send newly calibrated PSPs to AMF site for shipment to the next deployment.
 - ⇒ At end of each deployment remove old deployed PSPs and spare and to SGP for calibration.

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⇒ At start of each deployment install newly calibrated PSPs and **notify mentor.**

B. PIR

1. TWP(Manus, Nauru, Darwin) Requirements:

a) 24 PIRs for swapping out 3 deployed and 1 spare for each of 3 sites.

b) Process:

⇒ Annually – after borcal season SGP send newly calibrated PIRs back to each site.

⇒ Annually – replace SKY, GRND, and spare PIRs w/calibrated units at each site and **notify mentor.**

⇒ Annually – send old PIRs to SGP for calibration.

2. AMF(Main Site) Requirements:

a) 8 PIRs for swapping out 3 deployed and 1 spare.

b) Process:

⇒ After calibration and before end of each deployment SGP send newly calibrated PIRs to AMF site for shipment to the next deployment.

⇒ At end of each deployment remove old deployed PIRs and spare and to SGP for calibration.

⇒ At start of each deployment install newly calibrated PIRs and **notify mentor.**

C. B/W

1. TWP(Manus, Nauru, Darwin) Requirements:

a) 12 B/Ws for swapping out 1 deployed and 1 spare for each of 3 sites.

b) Process:

⇒ Annually – after borcal season SGP send newly calibrated B/Ws back to each site.

⇒ Annually – replace SKY and spare B/Ws w/calibrated units at each site and **notify mentor.**

⇒ Annually – send old B/Ws to SGP for calibration.

2. AMF(Main Site) Requirements:

a) 4 B/Ws for swapping out 1 deployed and 1 spare.

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- b) Process:
 - ⇒ After calibration and before end of each deployment SGP send newly calibrated B/Ws to AMF site for shipment to the next deployment.
 - ⇒ At end of each deployment remove old deployed B/Ws and spare and to SGP for calibration.
 - ⇒ At start of each deployment install newly calibrated B/Ws and **notify mentor.**

D. NIP

1. TWP(Manus, Nauru, Darwin) Requirements:
 - a) 12 NIPs for swapping out 1 deployed and 1 spare for each of 3 sites.
 - b) Process:
 - ⇒ Annually – after borcal season SGP send newly calibrated NIPs back to each site for shipment to the next deployment.
 - ⇒ Annually – replace SKY and spare NIPs w/calibrated units at each site and **notify mentor.**
 - ⇒ Annually – send old NIPs to SGP for calibration.

2. AMF(Main Site) Requirements:
 - a) 4 NIPs for swapping out 1 deployed and 1 spare.
 - b) Process:
 - ⇒ After calibration and before end of each deployment SGP send newly calibrated NIPs to AMF site.
 - ⇒ At end of each deployment remove old deployed NIPs and spare and to SGP for calibration.
 - ⇒ At start of each deployment install newly calibrated NIPs and **notify mentor.**

E. IRT

1. TWP(Manus, Nauru, Darwin) Requirements:
 - a) 3 SKY IRTs and 3 GRND IRTs – 2 at each of 3 sites – no swap outs.
 - b) Process:
 - ⇒ Annually – do comparison with black body and **notify mentor.**

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⇒ See PRO_____

2. AMF(Main Site) Requirements:

a) 2 SKY and 1 GRND IRTs – 2 deployed and 1 spare(SKY) – no swap outs.

b) Process:

⇒ Annually – At the start of each deployment do comparison with black body and **notify mentor**.

⇒ See PRO_____

F. MFRSR

1. TWP(Manus, Nauru, Darwin) Requirements:

a) 3 MFRSRs – 1 deployed and 0 spares – no swap outs because no spare.

b) Process:

⇒ Annually – no swap outs because no spare.

⇒ See PRO_____

2. AMF(Main Site) Requirements:

a) 2 MFRSR – 1 deployed and 1 spare.

b) Process:

⇒ Before end of each deployment SGP send newly calibrated MFRSR head and logger to AMF site for shipment to the next deployment as spare.

⇒ At end of each deployment remove old deployed MFRSR head and logger and send to SGP for calibration.

⇒ At start of each deployment install spare MFRSR head and logger and **notify mentor**.

G. SMET T/R/H

1. TWP(Manus, Nauru, Darwin) Requirements:

a) 12 probes for swapping out 1 deployed and 1 spare for each of 3 sites.

b) Process: Annually

⇒ check installed sensor with Std T/RH probe, then

⇒ replace sensor(and spare) w/ newly calibrated sensors, then

⇒ check newly installed sensor again with Std T/RH probe,

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- ⇒ **Send results to the mentor,**
 - ⇒ Send replaced sensor (and spare) to vendor (Vaisala) for cal, and
 - ⇒ Send Std T/RH probe to SGP for calibration.
2. AMF(Main Site) Requirements:
- a) 4 probes for swapping out 1 deployed and 1 spare.
 - b) Process:
 - ⇒ After calibration, SGP/Vaisala send newly calibrated sensors and newly calibrated Std T/RH probe to AMF for shipment with AMF for next year's deployment.
 - ⇒ At end of deployment, check installed sensor with Std T/RH probe (**send results to mentor**), remove old sensors and old spares and ship to SGP/Vaisala for calibration.
 - ⇒ At start of deployment install recently calibrated sensors and check w/ Std T/RH probe(**send results to mentor**).
 - ⇒ send Std T/RH probe to SGP for calibration.

H. SMET WND

1. TWP(Manus, Nauru, Darwin) Requirements:
- a) 12 Anemometers for swapping out 2 deployed and 1 spare for each of 3 sites.
 - b) At each site Process:
 - ⇒ Annually:Check in-place anemometer with "drive."
 - ⇒ **Every 2 years** replace anemometers (and spare) with newly calibrated anemometers from Darwin.
 - ⇒ **Every 2 years** send replaced anemometers to Darwin for calibration.
 - c) **At Darwin anemometer Facility every 2 years:**
 - ⇒ do "starting threshold check" w/ **Propeller Torque Wheel/Disc**
 - ⇒ do "vertical shaft wind drive bearings check" w/ **Vane Torque Gage**
 - ⇒ do to check anemometer wind speed/dir bearings w/ **anemometer drive**
2. AMF(Main Site) Requirements:
- a) 4 Anemometers for swapping out 1 deployed and 1 spare.

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- b) Process at the AMF:
 - ⇒ After calibration, SGP send newly calibrated anemometer to AMF for shipment with AMF for next year's deployment.
 - ⇒ At end of deployment, remove old anemometer and old spares and ship to SGP for calibration.
 - ⇒ At start of new deployment install recently calibrated anemometer.
- c) Process annually at SGP Anemometer Facility:
 - ⇒ do "starting threshold check" w/ **Propeller Torque Wheel/Disc**
 - ⇒ do "vertical shaft wind drive bearings check" w/ **Vane Torque Gage**
 - ⇒ do to check anemometer wind speed/dir bearings w/ **anemometer drive**

I. SMET BAR

1. TWP(Manus, Nauru, Darwin) Requirements:
 - a) 6 Barometers for swapping out 1 deployed and 1 spare for each of 3 sites.
 - b) Process:
 - ⇒ Annually compare barometer with Std Barometer.
2. AMF(Main Site) Requirements:
 - a) 4 Barometers for swapping out 1 deployed and 1 spare.
 - b) Process:
 - ⇒ After calibration, SGP/vendor send newly calibrated barometer to AMF for shipment with AMF for next year's deployment.
 - ⇒ At end of deployment, remove old barometer and old spares and ship to SGP/vendor for calibration.
 - ⇒ At start of new deployment install recently calibrated barometer.

J. SMET ORG

1. TWP(Manus, Nauru, Darwin) Requirements:
 - a) 4 ORGs for 1 deployed at each of 3 sites and 1 spare for all 3 sites.
 - b) Process:
 - ⇒ Annually compare w/ORG Calibrator.
2. AMF(Main Site) Requirements:

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- a) 2 ORGs for 1 deployed and 1 spare.
- b) Process:
 - ⇒ At start of each deployment compare w/ORG calibrator.

K. TBRG(ARM)

- 1. TWP(Darwin) Requirements:
 - a) 1 TBRG
 - b) Process:
 - ⇒ Annually calibrated at Darwin.
- 2. AMF(Main Site) Requirements: NA

L. DISDROMETER(ARM)

- 1. TWP(Darwin) Requirements:
 - a) 1 Disdrometer
 - b) Process:
 - ⇒ Annually send to SGP for calibration in June.
- 2. AMF(Main Site) Requirements: NA

M. AWS TBRG(BOM)

- 1. TWP(Manus, Nauru, Darwin) Requirements:
 - a) 3 AWS TBRG for 1 deployed at each of 3 sites.
 - b) Process:
 - ⇒ Annually calibrated by BOM.
- 2. AMF(Main Site) Requirements: NA

N. SKYRD, GRND LOGGERS

- 1. TWP(Manus, Nauru, Darwin) Requirements:
 - a) 13 Campbell Loggers for swapping 2 deployed and 1 spare for each of 3 sites.
 - b) Process:
 - ⇒ Every 2 years send to vendor (in Australia) for calibration
- 2. AMF(Main Site) Requirements:
 - a) 6 Campbell Loggers for swapping out 2 deployed and 1 spare.
 - b) Process:
 - ⇒ At start of every other deployment send 3 loggers to SGP/vendor for calibration.

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⇒ SGP/Vendor ship back 3 calibrated loggers to AMF before end of deployment.

O. SMET LOGGER

1. TWP(Manus, Nauru, Darwin) Requirements:
 - a) 3 Campbell Loggers for 1 deployed at each of 3 sites.
 - b) Process: Calibration not required.
2. AMF(Main Site) Requirements:
 - a) 1 Campbell Logger 1 deployed.
 - b) Process: Calibration not required.

P. CEIL

1. TWP(Manus, Nauru, Darwin) Requirements:
 - a) 3 Ceilometers for 1 deployed at each of 3 sites – spare at SGP.
 - b) Process: Annually Tip cell to test distance to known target – ie. trees.
2. AMF(Main Site) Requirements:
 - a) 1 Ceilometer for 1 deployed.
 - b) Process: At start of each deployment tip cell to test distance to known target – ie. trees.

Q. MPL

1. TWP(Manus, Nauru, Darwin) Requirements:
 - a) 3 MPL for 1 deployed at each site.
 - b) No calibration required.
2. AMF(Main Site) Requirements:
 - a) 1 MPL for 1 deployed, 0 spares.
 - b) No calibration required.

R. MWRP

1. TWP(Manus, Nauru, Darwin) Requirements: NA
2. AMF(Main Site) Requirements:
 - a) 1 MWRP for 1 deployed, 0 spares.
 - b) Process:

⇒ At start of each deployment and every 3 months calibrate with saddle and liquid Nitrogen and **notify mentor**.

S. MWRHF

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1. TWP(Manus, Nauru, Darwin) Requirements: NA
2. AMF(Main Site) Requirements:
 - a) 1 MWRHF for 1 deployed, 0 spares.
 - b) Process:
 - ⇒ At start of each deployment and every 3 months calibrate from side of instrument with liquid Nitrogen and **notify mentor**.

T. TSI

1. TWP(Manus, Nauru, Darwin) Requirements:
 - a) 3 TSIs for deployment of 1 at each of 3 sites, 0 spares.
 - b) Process annually:
 - ⇒ Align shadow band at solar noon aligned N-S w/shadow of camera arm.
 - ⇒ Check camera arm orientation to be plumb w/lens centered over mirror and image focus
2. AMF(Main Site) Requirements:
 - a) 1 TSI for 1 deployed and 0 spare.
 - b) Process at start of each deployment:
 - ⇒ Align shadow band alignment at solar noon aligned N-S w/shadow of camera arm.
 - ⇒ Check camera arm orientation to be plum w/lens centered over mirror and image focus

U. BBSS GCS Temp Sensors

1. TWP(Manus, Nauru) Requirements:
 - a) 4 GPS Temp Sensors for swapping out 1 deployed and 1 spare for each of 2 sites (replace every 2 years).
 - b) Process annually:
 - ⇒ Replace the temp sensor in installed GCS with freshly calibrated sensor.
 - ⇒ Put removed 1 yr old temp sensor in Spare GCS
 - ⇒ trash oldest temp sensor
 - ⇒ order new sensor for next year.
2. AMF(Main Site) Requirements:

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- a) 2 GPS Temp Sensors for swapping out 1 deployed and 1 spare for each of 2 sites (replace every 2 years).
- b) Process at start of each deployment:
 - ⇒ Replace the temp sensor in installed GCS with freshly calibrated sensor.
 - ⇒ Put removed 1 yr old temp sensor in Spare GCS
 - ⇒ trash oldest temp sensor
 - ⇒ order new sensor for next deployment.

V. MMCR/WACR

1. TWP(Manus, Nauru, Darwin) Requirements:
 - a) 1 MMCR for 1 deployed and 0 spares for each of 3 sites.
 - b) Process: Self calibrating.
2. AMF(Main Site) Requirements:
 - a) 1 WACR for 1 deployed and 0 spares.
 - b) Process: Self calibrating.

W. AERI

1. TWP(Nauru, Darwin) Requirements:
 - a) 2 AERI for 1 deployed and 0 spares for each of 2 sites.
 - b) Process: Self calibrating.
2. AMF(Main Site) Requirements:
 - a) 1 AERI for 1 deployed and 0 spares.
 - b) Process:
 - ⇒ At start of each deployment, calibrated by mentor.

X. ECOR

1. TWP Requirements: NA
2. AMF(Main Site) Requirements:
 - a) 1 ECOR for 1 deployed.
 - b) Process - at start of each deployment:
 - ⇒ SGP send new unit to AMF
 - ⇒ AMF send old unit to SGP for calibration. (Only need sensing head and electronics box – ie do NOT send Sonic Anemometer, or cables to SGP)

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Y. AOS

1. TWP Requirements: NA
2. AMF(Main Site) Requirements:
 - a) 1 AOS for 1 deployed and 0 spares.
 - b) Process:
 - ⇒ At start of each deployment calibrated on-site by mentor.

Z. CIMEL

1. TWP(Nauru, Darwin-owned by others) Requirements:
 - a) 1 CIMEL for 1 deployed and 0 spares for Nauru.
 - b) Process:
 - ⇒ Every 2 years replace with calibrated unit from Aeronet.
2. AMF(Main Site) Requirements:
 - a) 1 CIMEL for 1 deployed and 0 spares.
 - b) Process:
 - ⇒ Every other deployment replace with calibrated unit from Aeronet.

AA. NFOV

1. TWP Requirements: NA
2. AMF(Main Site) Requirements:
 - a) 1 NFOV for 1 deployed and 0 spares.
 - b) Process:
 - ⇒ At end of each deployment ship back to SGP for calibration.
 - ⇒ At start of each deployment SGP ship calibrated unit to AMF.

V. Procedures – for calibration equipment:

A. IRT Portable Black Body

1. TWP(Manus, Nauru, Darwin) Requirements: NA
2. AMF(Main Site) Requirements: NA

B. Std T/RH Probe (HMI70 w/HMP75 probe head

1. TWP(Manus, Nauru, Darwin) Requirements:
 - a) 3 Std T/RH Probes (HMI70 w/HMP75 probe head) for 1 at each of 3 sites.

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- b) Process Annually:
 - ⇒ after calibration at SGP, send Std T/RH Probe to TWP sites with newly calibrated T/RH sensors (Breedlove).
 - ⇒ after on-site comparisons, send Std T/RH Probe to SGP to be calibrated by SGP (Breedlove)

2. AMF(Main Site) Requirements:

- a) 1 Std T/RH Probe (HMI70 w/HMP75 probe head).
- b) Process:
 - ⇒ after calibration at SGP, send Std T/RH Probe to TWP sites with newly calibrated T/RH sensors (Breedlove).
 - ⇒ after installation and immediately after on-site comparisons, send Std T/RH Probe to SGP to be calibrated by SGP (Breedlove)

C. Wind – Vane alignment rod

- 1. TWP(Darwin) Requirements: No calibration needed.
 - a) One Vane alignment rod at Darwin for calibrating TWP anemometers, but not needed at each TWP site since alignment is already set to notch on tower.
- 2. AMF(Main Site) Requirements: No calibration needed.
 - a) One Vane alignment rod at AMF for aligning anemometer upon installation and
 - b) one Vane alignment rod at SGP for calibrating AMF anemometers.

D. Wind – Propeller Torque Wheel/Disc

- 1. TWP(Darwin) Requirements: No calibration needed.
 - a) One Propeller Torque Wheel/Disc at Darwin for calibrating TWP anemometers. Also one each at Manus and Nauru left over from old days, but not needed now since Manus and Nauru anemometers sent to Darwin for calibration every two years.
- 2. AMF(Main Site) Requirements: No calibration needed.
 - a) One Propeller Torque Wheel/Disc at SGP for calibrating AMF anemometers.

E. Wind – Anemometer drive (tac, rpm generator)

- 1. TWP(Manus, Nauru, Darwin) Requirements:
 - a) One Anemometer drive at Manus, Nauru, and Darwin for calibrating TWP anemometers.

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b) Process:

⇒ Every 4 years send Anemometer drive to vendor (RM Young) for calibration.

2. AMF(Main Site) Requirements: NA

a) One Anemometer drive at SGP for calibrating AMF anemometers.

F. Std Barometer (Precision PTB 220)

1. TWP(Manus, Nauru, Darwin) Requirements:

a) One Std Barometer at TWP to travel to Manus and Nauru for cal visits.

b) Process:

⇒ Every 2 years send Std Barometer to vendor (in Australia?) for calibration.

2. AMF(Main Site) Requirements: NA

G. ORG Calibrator (electronic rain maker, TST-800)

1. TWP(Manus, Nauru, Darwin) Requirements: No calibration needed.

2. AMF(Main Site) Requirements: No calibration needed.

H. PWA11 Calibrator Kit

1. TWP(Manus, Nauru, Darwin) Requirements: NA.

2. AMF(Main Site) Requirements: No calibration needed.

I. Radiometer Simulator Unit (RSU)

1. TWP(Manus, Nauru, Darwin) Requirements: No calibration needed that I know of.

2. AMF(Main Site) Requirements: No calibration needed that I know of.

J. MWRP Saddle

1. TWP(Manus, Nauru, Darwin) Requirements: NA.

2. AMF(Main Site) Requirements: No calibration needed that I know of.

VI. References:

None. [Or, enter items in a bulleted list below.]

1. [Text. Press ENTER to continue numbered list.]

VII. Attachments:

1. Calibration Table for TWP and AMF

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Attachment 1: Calibration Table for TWP and AMF

CALIBRATION					03Jan2008 version
Instrument	TWP Cal activity	Sensors req/avail	AMF Cal activity	Sensors req/avail	Notes/action
Radiometers					
PSP	Annually: replace w/calibrated rad(and spare) and notify mentor.	18 req/ 21 avail	1)After borecal season SGP send newly calibrated sensors to AMF for shipment with AMF for next year's deployment. 2)At end of deployment, remove old sensors and old spares and ship to SGP for calibration. 3)At start of deployment install recently calibrated sensors and notify mentor .	6 req/ 9 avail (2 extras needed for supplementary site)	<ul style="list-style-type: none"> o Send old rads to SGP every year. o Send newly calibrated replacement rads to site after borecal season. o Need two sets of 1 SKYRD, 1 GRNRD, 1 Spare - per site
PIR	Annually; replace w/ calibrated rad(and spare) and notify mentor.	24 req/ 17 avail	NOTE: All of PIR movement/calibration is on hold until mentor determines how to calibrated PIRs. 1)After borecal season SGP send newly calibrated sensors to AMF for shipment with AMF for next year's deployment. 2)At end of deployment, remove old sensors and old spares and ship to SGP for calibration. 3)At start of deployment install recently calibrated sensors and notify mentor .	8 req/ 7 avail (2 extras needed for supplementary site)	<ul style="list-style-type: none"> o Send old rads to SGP every year. o Send newly calibrated replacement rads to site after borecal season. o Not to be changed out in 2006. o Need two sets of 2 SKYRD, 1 GRNRD, 1 Spare - per site
B/W	Annually: replace w/ calibrated rad(and spare) and notify mentor.	12 req/ 12 avail	After borecal season send newly calibrated sensors to AMF for shipment with AMF for next year's deployment. At end of deployment, remove old sensors and old spares and ship to SGP for calibration. At start of deployment install recently calibrated sensors and notify mentor .	4 req/ 4 avail	<ul style="list-style-type: none"> o Send old rads to SGP every year. o Send newly calibrated replacement rads to site after borecal season. o Need two sets of 1 SKYRD, 1 spare - per site
NIP	Annually: replace w/ calibrated rad(and spare) and notify mentor.	12 req/ 12 avail	1)After borecal season SGP send newly calibrated sensors to AMF for shipment with AMF for next year's deployment. 2)At end of deployment, remove old sensors and old spares and ship to SGP for calibration. 3)At start of deployment install recently calibrated sensors and notify mentor .	4 req/ 4 avail	<ul style="list-style-type: none"> o Send old rads to SGP every year. o Send newly calibrated replacement rads to site after borecal season. o Need two sets of 1 TKR, 1 Spare - per site
IRT	Annually: Comparison with portable black body (Vaisala)	3 SKY req/ 3 SKY avail 3 GRD req/ 4 GRD avail	Annually: At start of deployment do comparison with portable black body (Vaisala)	1 SKY req/ 2 SKY avail 1GRD req/ 1GRD avail	<ul style="list-style-type: none"> o Need 1 set of 1 GRN IRT, 1 SKY IRT – per site o Verify that extra AMF SKYRD is indeed a spare of just the MWRP IRT

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MFRSR	None.	4 req/ 3 avail	Annually: 1)At the start of each deployment, install the spare sensor and logger, notify mentor, and send back the previously operating MFRSR and logger to SGP for calibration. 2)Mentor send newly calibrated MFRSR and logger to AMF to act as spare.	2 req/ 3 avail (1 extra needed for supplement ary site)	<ul style="list-style-type: none"> o No calibration required? - Ask GARY HODGES about the TWP o One for each site. o Send an AMF spare head to Darwin?
Met Instruments					
SM T/RH (HMP45D)	Annually: 1)check installed sensor with Std T/RH probe, then 2)replace sensor(and spare) w/ newly calibrated sensors, then 3)check newly installed sensor again with Std T/RH probe, 4)Send results to MR, 5)Send replaced sensor (and spare) to vendor (Vaisala) for cal, and 6)Send Std T/RH probe to SGP for calibration.	12 req/ 14 avail	1)After calibration, SGP/Vaisala send newly calibrated sensors and newly calibrated Std T/RH probe to AMF for shipment with AMF for next year's deployment. 2)At end of deployment, check installed sensor with Std T/RH probe (send results to mentor), remove old sensors and old spares and ship to SGP/Vaisala for calibration. 3)At start of deployment install recently calibrated sensors and check w/ Std T/RH probe(send results to mentor). 4)send Std T/RH probe to SGP for calibration.	4 req/ 4 avail	<ul style="list-style-type: none"> o Send newly calibrated T/RH probes to each site for replacement annually for TWP and before each AMF deployment. o Send replaced T/RH probes to vendor (Vaisala) for recalibration annually. o Send <u>Std</u> T/RH probe(see cal equip) to SGP (Craig Webb) for recalibration annually. o Need 2 sets of 1probe on tower, 1 spare - per site o We should have enough sensors to do this (Manus, Nauru, Darwin, AMF, have 4,3,5,5 spares respectively).
SM WND	Annually at each site: 1)Check in-place anemometer with "drive." Every 2 years 1)Replace anemometers (and spare) with newly calibrated anemometers from Darwin. 2)Send replaced anemometers to Darwin for calibration. Every 2 years at Darwin Anemometer Facility: 1)do "starting threshold check" w/ Propeller Torque Wheel/Disc 2)do "vertical shaft wind drive bearings check" w/ Vane Torque Gage	12 req/ 13 avail	1)After calibration, SGP send newly calibrated anemometer to AMF for shipment with AMF for next year's deployment. 2)At end of deployment, remove old anemometer and old spares and ship to SGP for calibration. 3)At start of new deployment install recently calibrated anemometer. Annually at SGP Anemometer Facility: 1)do "starting threshold check" w/ Propeller Torque Wheel/Disc 2)do "vertical shaft wind drive bearings check" w/ Vane Torque Gage 3)do to check anemometer wind speed/dir bearings w/ anemometer drive	4 req/ 3 avail (1 extra needed for supplement ary site)	<ul style="list-style-type: none"> o SGP and Darwin have anemometer repair and calibration equipment. o Need 2 sets of 2 on tower, 1 spare – per TWP(Manus, Nauru) site o Need 1 set of 2 on tower, 1 spare – per TWP(Darwin) site o Need 2 sets of 1 on tower, 1 spare – per AMF site. o TWP & AMF have model 106 (marine) – SGP has model 103 (regular) o Send 2 calibrated anemometers from Darwin to AMF Germany 14Dec, then when AMF anemometers are calibrated at SGP send 2 to Darwin.

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	3)do to check anemometer wind speed/dir bearings w/ anemometer drive				
SM BAR	Annually: Compare barometer with Std Barometer.	6 req/ 6 avail	1)After calibration, SGP/vendor send newly calibrated barometer to AMF for shipment with AMF for next year's deployment. 2)At end of deployment, remove old barometer and old spares and ship to SGP/vendor for calibration. 3)At start of new deployment install recently calibrated barometer.	4 req/ 6 avail	<ul style="list-style-type: none"> o TWP needs no spares for calibration (but what if one fails?) o Currently have 4 spare barometers at AMF o Possibly get spare barometer for TWP to be stationed at Darwin
SM ORG (815)	Annually: compare w/ORG Calibrator.	3 req/ 5 avail	At start of each deployment: compare w/ORG calibrator.	1 req/ 2-815 avail +1-115	<ul style="list-style-type: none"> o Currently an ORG Calibrator at Darwin and the AMF. o The ORG Calibrator does not need to be calibrated – a la MR.
TBRG (ARM)	Annually: calibrated at Darwin (at Darwin only)	1 req/ 1 avail	NA	NA	<ul style="list-style-type: none"> o Calibration is performed at the BOM Regional Maintenance Center TBRG Test Facility (TC). o No spare o Verify BOM calibration procedure and frequency.
Disdrometer (ARM)	Annually: Sent to SGP for calibration in June (at Darwin only)	1 req/ 1 avail	NA	NA	<ul style="list-style-type: none"> o When Disdrometer at Darwin is sent back (during dry season-US summer) to SGP for calibration, the associated TBRG(Mary Jane's) continues to run. o TWP spare not needed for calibration.
AWS TBRG (BOM)	Annually: BOM AWS TBRG calibrated by BOM (at M, N, D)	3 req/ 3 avail	NA	NA	<ul style="list-style-type: none"> o Calibration is performed at the BOM Regional Maintenance Center TBRG Test Facility, however annual (or 6 mo?) calibration consists of BOM approved field check (TC). o Verify BOM calibration procedure and frequency
AWS-FULL (BOM)	Annually: Calibrated in the field by BOM.(at Manus, Nauru only)	2 req/ 2 avail	NA	NA	<ul style="list-style-type: none"> o Calibrated by Australian BOM as per their procedures. (at Manus and Nauru only)
PWD	NA	NA	At start of each deployment and every 6 months: Calibrate as per Ritsche procedure using PWD Calibrator kit.	1 req/ 1 avail	<ul style="list-style-type: none"> o PWA11 Calibrator Kit is used(This was purchased with both PWD's and was sent with one to the PYE deployment) o Ritsche procedure includes forms to be filled in and returned to Ritsche. o PWD spare not needed for calibration.
GPS Souminet	No calibration needed.	3 req/ 3 avail	No calibration needed	1 req/ 1 avail	<ul style="list-style-type: none"> • No calibration? Ask <u>LILJEGREN</u> • No spare needed – just send back when broken.
SKYRD/GRN RD Loggers	Every 2 yrs: Send to vendor for calibration	13 req/ 13 avail spares – 1 at M, 1 at N,	Every 2 yrs (every other deployment): Send to vendor for calibration.	6 req/ 6 avail (4 spares 1 from Ancillary +	<ul style="list-style-type: none"> o All loggers are about 2 years old. o For TWP, starting with Darwin spares and rotate loggers to vendors and back. o Start AMF changeout after German deployment. o Send 1 spare logger from Darwin to AMF. That

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		3 at D, 2 ex-cal lgr		1 from Darwin)	gives the AMF 4 spares, the TWP 6 spares.
SMET Logger	Calibration not required.	3 req/ 3 avail	Calibration not required.	1 req/ 1 avail	<ul style="list-style-type: none"> o Troy says: Since all Campbell loggers are interchangeable between SMET, GRNRD, & SKYRD, perhaps all loggers should be calibrated (TC).
Stand Alone Instruments					
CEIL	Annually: Tip ceil to test dist to known target – trees (currently done at Manus only)		Annually: Tip ceil to test dist to known target – trees		<ul style="list-style-type: none"> o Spare is at SGP o Vic suggests holding up a piece of plywood or cardboard for a target if trees not available.
MPL	None		None		<ul style="list-style-type: none"> o Ask RICH COULTER
MWR	None		None		<ul style="list-style-type: none"> o Spare is at SGP
MWRP	NA		At start of each deployment and every 3 months: calibrate with saddle and liquid Nitrogen.		<ul style="list-style-type: none"> o Calibration procedure in interactive with mentor. o Requires 2 people and at least on cryogenics trained technician. o Ask Maria – check IRT with portable black body?
MWRHF	NA		At start of each deployment and every 3 months: Calibrate from side of instrument with liquid N2.		<ul style="list-style-type: none"> • Calibration procedure is interactive with mentor? ask Maria. • Requires 1 person spotting and 1 cryogenics trained technician.
TSI	Annually: Shadow band alignment at solar noon aligned N-S w/shadow of camera arm. Check camera arm orientation to be plum w/lens centered over mirror and image focus.		Annually: Shadow band alignment at solar noon aligned N-S w/shadow of camera arm. Check camera arm orientation to be plum w/lens centered over mirror and image focus.		
BBSS GCS Temperature sensor (calibration is good for 2 yrs)	Annually: 1)Replace the temp sensor in installed GCS with freshly calibrated sensor. 2)Put removed 1 yr old temp sensor in Spare GCS 3)trash oldest temp sensor 4)order new sensor for next year.	4 req/ 0 avail that are in cal. 4 are coming.	At start of each deployment: 1)Replace the temp sensor in installed GCS with freshly calibrated sensor. 2)Put removed 1 yr old temp sensor in Spare GCS 3)trash oldest temp sensor 4)order new sensor for next year. (REVISE?)	2 req/ 0 avail that are in cal? 2 are coming.	<ul style="list-style-type: none"> o Order 6 spare GCS temp sensors(4 TWP, 2AMF) – done. o Need 1 set of 2 for each site. o Vaisala will no longer re-calibrate used sensors
MMCR/WACR	Self calibrating		Self calibrating		
AERI	Self calibrating		At start of each deployment: by mentor		<ul style="list-style-type: none"> o Note: if 3rd body test is all that is required, this can be performed by BOM Techs (TC). o Ask DEDECKER

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ECOR	NA		At start of each deployment: 1)SGP send new unit to AMF 2)AMF send old unit to SGP. Only need a)sensing head, b)electronics box . Do NOT send Sonic Anemometer, or cables to SGP (REVISE?)		<ul style="list-style-type: none"> • Verify SGP ECOR to be sent to Germany • Send old ECOR back from Germany
AOS	NA		At start of each deployment calibrated by mentor on-site.		
CIMEL	Every 2 yrs: return to vendor for calibration.		Every 2 yrs: return to vendor for calibration.		o Part of overall ARM rotation of CIMEL calibrations.
NFOV	NA		Annually send to SGP for calibration?		o Is there enough time for this between deployments?
Calibration Equip/ process					
IRT portable black body		1 at Darwin 2 at Manus		1 at AMF	<ul style="list-style-type: none"> o Put one at each site for annual checks. o Does this need periodic calibration? o Unit is "Everest 1000 (Vaisala)"
<u>Std T/RH Probe (HMI70 w/HMP75 probe head) Portable aspiration unit??</u>	Annually: Send to SGP for calibration (Craig?)	3 req 0 HMI70s at any site. 3 are on their way.	Annually: Send to SGP for calibration (Craig?)	1 req 0 avail 1 is on the way	<ul style="list-style-type: none"> o Used for T/RH checks. o As part of <u>TWP traveling cal kit.</u> - no, get one for each site. o Send LANL unit to Darwin o Purchase new HM70s to be compatible with SGP calibrators? o Ask Troy if we have a portable aspiration unit for this.
	Anemometer calibration: Annually at Darwin Anemometer Facility: <ul style="list-style-type: none"> • starting threshold check • vertical shaft wind drive bearings check Annually at each site <ul style="list-style-type: none"> • use drive to check in-place anemometer 				
Wind – Vane alignment rod	Used to mount and align anemometer on newly erected tower, ie. not needed in TWP. Anemometers at TWP are set to already identified notch on	1 at Manus 1 at Darwin	Each installation: Used to mount and align anemometer on newly erected tower, ie. can be used at each AMF installation. Also can take back bearings with compass using correct declination.	0 at AMF	<ul style="list-style-type: none"> o This is part of calibration equipment that is to arrive from the SGP. BOM still needs to purchase spare consumables like bearings, cables, o-rings, etc. – done. o send at least one vane alignment rod to the AMF.

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	tower?				
Wind – Propeller Torque Wheel/Disc	Annually: Used to check “starting threshold” (done at Darwin Anemometer Facility)	1 at Darwin 1 at Manus 1 at Nauru	Not used at AMF since anemometers sent to SGP annually for calibration.	0 at AMF	<ul style="list-style-type: none"> ○ This is part of calibration equipment that is to arrive from the SGP. BOM still needs to purchase spare consumables like bearings, cables, o-rings, etc. – done. ○ These do not need calibration.
Wind - Vane Torque Gage	Annually: Used to check vertical shaft wind drive bearings (done at Darwin Anemometer Facility)	2 at Darwin 1 at Manus	Not used at AMF since anemometers sent to SGP annually for calibration.	0 at AMF	<ul style="list-style-type: none"> ○ This is part of calibration equipment that is to arrive from the SGP. BOM still needs to purchase spare consumables like bearings, cables, o-rings, etc. – done. ○ These do not need calibration.
Wind – Anemometer Drive (tac,rpm generator) (#18810)	Annually: Used to check anemometer wind speed/dir bearings (done at each site while anemometer is still on tilted down tower) Every 4 years send to RM Young for calibration.	3 at Darwin 1 at Manus 1 at Nauru	Not used at AMF since anemometers sent to SGP annually for calibration.	0 at AMF	<ul style="list-style-type: none"> ● Don’t need at AMF since this test is done at SGP. ● RM Young says if the “drives” are only used once a year or so, they only need calibration at RM Yong once every 4 years. So that means that we could probably rotate out the 5 “drives” we have in the system – need to verify this all with MR.
Std Barometer (Precision PTB 220)	Every 2 years: Send STD Barometer to vendor for cal	1 req/ 1 avail in cal kit	Not needed at AMF since barometers are changed out each deployment.	0 at AMF 0 req	<ul style="list-style-type: none"> ○ Used for Barometer check, ○ As part of <u>TWP traveling cal kit</u>. ○ STD Barometer checked by BOM annually
ORG calibrator (electronic rain maker) (TST-800)		1 req/ 2 avail in cal kit?		1 at AMF	<ul style="list-style-type: none"> ○ Used for ORG check. ○ As part of <u>TWP traveling cal kit</u>. ○ ORG Calibrator does not need to be calibrated.
PWA11 Calibrator Kit	NA			1 at AMF	<ul style="list-style-type: none"> ○ Used as part of PWD calibration procedure.
Radiometer Simulator Unit(RSU)		1 at Darwin 1 at Manus 1 at Nauru		1 at AMF	<ul style="list-style-type: none"> ○ Tests logger circuits.
MWRP Saddle	NA	NA	No calibration needed that I know of.	1 at AMF	
Send back to SGP					
Reference temperature sensor (Precision T-Meter)		4 at Darwin		0 at AMF	 <ul style="list-style-type: none"> ○ No longer needed (MR) ○ This is a useful check before and after T/RH changout (TC).
Wind - Vane		1 at Darwin		0 at AMF	 <ul style="list-style-type: none"> ○ No longer needed (MR).

Angle Fixture /Bracket (direction)-		(Bench stand) 1 at Manus (Tower mount) 1 at Nauru (Tower mount) 1 at Darwin			<ul style="list-style-type: none"> ○ This is a valuable check and should still be performed annually (TC). ○ New calibration equipment will be purchased with the creation of the new wind calibration/repair facility for Darwin & SGP.
CAVITY Radiometer		1 at Darwin			<ul style="list-style-type: none"> ○ No longer needed, but leave at Darwin for emergency, although it its calibration certification is getting older by the year. ○ Return to SGP?
Volt meter standard		1 at Darwin			<ul style="list-style-type: none"> ○ No longer needed ○ Part of TWP traveling cal kit. ○ Return to Darwin?
Chilled Mirror		2 at SGP	0 at AMF		<ul style="list-style-type: none"> ○ No longer needed.