

CURRENT STATUS OF DATA QUALITY CONTROL PROCEDURES  
IN THE SINGAPORE METEOROLOGICAL SERVICE

Prior to 1984, the quality control of meteorological data was performed entirely by manual checking in which simple, fairly straightforward methods were employed. In 1984 the operational work at the Singapore Meteorological Service was computerised and this enabled a more efficient manner of performing data quality control by means of both manual and automatic checking.

Table 1 shows a summary of the current status of quality control procedures performed on national data prior to their transmission on the GTS.

Table 1: Quality control checks performed on national data before transmission

	Surface Data	Upper-air Data
Source	Check for consistency and range (manual)	Check for hydrostatic balance and lapse rate check of vertical temperature profile (automatic) Visual check of tephigram
Data Entry	Compliance with WMO code standards e.g. identification, code and format checks (manual)	

Checking at Source

(1) Surface Data

- (a) Time consistency check using both preceding and subsequent observations from the same station.
- (b) Horizontal consistency check by comparison with simultaneous observations at other observation stations in Singapore.
- (c) Internal consistency check between elements in the same observation (e.g. high humidity when heavy rain is observed).
- (d) Tests of various parameters against statistically determined limits (e.g. the highest surface temperature in Singapore is 34.8 deg C and so a reported temperature of 37 deg C must be treated as suspect and must be verified).

(2) Upper-air Data

- (a) Check of hydrostatic balance and lapse-rate check of vertical temperature profile are performed automatically.
- (b) A visual check for unreasonable inversion and superadiabatic lapse rates is made by drawing the sounding in a tephigram. This procedure is normally carried out a few hours after the sounding and the corrected data is re-transmitted when any errors are detected.

Checking at Data Entry

During data entry, the surface and upper air messages are checked by the telecommunications operator to ensure that they comply with WMO code standards (e.g. identification, code and format checks) before they are transmitted on the GTS.

Table 2 shows a summary of the present status of quality control procedures performed on data in the processing system. The data first undergoes a pre-processing check followed by a check of the physical elements.

Table 2: Quality control checks performed on data in the processing system

	Surface Data	Upper-air Data
Pre-processing Check	Validity check of identification elements including check of adherence to data format (automatic and manual)	
Check of Physical Elements	Gross-error limit check (automatic)	Gross-error limit check (automatic)
	Visual check of surface pressure analysis	Check for horizontal consistency (automatic)

Pre-processing check

During pre-processing, validity checks are carried out on the identification elements and data formats of all bulletins received via the GTS. These bulletins include SYNOP, SHIP, TEMP, PILOT, AIREP and SATOB reports.

The following validity checks are applied:

- (a) Checking the date and time  
The date and time information in the heading and in the report are checked to ensure they are compatible. However the time is allowed to differ somewhat depending on the type of data and the base hour of data collection.
- (b) Checking the WMO block/station number and the position.  
A search is made to match the block number and station number from the report with a comprehensive WMO station index. This station index is regularly updated whenever the need arises. If the station does not appear in the index, the report is rejected. In the case of ship reports, a check is made that the latitude and longitude lie in the range 0 to 90 degrees and 0 to 180 degrees respectively. A check is also made that the quadrant notation is equal to 1, 3, 5 or 7.
- (c) Checking the data format  
The data formats of all bulletins received are checked to ensure they conform to standard WMO format specifications.

All rejected messages are transferred to a correction file where they undergo manual correction. If the errors are too serious, the whole report is discarded. The corrected messages are then returned to the data processing system where they undergo a check of the physical elements.

### Check of Physical Elements

#### (1) Surface Data

- (a) An automatic gross-error limit check is performed on parameters given in code form whereby the coded data is checked against certain fixed-limit values. The parameters are considered erroneous if their coded values lie outside their respective fixed-limit values.

The limit check is also applied to parameters containing information in physical units like wind speed, air temperature, etc. At present the limit values for this check do not depend on area or time of year but we hope to introduce these features into the check in the future.

- (b) A check to detect unreasonable values of sea-level pressure by viewing the surface pressure analysis on a video display unit. When examining the surface pressure analysis, emphasis is placed on maintaining continuity of surface pressure systems and detecting developing systems. A pronounced high or low pressure system which was not present six hours earlier would be considered as suspect and the pressure reports in the area concerned are then inspected for possible errors.

(2) Upper air data

- (a) An automatic gross error limit check is performed in a similar way as for surface data.
- (b) An automatic check for horizontal consistency is made by comparison with similar observations at adjacent stations or analysed fields.

In recent years, the increasing number of enquiries on meteorological data which relate to legal cases or detailed local weather on specific days have led to a greater need for quality control of meteorological data.

In the climatological processing of national meteorological data, the compiled data is manually checked to ensure the data is correctly entered and the respective code formats are adhered to. In addition, the TEMP reports are again checked for vertical consistency. Here the temperature profile is checked for superadiabatic layers and the geopotentials together with the temperatures at the standard pressure levels are checked for hydrostatic balance.

Finally we hope to develop a more comprehensive set of quality control algorithms for our data processing system. This will help to complement our work in NWP which is still in an infant stage in Singapore. Some of the quality control features which we plan to introduce to our data processing system include the following :

(1) Pre-processing

- Incorporating some easy checks during the decoding procedure to make sure the decoded values are reasonable for the expected parameters.

(2) Quality control of Physical Elements

Internal consistency checks for surface data whereby the different parameters in the same report are checked against each other.

- Vertical consistency checks for upper-air data (check for hydrostatic balance, extreme wind shear and superadiabatic lapse rates).

- Time consistency checks for both surface and upper-air data.