DQM Annual Hopper QA Checks

The following document is intended to be a guide for conducting annual Dredge Quality Management quality assurance checks on hopper dredges. The procedures should provide general guidance for the process to be followed however as in all marine operations it is important that personnel be aware of the vessel's specifics and use critical thinking to ensure that the process applied is the best way to safely and reliably collect the needed data.

It is our goal to provide safe expeditious service in performing the QA check and as such there is no set order or procedure for the check as a whole. It is the job of the QA check team to work with the dredger and system provider to make sure that all required checks are performed and data collected while attempting to minimize interruptions to normal operations.

For hopper dredges all components – Position, Draft, and Ullage Sounding, and Draghead Depth - are required; the water test which is only needed if there has been a modification to the volume of the hopper or other major vessel modification.

Position Check

The annual QA check process will include checking the Latitudinal and Longitudinal position of the dredge as reported on the DQM onboard screen against readings from a handheld GPS receiver. The two readings should differ by no more than 3 meters (or 10 ft), depending on the number of satellites available.

Purpose:

The purpose of the position check is to verify the accuracy of the dredge positioning system.

Material required:

1) Dredge Position check form
2) Handheld GPS

Procedure:

Turn on the handheld GPS and allow sufficient time to acquire the maximum number of satellites at a static location. The GPS location should be taken as close to the DQM GPS antenna location as possible (see DPIP for antenna location); the position reading indicated on the DQM onboard display should also be noted at the same time (this may require a second person or a camera/screenshot). The two readings will then be entered into the spreadsheet for and the difference in location calculated. Number of satellites received should be noted in remarks. Difference in position should be less than 10 feet. Note: in almost all cases this data should be entered in the columns labeled GPS1.

GPS Position Comparison					
	GPS1 location		GPS2 location		Calculated Center
	Degrees	Min	Degrees	min	
DQM received Latitude					
DQM Support Team Latitude					
Delta	0		0		
DQM received Longitude					
DQM Support Team Longitude					
Delta	0		0		
Position Delta (ft)	#DIV/0!		#DIV/0!		
Remarks:					

Draft Sensor Check

For all Hopper Dredge, the annual QA check will verify the accuracy of the draft sensors, forward and aft by comparing the observed dredge hull draft marks to the corresponding sensor readings from the DQM data. The QA check team will review the difference between instrument and manually-measured averaged drafts to insure that the system is operating within acceptable accuracy (+/- 0.1 ft. in calm seas conditions), directing the contractor to re-calibrate or repair system components as necessary.

Purpose: To verify accuracy of draft sensors forward and aft

Material Required:

1) QA check spreadsheet / Notebook
2) Auxiliary vessel to observe hull draft marks
3) Radio communication between the vessels
4) A second person to read the draft marks from the auxiliary vessel

During the check, the dredge should lie in relatively calm seas to minimize wave induced measurement error

Procedure:

One person boards the auxiliary vessel and circles the dredge to observe and record draft markings forward and aft (both port and starboard). The second person on the dredge records the system measured draft values. The values are entered into the spread sheet and the difference between instrument and manually-measured drafts are calculated. This difference should be within +/-0.1 foot under ideal sea conditions. As wave heights increase measurement error increases; record remarks accordingly. This check should be made both when the dredge is light and loaded to verify accuracy throughout the working range of the draft sensor. If either if outside of what is deemed

acceptable by the QA check team for the given conditions, then the sensors should be calibrated by the contractor.

A draft mark is read by interpreting where the water crosses the draft mark. The width of the font of a draft mark is typically equal to a tenth of a foot with the bottom of the number equal to zero and the top equal to 0.5. The blank space between the two numbers is also 0.5 for a total of 1 foot of change from the bottom of one number up to the bottom of the next. In the figure below, the arrow above 13.0 would be 13.1 and continue incrementing by .1 until 13.5.

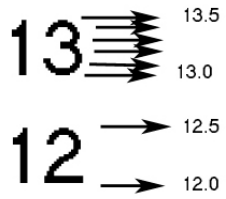

Figure 1. Draft mark interpolation.

Draft Re-Test					Version 1.4
Light Drafts					
	Manually Measured			DQM Drafts	
	Port	Stbd	Average (ft)	Instruments	Difference (ft)
Fwd			0		0
Aft			0		0
Loaded Drafts					
	Manually Measured			DQM Drafts	
	Port	Stbd	Average (ft)	Instruments	Difference (ft)
Fwd			0		0
Aft			0		0

Ullage Sounding Check

For all hopper dredges the annual QA process will include checking the reported bin ullage using a bin ullage tape measure. The Contractor shall have available a bin ullage tape that is clearly readable weighted tape, marked in tenths of a foot, capable of measuring throughout the full range of bin depth. The weight for this tape shall be between 2 and 3 pounds and whenever possible a 6-inch diameter disk. The QA check team will review the bin ullage data to insure that the system is operating within acceptable accuracy (+/-0.1 foot), directing the contractor to re-calibrate or repair system components as necessary.

Purpose: To verify accuracy of bin ullage sensors.

Material Required:

1) QA check spreadsheet / Notebook
2) Weighted tape, marked at intervals to a tenth of a foot.

Procedure:

Review the relevant section of the DPIP for the plant being checked to determine the correct reference point for ullage measurements and any plant specific procedures.

With the hopper light and with just enough material so that the ullage sensors have a uniform fore and aft surface to provide a consistent measurement, and manual soundings can be taken relative to the hopper datum (zero ullage) in the vicinity of the sensor. Three soundings are taken forward and aft; port, starboard and centerline. On some vessels this is not possible and either port and starboard or centerline soundings will be taken. At each location, the weighted tape shall be lowered until the weight touches the fluid surface and the distance noted. The DQM system values should be read from the display (vendor specific). The measured ullage values and DQM system-measured ullage values are recorded into the spread sheet and the difference between measurements calculated.

Then the bin is filled with dredge material or water to a level high enough to provide a single, continuous, horizontal fluid plane and the above measurement procedures are repeated

During the check, the hopper should be in relatively calm waters to minimize wave induced measurement errors. Difference between manually and system-measured values should not exceed +/-0.1 foot.

Ullage Re-Test						Version 1.4
Light (Residual/almost empty) ULLAGE-LEVEL CHECK						
	Manually Measured				DQM Ullage	
	Port	Stbd	Center	Average (ft)	Instrument	Difference (ft)
Fwd				0		0
Aft				0		0
LOADED (Full) ULLAGE-LEVEL CHECK						
	Manually Measured				DQM Ullage	
	Port	Stbd	Center	Average (ft)	Instrument	Difference (ft)
Fwd				0		0
Aft				0		0

Water Test

Each water test shall consist of pumping the bin out to its lowest level and then filling the bin to capacity with water, taking ullage and draft measurements at both levels to determine bin volume and displacement. If the results of the water test indicate that the system is not operating within acceptable accuracy, the Contractor shall be required to correct the deficiencies causing the error and repeat the water test until the results are acceptable.

Purpose:

The objective of the water test is to assure accuracy of the dredge's reported displacement and bin volume. In order to conduct this test successfully, proper operation of ullage and draft sensors is necessary. By filling the bin with water, the calculated density of the water can be compared to that of the water sampled from the bin, and the value of Tons Dry Solids can be calculated and should equal zero.

Material Required:

1) A copy of the SCIF spreadsheet and portable computer
2) Auxiliary vessel to observe vessel hull draft markings
3) Handheld radio to communicate with bridge and auxiliary vessel
4) Water sampling device to retrieve a water sample from the bin
5) A refractometer with automatic temperature compensation to determine the specific gravity of the bin water sample. The refractometer shall be capable of measuring the bin water's specific gravity with a resolution of 0.001 and minimum accuracy of $\pm$ 0.001. Distilled water should be available for calibration of the refractometer.

Procedure:

Note: It is strongly recommended that all instrumentation is in calibration prior to this test being conducted

With the dredge light and washed clean of dredge material, the bin is filled with just enough water so that the ullage sensors have a uniform fore and aft surface to provide a consistent measurement, and manual soundings can be taken relative to the bin datum (zero ullage) in the vicinity of the sensor. Three soundings are taken forward and aft, at port, starboard and centerline. On some scows this is not possible and either port/starboard or centerline soundings will be taken. A representative of the DQM support team and a crew member familiar with sounding the bin record the soundings. While these measurements are being taken, the launch will read the draft marks in feet and tenths of feet. These manual draft measurements are coordinated by the second DQM team member on the bridge. They are taken simultaneously to insure that the readings are reflective of a steady state ship. The team member on the bridge also records the corresponding electronic readings from the DQM computer. The bin is then filled with water and the above steps are repeated. While the bin is full, a small water sample from the bin is collected to calculate the specific gravity of water. Use the refractometer to determine its density. Record this value in the spreadsheet. From the DPIP enter the horizontal offsets between the ullage sensors and the horizontal offsets between the draft sensors.

After all values are entered into the spreadsheet, observe the calculated value of Tons Dry Solids. The acceptable accuracy is from -200 LT to +200 LT. The difference between the bin measured water density and the spreadsheet calculated water density should be within (plus or minus) 5.0%. The calculated value of trim-trim angle should be 0.3 degrees or less.

If the calculated water density is outside the acceptable range look at the draft and ullage sensor difference. If these are outside the acceptable range for the corresponding sensors then the long hand calculation sheet should be completed by someone experienced with stability and trim calculations, contact the DQM support center if you need assistance. If this is not the case then discretion should be taken and numbers should be re-checked. If they still don't agree then the validity of the tables will come into question and other redundant methods of calculation should be attempted though use of the stability and trim booklets on the vessel and/or its hydrostatic tables.

Draghead Depth Check

The annual QA check for hopper dredges will require calibration checks of the reported draghead depth using manual means such as tape measures or sounding lines to directly measure draghead depth. The Contractor shall have on the dredge a steel tape, chain, or wire with clearly visible flags/tags placed at 1 foot increments within the operational range of the dragarm. This tape or chain shall be capable of measuring the depth below the water surface to the lowest fixed point of each draghead (often the heel) with sufficient length to measure 5 feet over the maximum project depth. Where pressure sensors are used to calibrate the draghead depth sensors there is little ability to prove the calibration of either sensor and this method is only acceptable in areas where current flow past the vessel/dragarm cannot be minimized enough to safely handle a measuring chain/tape. If this type instrument is used for dragarm calibration, it must be a vented pressure gage and shall be required that it be sent out for yearly manufacturer's calibration and then checked at a known depth during inspection. Extra care shall be taken not kink the cable or restrict the vent during deployment.
The QA check team will review the draghead depth data to insure that the system is operating within acceptable accuracy, directing the contractor to re-calibrate or repair system components as necessary. Weekly calibration of the draghead depths are recommended as these sensors are sensitive to environmental conditions.

Purpose:

To verify accuracy of draghead depth sensors.

Material Required:

1) Draghead Depth Check form / Notebook
2) Chain or tape, marked at foot intervals, or known distances within the operational range of the dragarm
3) Handheld radio to communicate with bridge

Procedure:

For each draghead, the steel tape or chain shall be attached to the draghead and any offset to the bottom shall be noted. The draghead shall be lowered so that one of the flags is even with the water surface. Note the depth indicated by the chain or tape. Call up to the bridge and record the value they are reading on the DQM screen. Repeat the procedure for a minimum of three depths within the operating range of the draghead.

Difference between manually- and system-measured averages should be equal to or less that 0.5 ft.
This test is highly dependent on wave heights and should be conducted in very low wave situations due to error caused by reading the measuring tape correctly.