BART™ testers provide a very easy way to test for active bacteria in water, Why is that?

Active bacteria are the ones that can cause problems in the water and to the people using the water. There are several different bacteria that be active in water but under different circumstances. Selecting the right BART™ tester(s) to determine the activities can be very important. Think about the problems that might occur and then select the right BART™ to get to the heart of that problem.

The BARTs™ are classified into several product groups that look for specific bacterial activity. If you analyze the problem, you can narrow the possibilities of activity, then select the appropriate BART™(s) for the category of bacterial activity. For example, corrosion is caused by sulfate reducing bacteria. Thus the logical choice would be the SRB BART™.

How can the BART™ tester help?

The BART is easy to use, tells you something about how active the bacteria, which types of bacteria are active in the water sample. Additionally, if you are applying a treatment then the effectiveness of that treatment can be measured using the selected BART™ testers.

The BART testers can provide a variety of information that can be useful in understanding bacterial activity. They provide three key features to bacterial water analysis. First, they can provide you an interpretation on the bacterial activity in a given water source. Secondly, they can address what types of bacteria are currently active in the water source. And finally, they are easy to use in both laboratory and field study.

How do you measure bacterial activity?

In setting up a BART tester leave it at room temperature and look periodically. That time interval is called the time lag and can be used to determine activity. Remember that the shorter the time lag then the greater is the activity and the bigger the population.

The BART testers operate at room temperature to stimulate bacterial reactions. These reactions are listed in reaction charts to help identify, and classify, the bacteria. The tests produce the various reactions that are noted by the technician by recording the reaction code, time and date. The lag time from start date to reaction is then used to calculate the approximated activity. Remember that the quick the lag time the higher the population.

What is the time lag?

It is the start between starting up a BART tester and it going positive. Usually at room temperature that time lag is measured in days with a one or two day time lag meaning the bacterial population is very active whereas a time lag of greater than six days means the bacteria aren't very active. If the BART tester is being operated (incubated) at 28^{o}C then the time lags are much shorter and can be measured commonly in seconds rather than days.

What temperature should I use to test the water samples?

When the BART is being used in the field or office, no extra equipment is needed to operate at room temperature (nominally 22^{o}C) and so that is a preferred temperature. However, water samples can commonly come from sources as cold as 0^{o}C or as hot as 45^{o}C. Room temperature is in the middle of that range and will tend trap much of the activity. If you have a special need or a BART reader then 28^{o}C or 37^{o}C can be applied.

How many different types BART™ testers are there being manufactured?

The answer to this is best down in a table that shows when the BART™ tester of that type was first produced commercially, whether there has been verification and the tester is a part of a full BART™ system.

Bacterial Group	Notation	Verification
Algae	ALGE-BART™	
Acid Producing Bacteria	APB-BART™	
Denitrifying Bacteria	DN-BART™	
Fecal Coliform Bacteria	F-COLI-BART™	In progress (system)
Heterotrophic Bacteria	HAB-BART™	ETV (system)
Iron Reducing Bacteria	IRB-BART™	ETV
Nitrifying Bacteria	N-BART™	
Slime Forming Bacteria	SLYM-BART™	
Sulfate Reducing Bacteria	SRB-BART™	ETV
Total Coliform Bacteria	T-COLI-BART™	In progress (system)

If I have a problem which BART™ testers should I use?

It is the nature of the "problem" that will define the BART testers you will use. As a guide then begin with a range. For water wells it is common to use a combination pack (COMBO) of three different testers that will give some answers to the problem if it is bacterial in origin. For wells that do not have any known spills/ contamination then the common combo includes SRB, IRB, and SLYM-BART™ testers. If the wells are on an hazardous waste site or contamination is suspected then a combo of SRB, IRB and HAB-BART™ testers may be more appropriate. In the following table, some selections of BART tester types is suggested depending upon the nature of the recognized problem.

Problem	Recommended BART™	Comment
Blackened water	SRB-BART™	May also have rotten egg odor
Red, Brown, yellow water	IRB-BART™	May also contain iron floc
Clouded water	SLYM- & HAB-BART™	When looking though the water, clouds may be seen in the light
Loss in water production	IRB-, SLYM- & HAB- BART™	Sampling may be difficult because most of the bacteria are not in the water but in attached biomass
Fishy odors	HAB-BART™	Some bacteria produce strong fishy odors
Septic odors	T-COLI- & DN-BART™	Fresh septic contamination will give active total coliform but older contamination will give high denitrifiers
Corrosion of metal fittings	SRB-, & APB-BART™	Perforation of metals most likely would be SRB but could also be APB
Bioremediation	HAB-BART™	For these sites it is recommended that the system be employed since activity commonly very high
"Safe" water	T-COLI-BART™	Presence of active total coliform bacteria considered first indicator of unsafe water

Slimes in cooling towers and heat exchangers	HAB-, & SRB-BART™	HAB will give the level of bacterial and SRB indicate nature of growth
Bottled water	HAB-BART™	In good bottled water then no HAB activity should be detected in 8 days

What makes a BART™ tester work?

The tester has been designed to provide a range of environments from very **reductive in the base** cone to very **oxidative around and under the floating ball**. This means a gradient is created vertically in the tester that can encourage many different types of bacteria to grow. To encourage different communities of bacteria to grow then a crystallized pellet of chemicals that are selective nutrients are placed in the base cone of the tester. These selective nutrients diffuse up and cause only the bacteria being investigated to grow and trigger reactions. The BART tester is therefore a very "friendly" environment created to maximize the detection of the active bacteria. This is done by a combination of looking for a reaction and timing that event to gauge the activity.

When are bacteria active?

If the environment from which the sample was taken was favourable to the bacteria then they become active. This activity is a measure of just how aggressive they are and also can determine (through the time lag) just how large the population of active cells is within the sample.

What about bacteria that are not active, aren't they important too?

Bacteria can easily 'fall asleep' (become inactive) and it takes a while for these bacteria to wake up and become active again. In general the BART tests are not long enough to trigger these inactive bacteria to become active again. Because the cells are in the sleep mode then it is unlikely that their presence will have any impact on test and the results.

How accurate are the BART™ testers?

Common trends do emerge although every 15mL sample used for a BART test will be a little different. On a water sample when duplicate tests are performed, the time lags commonly vary by less than 5% and the same sequence of reactions is observed. Some operators use a staged approach to testing using BARTs. They will set a minimal time lag (such as 4 days) that would indicate that the water was OK and no treatment is required. When a test comes in with a time lag of 3 days then this could be a problem since the bacteria are getting more active. Before running an expensive treatment these operators will now run duplicate tests to determine whether that result was not typical. If the duplicates also show shorter time lags (in this case, less than 4 days) then a treatment is undertaken. After treatment the tests should show the activity now at 4 days or better. Some operators therefore do routine BART tests to monitor the activity reacting with duplicate tests when a problem may be emerging (i.e. time lags shortening)

Are these BART™ tests considered regulatory tests?

Getting any new test accepted by the regulatory process is a long and complicated process. For the BART testers, this is a particularly challenging process because there are no easy comparative tests. In microbiology, the agar plate remains a standard but it does not allow the variety of bacteria to grow that will grow in a BART tester. Membrane filtration is another standard but it suffers from serious overgrowth issues. ATP (adenosine triphosphate) analysis has become a new standard but it only quantifies the total number of active cells regardless of their relevance to the test. The BART tester's process of getting regulatory approval has

been slow while we build up the perfect the systems. Three testers have got Canadian Environmental Verification (IRB-BART™, SRB-BART™ and HAB-BART™) because they provide field applications where answers are required quickly.

What does aggressivety mean it is used in some of the BART™ literature and protocols?

Aggressivity means the level of activity of the bacteria and was used since it was thought that it was a better term to illustrate the ability of the bacteria to dominate. Today most users prefer the term "activity" and so this has been adopted. Consider activity and aggressivity to mean the same thing for all practical purposes.

How constant are the reaction patterns in the BART™ tester?

In general, the reaction patterns are very constant but the order (in the IRB-BART™) may vary a little from sample to sample but usually all of the reactions will occur in the same pattern for duplicates from a sample.

What is the shelf life on a BART™ tester?

The standard shelf life for most BART testers is four years provided that the aluminum foil pouch has not been breached. Once the foil pouch has been opened then it is recommended that (1) you use the BART testers from that opened pouch as quickly as possible; and (2) that the unused BART testers are kept in a refrigerator with the foil pouch closed shut with tape. Note that these pouches hold either three field testers or five laboratory testers.

When should I use the Field tester kit and when would the Laboratory kits be better?

If you are in the field doing testing or you are going to take the BART testers and do the testing in an office or hotel room then the Field BART testers are better. There are a number of advantages in using the Field tester: (1) is has two complete sets of tubes that protects the tester (the inner vial) making it able to take a rougher environment; (2) if any smells are produced by the tester then the outer vial prevents the odors getting out and causing "problems"; and (3) are very stable and can easily be lined up on a shelf or table top and are not likely to fall over. You will notice that the labels do restrict the view of the inner vial but this has been positioned not to interfere with the observation of the reactions. Advantages with the Laboratory testers are that they: (1) are more economical to use; (2) have good visibility for detecting he reactions; and (3) can allow more testing to be done within a given area (important in many laboratories. Disadvantages for the Laboratory tester is: (1) they can generate smells; (2) they can easily fall over (some people using Laboratory testers actually put them in seedling trays that keep them upright) and (3) there is a higher potential for spillage. It is a good idea to keep a bactericidal aerosol handy to spray down affected surfaces. Wearing disposable latex gloves is also recommended when handling Laboratory BART testers. It should be noted that the smells emanating from the testers can be turned into a diagnostic toll. When clients do not believe that the BART testers have detected some of the problem microbes then loosening the outer cap on the Field tester and asking them to smell the odor usually validates the effectiveness of the BART tester!

Is the BART™ testers still OK to use if it has got frozen along the way to my test site?

If the BART tester is still sealed within the aluminum foil pouch then freezing will not affect the performance of the tester. However repeated freezing can cause problems with the break up of the crystalline chemical medium in the floor of the inner vial that can cause failure. It is recommended that the BART testers are not subjected to any freezing.

Is it better to load the BART™ testers in the field and then take then back for testing or take the sample back and fill the BART™ testers where the tests are going to be done?

Once the BART™ tester has been filled with the sample it is very important to keep the testers upright (within 5^{o} of vertical) and avoid vibration. This is to ensure that the different environments set up quickly within the tester. Minor vibration or a gentle motion (such as at sea) does not appear to affect the performance of the BART testers. If you are going to transport the water sample then let it come up (or down) to room temperature as it is shipped (less than four hours). If shipping is going to be over four hours then ship over ice. The answer then depends upon the local conditions but setting the sample up as quickly as possible with no subsequent major disturbance of the tester is the prime concern.

What are the advantages of me doing BART™ tests when I could send the samples to all labs?

If you want be to in control of bacterial problems then the sooner that you find out then the quicker you can take action. BART testers give you the opportunity to keep right on top of the events without having to wait for a laboratory to complete the tests and send you the results. Remember the laboratory can always confirm (or deny) what you have found using the BART testers but the bottom line is that you are "in the trenches" and you need to know quickly when there are incoming bacterial challenges. You will get familiar with the reactions and time lags that means the water is not biofouled but you will also see when a problem is beginning to emerge sometimes even before your instruments tell you.

Would a BART™ tester be economical to use compared to sending the sample to a laboratory?

The savings are twofold. First you can set the test up straight away when the sample has been freshly taken (shipping the sample to a laboratory takes time and the microbes in the sample would change in their activity level during the shipping to create a compromised sample). Second you do not have to pay the costs of shipping the sample to a laboratory or the laboratory fees for the testing. The costs are your time and the cost of the BART tester itself. Remember that you have a concern with the results and want a confirmatory you can either repeat the test yourself (preferably in duplicate) or you can send the test properly packaged to a certified microbiology laboratory.

What is the sensitivity of the BART™ tester to detecting bacteria?

If you were to take a one liter water sample, the sensitivity of the tester would be to detect down to 67 bacteria in that one liter of sample if it was all tested. For the BART tester, the limit of detection would be one cell in 15mL or 0.07 active cells per mL BART sensitivity is dependent upon the cells inside the sample being active. It is these active cells that can present the greatest risk and that is one reason why the term "predicted active cells" is used.

Is the 15mL of water sample used in the BART™ tester enough to get accurate results?

15ml is an odd number but through about five years of research in the 1980s it was found the smaller volumes did not allow the various environments within the tester to get established (even when 10mL was used!) and so that volume is the minimal volume to achieve repeatable and interpretable data.

What does p.a.c mean and how does it relate to colony forming units?

Time lags are converted by standard formulae to cell population numbers. Traditionally, the colony forming units have been the standard because they relate to a count of individually growing colonies on an agar plate. For the BART tests, the colonies are not counted because activity can be recorded as time lags. From this the predicted active cells (p.a.c.) can be calculated which is similar to a colony count.

What are heterotrophic bacteria?

Well let's call them the "munchies" since they will feed off most sorts of organic food whether it is sugars, fats, proteins or even DNA! They are the trash disposers for organic wastes, the degraders of the solvent and fuel spills. They also come in two forms. One form loves to "munch" in the presence of oxygen and they are called aerobes. They can be very efficient and remove a lot of organics quickly. In the HAB-BART™ tester they generate an UP reaction. The other group of HAB bacteria does not like oxygen and are fermentors often making lots of acids. They cause a DO reaction.

Define the UP and DO reactions for the HAB-BART™?

UP is for a reaction that begins in the base of the tester and moves up the tester. DO is a reaction that starts commonly just below the ball. It sometimes takes a while to form but when it does then it will move downwards.

How do you recognize the HAB-BART™ reaction?

When you start the tester, follow the instructions (protocol DBHSOP05 for fresh water and DBHSSOPO5 for brackish and salt water). The water sample will go blue. This is because the shaking during the protocol saturated the tester with oxygen and the blue color is from the oxidized methylene blue used in the tester. When bacteria have used up all of the oxygen in one part of the tester it blue disappears (as of bleached). If this "bleaching" is first seen starting in the base of the tester then this is an UP reaction. Normally this bleaching will move steadily up the tester to around the ball but there is almost always some methylene blue left as a ring around the ball. In the DO reaction the bleaching begins just under the ball.

What do all of these IRB-BART™ reactions mean to me?

In waters that contain IRB then these reactions mean a lot not only through the time lags generated but by the sequence in which the reactions occur. While the possible permutations appear endless there are some clear trends that can tell you a lot about the water. These will be tackled in two ways: (1) what the individual reactions mean as far as bacterial population make up are concerned; and (2) coding the reactions to form a treatment strategy. Each of these aspects is addressed in the two tables below:

Table (1), interpretation of reaction patters and bacterial characterization

Reaction	Descriptor	Bacterial Characterization	Sequence
WB	White Base	Carbonate producing bacteria. In treating such bacteria consideration should be given to the use of acidic treatments to break up these carbonate deposits.	Primary
CL	Clouded (turbid)	Aerobic IRB community growing in oxidative or redox front conditions. Treatment may require the use of a penetrant as well as a biocide	Secondary
FO	Ring of foam bubbles around ball	Anaerobic IRB community generally deep set and much more difficult to treat. Longer treatments able to break up the biomass would be very important	Secondary
BC	Brown clouded	Usually aerobic IRB that have an ability to accumulate very significant levels of iron within the biomass which may require the use of an iron sequestering agent as well as biocidal penetrant.	Tertiary

BR	Brown ring around ball	Very aerobic IRB found restricted to the redox front and able to cause radical plugging which is commonly easier to treat since the biomass is focused. Treatment can be successful with a good penetrant and biocide or acidic treatment	Tertiary
BG	Brown gel	Generally aerobic, these bacteria produce very thick slime mats that are rich in iron. They generally take longer treatment times to break the biomass down. Often dominated by enteric bacteria.	Tertiary
GC	Green clouded	Commonly aerobic bacteria belonging to the pseudomonad bacteria. These bacteria can produce large volumes of slime that can be controlled by the application of penetrants along with dropping the pH by at least four pH units. It should be recognized that it will take significant time for a treatment to penetrate all of the slime material.	Tertiary
RC	Red clouded	These bacteria can grow aerobically or anaerobically and so can penetrate deeper into the biofouled regions. Treatments have to be moiré vigorous involving pH amendment, iron sequestering agents, penetrants and biocides. Often dominated by enteric bacteria.	Tertiary
BL	Black liquid	This is a mixed community of aerobes and anaerobes including enteric and pseudomonad bacteria. Treatment is challenging because the biomass extends right through the redox front making any treatment more difficult. General treatment should include of biocides, penetrants, pH amendment by at least 4 units and consideration of a large than usual treatment zone. Coliform testing is recommended if there is a "safe" water concern.	Terminal

Note: Consideration should be given to the application of heat as a part of the treatment since this has the double advantage of speeding up the chemistry and traumatizing the bacteria.

Table (2), Coding in a Treatment Strategy for the IRB-BART™ reactions

Reaction	Descriptor	Code number	Sequence
WB	White Base	0	Primary
CL	Clouded (turbid)	1	Secondary
FO	Ring of foam bubbles around ball	2	Secondary
BC	Brown clouded	3	Tertiary
BR	Brown ring around ball	4	Tertiary
BG	Brown gel	5	Tertiary
GC	Green clouded	6	Tertiary

RC	Red clouded	7	Tertiary
BL	Black liquid	8	Terminal

Common reaction patterns may start with code 0, 1 or 2. It is rare for another reaction to occur first. Each of these three codes reflects a specific challenge to treatment. For example code "0" means that there is a high probability of carbonate involvement in the biofouling and that some acidic treatment may have to be applied to break up the carbonates. If "0" has occurred than it is most likely to be followed by either a "1" or a "2" and it is must be treated as a carbonate event as well the treatment associated with the second code. Code "1" indicates that the biofouling is likely to be aerobic (oxidative) and growing closer to the sampling source. Code "2" on the other hand indicates a reductive environment and the possibility that the biofouling is more diffuse and difficult to treat. Treatment should be based for the IRB and the full code observed during the testing period. Code "0" is an overriding code that indicates acidic treatments will be required to break up the carbonates regardless of what other codes were entered. Some of the common code patterns and the potential impact on treatment strategies are listed below:

Code stream	Biocide	Penetrant	pH modification	Physical treatment
1 - 6	+++	+++		++
1 - 3 - (4)		+++	+++	+++
1 - 5 - 3 - (4)	+++	+++	+++	+++
1 - X - X - 8	+++	+++	+++	+++
1 - 7	++	+++	+	+++
2 - 3 - (5)	+++	+++	++	++
2 - 7	+++	+++	+	++
2 - X - X - 8	+++	+++	+	+++

Note: () brackets indicate optional reaction, - X - X - indicates the intermediate reaction codes are not of major significance compared to the terminal reaction 8 code; the + signs indicate the level that should be placed on that form of treatment (+++, high intense, +, marginal importance).

What do the reaction patterns in an IRB-BART™ test mean?

This question is one of the most difficult because there are so many communities of iron related bacteria that each has their own signature. In the IRB-BART™ tester, there is a sequence of reactions that can be used. These are addressed below in the type of order in which they are likely to occur. Reactions occur in four time intervals with the first reaction (primary when it occurs) happening within twelve hours while the secondary, tertiary and terminal reactions occur in a sequence that relates to the type of bacteria that are present and active. These reactions are listed in the table below in the sequence in which they can commonly occur:

Reaction	Descriptor	Characteristics	Sequence
WB	White Base	White crystalline deposit forms within the base of the tester in less than 12 hours. Indicates biological formation of carbonates.	Primary
CL	Clouded (turbid)	Liquid in tester may turn yellow or green (not significant for this reaction) and cloudiness (turbidity) will be seen in the water when held up to the light.	Secondary
FO	Ring of foam bubbles around ball	Gas bubbles on the walls of the tester should be ignored and an FO reaction only occurs when there is a ring of bubbles forming a foam ring around the ball.	Secondary
BC	Brown clouded	Liquid in the tester generates a brown color throughout its length and the tester is too clouded to allow objects to be clearly viewed through the tester	Tertiary

BR	Brown ring around ball	Brown slime ring forms around the ball. Usually 2 to 4mm thick and generally not reflective in light.	Tertiary
BG	Brown gel	Bottom quarter to a third of the tester becomes a brown gel with the liquid above being clear or slightly yellow but not clouded. This reaction will commonly move to BC.	Tertiary
GC	Green clouded	Liquid becomes universally green beginning with a light lime green and moving to a darker shade of green with heavy clouding.	Tertiary
RC	Red clouded	Liquid becomes a distinct shade of red with the color intensifying and becoming clouded before shifting commonly to a BC reaction.	Tertiary
BL	Black liquid	Liquid becomes blackened generally starting at the bottom first and creeping up the walls of the tester to the ball. When this happens the liquid contents of the tester will appear to crystal clear if the tester is tipped.	Terminal

I get confused by the color reactions in the IRB-BART™. How do I decide the best reaction?

IRB-BART™ has a number of reactions that can be confusing. That was one reason why we do not show color reaction charts any more and reduced the number of reactions to the clear and more obvious ones.

There are two reactions for the SRB-BART™, what are they?

SRB stands for sulfate reducing bacteria and these bacteria are commonly associated with microbially influenced corrosion events. There are two very clear reactions. One reaction occurs in the basal cone as an expanding black ring. It begins to form commonly just around the spike in the base of the tester and moves outwards. A positive is considered to have occurred when there is an intense black ring at least 3mm (1/8th inch) around the spike or a intense black patch of similar size elsewhere on the base. This is called a black base (BB) reaction. The other reaction occurs on the lower side of the floating white ball. Here, small black granules form in patches over this area and gradually become more numerous. The centers of these granules have to be an intense black and they have to occupy greater than 5% of the lower hemisphere of the ball. This is known as a black (at the) top reaction or BT. One or other reaction will occur first but if both occur one after the other then the SRB-BART™ will gradually go black throughout the liquid. This is not a recognized reaction but used to be known as the BA (black all) reaction.

Define the difference between the BB and BT reactions in the SRB-BART™?

BB reactions occur deep in the base of the tester and signify that the SRB are actually growing deeper in the media, will be more difficult to treat. These SRB are growing at very deep reductive sites. BT reactions are very different because the SRB are actually growing within aerobic biofilm growths where they are protected from oxygen by the slimes while the other bacteria create suitable reductive conditions for their growth.
By comparison the BT reactions indicate that the SRB are very vulnerable to treatments and controls can be more easily achieved than for the BB reactions.

What is the SLYM-BART™ and what does it detect?

SLYM-BART™ testers are among the most sensitive of the family of BART™ products. It is unusual for another type of BART™ to go positive faster. The reason for this is that the tester contains chemical nutrients that encourage the growth of bacteria that make biofilms (forms slimes). Because the tester is detecting slimes, the reactions are less precise with cloudiness (CL) being the most characteristic reaction and other

re actions more transient. A summary of the reactions are listed in the table below:

Reaction	Reaction term	Definition
CL	Clouded	Turbidity usually general with plate-like growths occasionally occurring early on.
FO	Foam around ball	Foam rings occur occasionally and are normally short lived
DG	Dense gel	This occurs when the clouding occurs only in one region of the tester (near the bottom), the liquid above is clear. Commonly this reaction is transient turning rapidly to a CL
SR	Slime ring	White or light grey slime ring forms around the ball. It often follows a DG or CL reaction.
TH	Threads	White or light grey slime threads interconnect the ball to the base of the tester. They are commonly transient and turn to a CL reaction.
BL	Blackened liquid	Walls of the tester become blackened with a coating that commonly starts near the base of the tester
PB*	Pale Blue	A pale blue glowing zone appears around and for 5 to 10 mm below the ball. It will fluoresce in a UV light (recommended to confirm the PB reaction)
GY**	Greenish Yellow	Commonly the upper third of the medium in the tester will begin to develop a glowing greenish yellow color. It will fluoresce in a UV light (recommended to confirm the GY reaction)

Note: * indicates that the PB reaction will form between days 2 and 5 and will commonly persist for two to four days and will then dissipate; ** indicates that the GY reaction will form in 1 to 3 days and persist for as long as 15 days.

What do the reactions in a SLYM-BART™ mean?

Reactions observed in the SLYM-BART™ do give an idea of the types of bacteria present in the sample. Because the test is one of the more sensitive then these reactions can occur more quickly. A summary of these interpretations is given in the table below:

Reaction	Reaction term	Bacterial types likely to be active
CL	Clouded	This reaction is caused by heterotrophic bacteria in only 50 to 70% of the lag times recorded for the HAB-BART™. These bacteria can be either aerobic or anaerobic and are not differentiated by this test
FO	Foam around ball	This reaction occurs rarely (<5% of the tests) and indicates that the sample is reductive and anaerobic fermentative bacteria are dominating
DG	Dense gel	Some bacteria that form very tight slimes / capsules initially gel up the lower part of the medium. Its size can shrink before it disperses. Commonly these are capable of growing both aerobically and anaerobically and can be associated with tight slime formation,
SR	Slime ring	Aerobic bacteria that produce slimes often will form a plugging ring around the ball. SR are commonly seen when severe slimes or plugging are occurring under oxidative conditions

TH	Threads	Only a few bacteria can produce slime threads (e.g. Zo**ogloea, Alcaligines**). Generally these thread-like growths only last a few days and then disperse into a CL reaction.
BL	Blackened liquid	This occurs when aerobic and total coliform bacteria are both present in the water. Coliform testing is recommended to determine whether there could be a safe water issue.
PB*	Pale Blue	This reaction most commonly occurs in the presence of aerobic bacteria which include the species **Pseudomonas aeruginosa**. This bacteria does present potential health risks to bathers and the sample should be subjected to confirmation by a certified microbiology laboratory
GY**	Greenish Yellow	This reaction most commonly occurs in the presence of aerobic bacteria which include the species **Pseudomonas floutescens**. This species is very common in bioremediation sites and sites with aerobic degradation of organics.

Does the occurrence of bubbles on the walls and scattered under the ball have any meaning?

Bubbles can be a menace in a BART test due to a number of reasons. These include: (1) oxygen coming out of solution as a cold water sample warms up the room temperature; (2) covert gas production such as carbon dioxide, methane and hydrogen by indigenous bacteria in the water that is not a part of the recognized reactions; and (3) geomagnetic effects wherein packets of gas bubbles are seen to cluster on one side of the tester. The only gas events recognized are those that occur when a gas foam ring forms around the ball (common when anaerobic bacteria are present during an IRB-BART™ test as well as the DN-BART™ where it is the crucial component in the test).

Can I test for total coliform bacteria in water using the T-COLI-BART™ system?

Yes you can. The test uses a patented detection method utilizing the fermentation gas produced in the sample. It was developed from the most probable number method (MPN) of enumeration. There are some major advantages over the MPN in that only a single tester is employed and the system includes an incubator, computer controlled monitoring that ensures that the data is interpreted, a presence/ absence test and the population is predicted (as predicted active coliform cells per 100mL, or p.a.c.c./100mL). The tester has three levels of protection to protect the operator and the interpreted data, and graphs, are saved to create an effective chain of custody.

What unusual places have the BART™ testers been used?

BART™ testers have been used extreme environments such as at depths of 10,000’ in the deep ocean, down 1,500’ in experimental mines, in icy conditions with the temperatures just above freezing and in brines approaching saturation. They have also been used to detect bacteria in rain and snow and also in the gas hydrates in the Gulf of Mexico. The robustness of the design extends the ability to detect the “undetectable!”