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THE StressPoint™

FOR EXPERTS | BY EXPERTS

A publication of Engineering Design & Testing Corp.

HURRICANES:
Earth's Super Storms

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STAR BOLTS
The History and Significance

SUBCHAPTER M
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Engineering Design & Testing Corp. is an association of forensic engineers dedicated to the study, and interpretation of loss.

A Message from the President

Dear Friends,

As I sit to write this note to you, it is the Sunday after Thanksgiving and you will receive it in the midst of much holiday busyness. At the risk of seeming like a platitude, I must say that this time of year finds me thankful. Thankful for the chance to reflect on that which has been good, to resolve to make that which was lacking a bit better, and in general to do our best in each thing we find to do.

This issue will discuss star bolts that help preserve and extend the life of buildings, hurricanes that reveal both weakness and strength, and safety on tugboats which help to deliver via ships a lot of what we are able to take for granted.

So, as this year winds down and we move toward the next, take time to reflect. Wishing you every happiness this holiday season and throughout the coming year.

Until Next Time,

Mark D. Russell

Mark D. Russell, Ph.D., P.E.
President and Chief Engineer

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THE StressPoint®

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FEATURE

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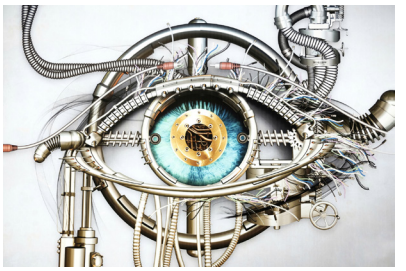
DEPARTMENTS

"Give me a fulcrum and a place on which to stand, and I will move the world."

—Archimedes, Greek Inventor and Mathematician

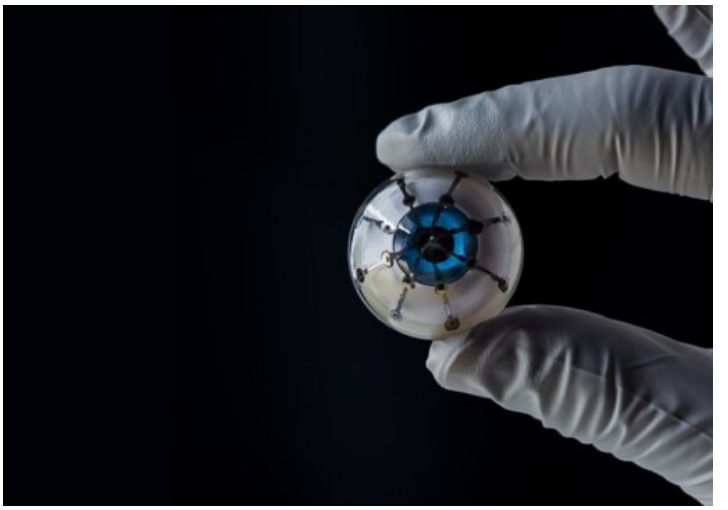


Researchers 3D-Print A Prototype for 'Bionic Eye'

For the first time, a team of researchers at the University of Minnesota have successfully 3D printed a series of light receptors on a hemispherical surface. This success marks a significant step toward creating what has been dubbed, a "bionic eye," that could someday help blind people see or sighted people see better.

When someone thinks of a "bionic eye," their first thought is that of science fiction - like a robot, like the "Terminator" or Cyborgs. But now, we are closer than ever by using a multi-material 3D printer.

Researchers started with a glass dome hemisphere to show how they could overcome the challenge of printing electronics on a curved surface. Using their custom-built 3D printer, they started with a base ink made up of silver particles. Luckily, the ink stayed in place and dried instead of running down the curved surface area. Then the researchers used semiconducting polymer materials to 3D print photodiodes, which helps convert light into electricity.

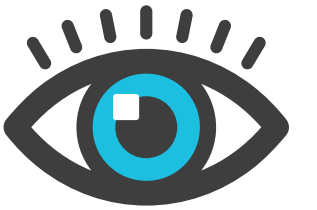


Researchers at the University of Minnesota have fully 3D printed an image sensing array on a hemisphere, which is a first-of-its-kind prototype for a "bionic eye."

To everyone's surprise, the fully 3D-printed photodiodes were able to produce 25 percent efficiency in converting light into electricity. The entire printing process took about an hour to complete.

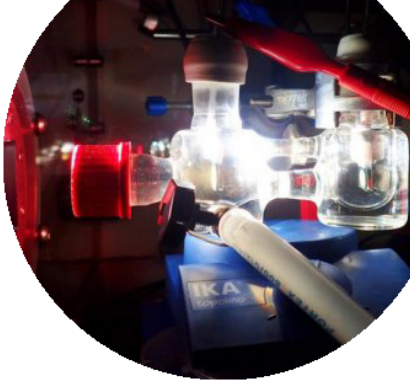
"We have a long way to go to routinely print active electronics reliably, but our 3D-printed semiconductors are now starting to show that they could potentially rival the efficiency of semiconducting devices fabricated in microfabrication facilities," Michael McAlpine, co-author and Professor of Mechanical Engineering, said. "Plus, we can easily print a semiconducting device on a curved surface, and they can't." The next steps in this process are to create a prototype with more light receptors that are even more efficient than the ones they have produced today. Additionally, they would like to find a way to print onto a more softer, realistic hemispherical material that can be used as an implant.

McAlpine and his team are known for combining 3D-printing, electronics, and biology on a single platform. They recently received international attention for also printing a "bionic ear." Since then, they have 3D-printed life-like artificial organs for surgical practice, such as an electronic fabric that could serve as "bionic skin," and cells and scaffolds that could help people living with spinal cord injuries regain some function.



Story source: The University of Minnesota. The story provided by "Science News" of *Science Daily*. Image credit: University of Minnesota, McAlpine Group | Note: Content may be edited for style and length

Turning Sunlight Into Fuel



Scientists have discovered a new way to turn sunlight into fuel. A new study coming out of St. John's College of the University of Cambridge, uses semi-artificial photosynthesis to produce and store solar energy. Taking natural sunlight to convert water into hydrogen and oxygen by using a mixture of biological components and human-made technologies.

To understand how this happens, we need to understand the process of how photosynthesis works. Photosynthesis is the process that plants use to convert sunlight into energy. Oxygen is then produced as a by-product of photosynthesis, and when water absorbed by plants is split, hydrogen is created. The problem with natural photosynthesis, however, is that it is not efficient because it has only evolved just to survive, so it makes the bare minimum amount of natural energy to convert and store. Artificial photosynthesis has been around for years but hasn't been successful for renewable energy because it relies heavily on the use of catalysts, which can be expensive and toxic.

The team of researchers has successfully improved the amount of storage and energy produced by activating a process in algae that has been dormant for a millennia. Hydrogenase is an enzyme present in algae that is able to reduce protons into hydrogen. During evolution, the process had deactivated because it became less necessary for survival. By splitting the water into hydrogen and oxygen, the team can selectively choose the processes they want in order to achieve the reaction they want which is accessible in nature, which would greatly assist in the development of solar technologies. The model in the image (above) is the first to showcase the successful use of hydrogenase and photosystem II in order to create semi-artificial photosynthesis driven purely by solar power.

Story source: Materials provided by St. John's College, University of Cambridge. The story provided by "Science News" of *Science Daily.*
Image credit: Katarzyna Sokól | Note: Content may be edited for style and length

Climate-Induced Soil Changes

The ground on which we stand isn't usually the first thing that people think about when it comes to the impacts of climate change. However, a recent study by researchers at the University of California Riverside predicts that climate-induced reduction in large soil pores might intensify the water cycle which will result in more flash flooding and soil erosion by the end of the 21st century.

Scientists studied the effects of climate change on macroporosity--the amount of large pores in the soil. Macropores, which are greater than 0.08mm in diameter, allow water to be absorbed easily into the surrounding soil. "It's important to predict the response of macroporosity to climate change because of its role in the water cycle, and ultimately in water scarcity, food security, human health and loss of biodiversity," said Daniel Hirmas, an associate professor in the Department of Environmental Sciences and lead author on the study.

Drawing on information contained in a database of soils collected over 50 years from areas across the entire continental U.S. combined with atmospheric data collected from a range of weather stations, researchers examined the changes in macroporosity across a scale of rainfall, temperature, and humidity gradients. They found that macropores were more likely to develop in areas with drier climates rather than humid climates, and that climate-related changes in macroporosity occur over a shorter period of time than they had originally anticipated.

The consequences could be less water filtration into the ground, and more surface runoff, erosion, and more flash flooding. Daniel Hirmas, lead author and Associate Professor in the Department of Environmental Sciences at UC-Riverside, said, "This is the first study to show that the development of macropores is influenced by climate at short timescales and it reinforces the hypothesis that climate change will probably intensify the water cycle. Our results suggest that macroporosity should be incorporated into global climate models to better understand the water cycle, anticipate changes, and prepare for the future."

Story source: Materials provided by University of California - Riverside. The story provided by "Science News" of *Science Daily.*
Image credit: Flooded Farm (Stock image) © Patrick Ziegler / Fotolia | Note: Content may be edited for style and length

HURRICANES

Earth's Super Storms

By: Danielle Newbanks, Editor

Hurricanes are major storms with sustained winds of at least 74 miles per hour (mph) and form over tropical and subtropical ocean water. They start when warm water, moist air, and strong winds collide and create rotating thunderstorms and clouds. A Hurricane's life can span from a few hours to several days, sometimes even weeks. The term "hurricane" is derived from "Huracán," a God of evil recognized by an ancient tribe from Central America. In other parts of the world, hurricanes are known by different names such as typhoons and tropical cyclones.

While all hurricanes can cause harm to people and property, none of them are equal in strength – some can be relatively weak resulting in minimal damage, some can be catastrophic by wreaking havoc on coastlines (and sometimes inland) bringing violent winds, torrential rain and storm surge which can cause landslides and/or flash floods.

Thankfully, we are able to know and assess a hurricane's strength and potential damage by using what is called the Saffir-Simpson Hurricane Wind Scale. The development of this scale has contributed to helping forecasters make more accurate warnings.

The Saffir-Simpson Hurricane Wind Scale

The Saffir-Simpson Hurricane Scale is named after Herbert Saffir (a distinguished Civil Engineer) and Dr. Robert Simpson (a former director of the National Hurricane Center). The scale has been widely used since the 1970s and helps determine the amount of potential damage that may come from hurricanes. Until 2008, the Saffir-Simpson Hurricane Scale factored in such things like storm surge and central pressure. Now, the scale attempts to primarily categorize just wind speeds and is now called the Saffir-Simpson Hurricane Wind Scale. According to the National Weather Service, wind speeds are measured at 33 feet, and the average sustained wind speed recorded is over the duration of 1 minute.

Hurricane Categories

There are five categories of wind strength according to the Saffir-Simpson Hurricane Wind Scale. There are several "damage" thresholds for each wind speed category, but here are the broad-based types of damage that can be expected by each category:

Category 1 Hurricane(s)

Hurricanes with sustained wind speeds of 74 mph to 95 mph are classified as Category 1 Hurricanes. They can cause damage to unanchored mobile homes and some signs, and loose outdoor objects which can become flying debris and break windows. In addition, trees can become uprooted and fall over or large tree branches can break and fall on cars, people, and powerlines causing harm, damage and power outages.

Category 2 Hurricane(s)

Hurricanes with sustained wind speeds of 96 mph to 110 mph are classified as Category 2 Hurricanes. These winds are strong enough to break power poles causing blackouts, but also can cause major damage to roofs, windows and doors.

Category 3 Hurricane(s)

Category 3 Hurricanes have sustained wind speeds of 111 mph to 130 mph and are classified as "major" Hurricanes. Winds from a Category 3 Hurricane which causes damages as previously noted along with the destruction of unanchored objects, mobile homes, detached garages and/or sheds. Blackouts are inevitable and may cover large areas.

Category 4 Hurricane(s)

Hurricanes with sustained wind speeds of 131 mph to 155 mph are classified as Category 4 Hurricanes. These Hurricanes will cause extreme damage to homes, mobile homes, and stores, and structures. Signs are destroyed, trees are uprooted and/or snapped, and blackouts are widespread.

Category 5 Hurricane(s)

Hurricanes with sustained wind speeds of 156+ mph are classified as Category 5 Hurricanes. Most structures in the path of the eye of a landfalling category 5 hurricane are damaged or destroyed. Category 5 Hurricanes cause absolute catastrophic devastation which can result in several years of recovery.

What about a Category 6?

While some media have referred to the possibility of a Category 6, there are currently no plans to modify the Hurricane Wind Scale to include a Category 6 ranking. Some scientists who have proposed the idea of adding a Category 6 ranking say that a few rare hurricanes have winds high enough to warrant a new category. However, should a Category 6 ever become official on the hurricane wind scale, it would likely include hurricanes with winds of 175-180 mph or greater.

What Causes Hurricanes?

Ingredients for Hurricane Formation

What does it take for a hurricane to form? There are seven atmospheric conditions that can cause a hurricane to form such as:

• **Pre-existing Disturbance** or low pressure that forms in low levels of the atmosphere. This starts winds converging and rising upward.

• **Warm Water** to a sufficient depth to support the energy that a hurricane will need. The temperatures need to be roughly 26.5° C or 80° F to a depth of about 50 meters or 150 feet deep.

• **Low Stability** to allow deep convection or cumulonimbus clouds to build to great heights in the atmosphere.

• **Coriolis Force:** The disturbed area of weather needs to be at least 4-5° away from the equator which allows the coriolis force to achieve a gradient wind balance to sustain the low-pressure area.

• **Moist Mid-Level** of the atmosphere. If there is dry air aloft, it will weaken or choke off the updrafts in the cumulus clouds

• **Low Vertical Wind Shear** from the surface to upper troposphere which allows for thunderstorm clouds to build. If the wind speed increases or changes direction with the height, the cumulonimbus clouds get deformed and cannot sustain the hurricane heat engine.

• **Divergence in the Upper Atmosphere** which allows for the transport of mass away from the hurricane.

Hurricane Formation

If the seven conditions listed above are met, a storm will begin to organize, and low-level winds converge toward the center of the low-pressure area. The cluster of convection will start to form rotational bands, and as convection increase, the warm air rises and cools. As the air rises near the core in the low-pressure area, the pressure lowers, and the intensity of the storm and the winds increase, and a tropical storm is formed when sustained winds reach 39-73 mph.

Note that even if all ingredients are in place, it does not always guarantee the formation of a hurricane.

What to do to prepare for a Hurricane?

• Check your surrounding area and identify a safe place of shelter. Determine if wind or storm surge can damage or affect your place of shelter

• Remove lawn furniture, grills, and other yard items to ensure they do not become projectiles during the Hurricane

• Board up windows using plywood or shutters

• Plan for an evacuation and know which evacuation route to take - so have an evacuation map on-hand if possible

• Fill your car with gas in the event you have to leave

• Have a radio and flashlight with backup batteries

• Identify and have a few weeks of medication

• Take some bottled water and non-perishable food if possible or have the means to purify water such as Life Straws or water purification tablets. Pack enough to last for a few weeks

• Buy a portable generator for power, a portable propane grill to cook with, and a chainsaw to remove debris

A Word of Caution from EDT...

Stop and listen to the local authorities. It may not be safe to rush in and investigate. They will let you know when it's OK to return. Roadways and bridges remain susceptible to collapse. Buildings may not be structurally sound. Downed power lines could still be live. It is best to first let the professionals who can safely conduct these evaluations do their jobs before you return, and EDT has engineers with experience and training to assess these very conditions.

As forensic engineers, we understand the potential dangers associated with a catastrophic event. We strive to aid in the recovery process. Our engineers are trained in the evaluation of structural, mechanical and electrical damage. We understand root cause analysis, especially when separating wind-related damage from storm surge and/or flooding. Our large loss engineers assist in the determination of damage and value of loss for large commercial and industrial properties. Our goal is to work as a team to resolve issues, so that people may go back to living their lives.

Subchapter M

What is it, and how is it useful to you?

By: Steven M. Lindholm, P.E., P.M.P.

EDT is now a certified Third Party Organization alongside the US Coast Guard for Subchapter M. Now, let's take a deep dive into the regulations of Subchapter M, certification of towing vessels.

Do you or someone you know operate a towing vessel – better known as a 'tugboat?' Then listen up! This article is for you...an introduction into Subchapter M, certification of towing vessels.

What is Subchapter M?

Subchapter M is a part of the Code of Federal Regulations (CFR), Title 46 (Shipping), Chapter I, Parts 136 to 144. The intent of Subchapter M is to provide a unified basis to inspect towing vessels – tugboats or towboats – which had not been regularly inspected by the United States Coast Guard (USCG) in the past. Subchapter M applies principles worked out for the inspection and certification of many other vessel types to towing vessels.

The mandate to the USCG to develop and implement Subchapter M begins with the 2004 Coast Guard and Maritime Transportation Act. This Congressional legislation instructed the USCG to develop rules for uninspected towing vessels which were operating under Title 46, Subchapter C (Uninspected Vessels, in general), Part 26 and was influenced by two incidents involving towing vessels: the 1993 allision of a tow controlled by the towboat 'MAUVILLA' with the Bayou Canot Bridge, resulting in 47 deaths and 103 injuries when a passenger train derailed as a consequence of the damages and the 1998 Eads Bridge Allision in Illinois with $11 million in repairs.

The USCG estimates, as of 2014, that there were over 5700 uninspected towing vessels which would need to transition into the Subchapter M. At that time, this number represented a 50% increase in the workload of the USCG, without a budget authorization for more inspectors. These 5700 towboats are owned by about 300 operators throughout the country.

The Regulations

There are nine Parts within Subchapter M – four deal with administrative requirements for inspection and five address specific requirements for manning, operating, equipping, and constructing towing vessels. Each Part addresses a specific set of requirements:

- **Part 136 – Certification.** This Part addresses the applicability of Subchapter M to towing vessels, how to get a certificate of inspection, and other administrative duties of the USCG.
- **Part 137 – Vessel Compliance.** This Part specifies the type of inspections, who may inspect, and what the inspections will encompass.
- **Part 138 – Towing Safety Management System (TSMS).** This Part describes what a TSMS is, why an operator may choose to have a TSMS, what equivalent Safety Management Systems are, who can issue a TSMS Certificate, and how compliance of a TSMS will be evaluated.
- **Part 139 – Third Party Organizations (TPO).** This Part defines the requirements a TPO must have to be qualified to audit a TSMS, issue a TSMS Certificate,

perform surveys in lieu of the USCG, and how the USCG will oversee TPO's.

• **Part 140 – Operations.** Requirements for operating and documenting the safe operation of a towing vessel.

• **Part 141 – Lifesaving.** Minimum requirements for equipment onboard a towing vessel, based on its size and operating area, to save the crew in the event of abandoning the towing vessel.

• **Part 142 – Fire Protection.** Minimum requirements for firefighting and fire prevention onboard a towing vessel.

• **Part 143 – Machinery and Electrical Systems and Equipment.** Minimum requirements for mechanical or electrical equipment and systems onboard a towing vessel for propulsion, maneuvering, electrical control, and operational safety.

• **Part 144 – Construction and Arrangement.** Minimum requirements for the design, construction, and arrangement of towing vessels to comply with stability requirements, structural fire protection, habitability, egress and crew protection, and ventilation.

This article will focus primarily on Parts 136 through 139. If you are interested about the technical requirements of Parts 140 through 144, please contact your local EDT office or view the information on EDT's website on Subchapter M: *http://www.edtengineers.com/subchapterm*

Subchapter M became effective July 20, 2018. Not every towing vessel will be required to comply with the requirements of Subchapter M – there are exclusions, such as:

1. Small towing vessels (less than 26 feet in length);

2. A vessel engaged in assistance towing (towing a disabled vessel) or towing recreational vessels;

3. A workboat operating exclusively within a worksite and performing intermittent towing within the worksite;

4. A seagoing towing vessel of 300 gross tons or more subject to the provisions of Subchapter I of Title 46 (an inspected vessel); or

5. A vessel that is laid up, dismantled, or otherwise out of service.

The document each towing vessel must have onboard will be the Certificate of Inspection (COI), issued by the USCG. There is a phase-in period for obtaining a COI for a towing vessel, dependent on the size of the operator's fleet. Yearly, starting on July 20, 2018 through July 19, 2022, one quarter (25%) of each towing vessel operator's fleet (subject to Subchapter M) will need to have a COI at the end of the next year. Operators with a single existing towing vessel will need to have a COI not later than July 20, 2020.

There are Three Means to Obtain and Retain a COI:

1. Have the local USCG Office(r) in Charge of Marine Inspections (OCMI) send a USCG inspection party (USCG Option), or

2. Have an approved Towing Vessel Safety Management System (TSMS) or equivalent (TSMS Option) and:

a. Have a survey by a Third Party Organization (TPO) or equivalent documenting the vessel condition, or

b. Have a survey by internal surveyors documenting the vessel condition, audited by a TPO.

What is a TPO?

A Third Party Organization is an independent, commercial entity which has been approved by the USCG. The TPO acts as a certifying body – very similar to a certifying body for an ISO 9001 Quality Management Certificate. The TPO itself must have a Quality Management System, qualified auditors and surveyors, and have submitted extensive documentation to the USCG explaining how it will conduct audits and surveys.

Audits and Surveys

As mentioned previously, Part 137 addresses inspection requirements and Part 138 addresses requirements of a TSMS. Having an approved TSMS is a requirement to elect to use the TSMS Survey option; a towing vessel operator does not need to have a TSMS to be granted a COI – there is the USCG Option, where the inspection is done by the USCG.

However, there are compelling reasons to choose the TSMS option. The most significant is to have surveys done at the operator's convenience, rather than the USCG's. As stated in the beginning of this article, the USCG expects a 50% increase in workload with no increase in capacity. Choosing a TPO to provide these services allows the operator to have flexibility, working with a non-governmental company. to arrange for surveys and audits at their convenience.

(Continued on the next page...)

A TPO may provide the following services to the towing vessel operator:

TSMS Audits and Certification

The first step a towing vessel operator must do to work with a TPO – besides choosing a specific TPO to work with – is to create a Towing Vessel Management System. The TSMS should address the operations of the towing vessel company; policies regarding hiring, training, and retaining crew; responsibilities of the Safety Management Officer and the Master(s) of the towing vessels; and specific requirements set forth in Subchapter M on towing vessel operations.

Some operators may be able to take advantage of another solution for the TSMS – having an approved International Safe Management (ISM) system and certificate. Certified ISM are considered to meet the requirements in Part 138, as long as elements specific to towing vessels as described in Parts 140 through 144 are included in the ISM system. Other SMS, such as the Responsible Waterways Operator (RWO) program, may be accepted by the TPO as equivalent.

With a TSMS created, it will be reviewed by the TPO and audits will be arranged. TPO auditors attend the following audits:

1. The initial audit of the towing vessel operator's office(s) for compliance with the TSMS.

2. Shipboard audits for verification of compliance onboard the towing vessels. All towing vessels within an operator's fleet shall be audited at least once within the five-year validity of the TSMS Certificate.

3. A mid-term – sometimes referred to as an intermediate – audit at around 2-1/2 years. This is an audit to verify continued compliance with the TSMS, looking for changes in the TSMS and validating the corrective actions taken to curb drift in compliance.

4. A renewal audit prior to the expiration of the TSMS Certificate.

After a successful initial audit and one shipboard audit, a TSMS Certificate will be issued by the TPO.

Initial and Annual Surveys

Once the TSMS has been approved, a report of a satisfactory survey must be provided by the towing vessel operator to the USCG. The 'TSMS Option' allows for two ways an operator can satisfy the inspection criteria of Subchapter M given in Part 137: external or internal surveys. These do not refer to the extent of the survey (outside versus inside); rather, they describe who carries out the survey – a TPO or internally by qualified employees/contractors of the operator.

The 'TSMS Option' with internal survey may use employees of the operator or hired external contractors. In either case, sections 139.130 and 139.210 have very specific requirements the operator must plan for:

- The TSMS must be specific in addressing the degree of survey, means to identify non-conforming results and their corrective actions, identification of who can hold or release the vessel (in cases of serious deficiencies), and the experience required to conduct the survey;
- An internal survey program would need to be created for the OCMI;
- Identification of the survey persons;
- The qualifications of the survey persons; and
- TPO oversight of the internal survey

The major advantage of the internal survey method of the 'TSMS Option' is the ability for the operator to make the survey a 'continuous' survey, where the elements of the internal survey program are evaluated over a year, as long as all elements are evaluated at least once in each yearly cycle. The TPO would then endorse the survey report to the USCG.

The external survey is done by the TPO. The TPO has approved survey programs, personnel, and authority by the USCG. The TPO simply provides a survey report to the USCG. After the issuance of a COI, the towing vessel must be surveyed annually to retain the COI.

Dry-docking and UWILD

Depending on the service profile of a towing vessel, a periodic inspection of the complete hull of the towing vessel will need to be done. This has to be done out-of-water – thus, a 'dry-dock' survey – and with the following frequency:

- A towing vessel which operates in salt water for more than 6 months of each year needs to have two (2) 'dry-dock' surveys in each 5 year period of the Certificate of Inspection (COI). The 'dry-dock' surveys shall have no more than 36 months (3 years) between surveys.
- A towing vessel which operates in salt water for 6 months or less of each year needs to have one (1) 'dry-dock' survey in each 5 year period of the COI.

Part 137 of Title 46, Subpart C, defines the 'dry-dock'

survey. This Subpart is entitled 'Dry-Dock and Internal Structural Survey,' which describes completely the scope of this periodical survey. A 'dry-dock' survey will cover an inspection of the external hull, propulsion, and external machinery components. It will also examine internal structure of the towing vessel, including the ship sides, bow, stern, foundations, voids, ballast tanks, fresh water tanks, built-in fuel tanks, and bulkheads.

The UWILD survey – UnderWater Inspection in Lieu of Drydocking (another cute acronym from our government) – is a substitute for a 'dry-dock' survey. For vessels approved for this program, an external survey of the underwater portions of the towing vessel can be done by a diver with supplied video to a surveyor/inspector.

For a vessel to be considered for the UWILD survey option, the following conditions must be satisfied:

- No obvious damages or defects have been reported to the towing vessel hull;
- The operation of the towing vessel has been satisfactory since the last dry-docking;
- The vessel is less than 15 years old (though there are provisions for older vessels – keep reading)
- The towing vessel hull is made from steel or aluminum;
- The hull is protected with a protection system.

If a towing vessel is over 15 years of age, but otherwise meets the five bullet points above, it may still be allowed to have a UWILD survey. For vessels over 15 years of age, a UWILD survey may be conducted at alternating intervals – that is, once in each 10-year span – provided:

- The bullet points above are met (except for the 15 years or less requirement);
- A complete set of hull thickness measurements (gauging) had been carried out at the previous 'dry-dock' survey.

Verification of Compliance (Plan Review)

Verification of compliance of a towing vessel to this part must be performed if the vessel is new, is undergoing a major conversion or alteration, or a new installation that is not 'replacement in kind' prior to the action or issuance of the COI. Verification can be done by a Professional Engineer, working within his scope of registration, or an authorized classification society. Verification of compliance with the design standards may be required for one of the following circumstances:

1. The towing vessel is new – constructed after July 20, 2017;
2. The towing vessel is to undergo a major conversion or alternation after July 20, 2017; or
3. The towing vessel is being equipped with a new installation which is not 'replacement in kind.'

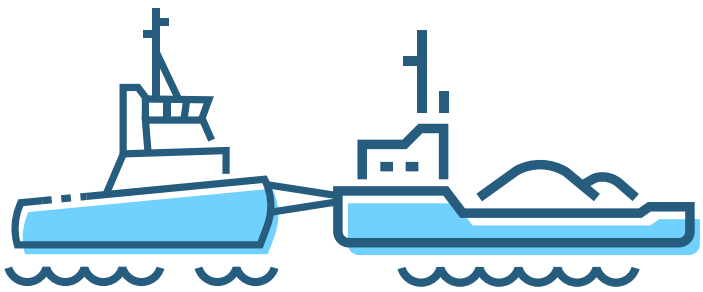
For a new vessel, the verification of compliance must be completed prior to issuance of the towing vessel's initial Certificate of Inspection. For a major conversion, the verification must be performed prior to the change. For a new installation which is not 'replacement in kind,' the verification must be done prior to the new installation.

The terms 'major conversion' and 'replacement in kind seem quite vague on initial reading. Fortunately, the Subchapter M includes definitions for all phrases used in Subchapter M which could be confusing. Subchapter M defines 'major conversion' as:

1. A substantial change in dimensions or carrying capacity;
2. A change in the type of vessel;
3. A change which substantially extends the life of the vessel; or
4. Otherwise changes the vessel so that it can be considered a new vessel by the USCG Marine Safety Office.

Likewise, 'replacement in kind' is defined as the replacement of existing equipment with new equipment with the same specifications and performance as the original equipment. If the replacement equipment upgrades or improves the system in which the replacement is made in any way, it is not 'replacement in kind.'

(Continued on the next page...)



Systems which a 'major conversion' or not 'replacement in kind' may include:

- Hull and superstructure
- Stability
- Habitability
- Egress and personnel protection
- Ventilation
- Lifesaving
- Firefighting
- Propulsion or auxiliary machinery
- Electrical equipment and distribution

While the USCG could verify compliance directly, the towing vessel operator may find this to be a lengthy process. Part 144 of Subchapter M allows other entities to verify compliance through plan review – Professional Engineers and classification societies. There are compelling reasons to choose one or the other – flexibility and availability are two important considerations. Familiarity is another. If an operator has a relationship with a classification society, this would be a prime reason to have plan approval done by a classification society.

EDT as TPO

EDT has been approved by the USCG to be a TPO and provide the following services to a towing vessel operator:

1. Review TSMS and audit towing vessel operators;
2. Issue TSMS Certificates;
3. Conduct initial and annual inspections of towing vessels;
4. Conduct dry-docking inspections (or approved equivalent) of towing vessels; and
5. Carry out Verification of Compliance reviews (plan reviews).

EDT's TPO Program is spearheaded by the Oakland, California District Office. Applications to participate in the 'TSMS Option' using EDT as your TPO should be made to the Oakland District Office. As interest in Subchapter M expands, EDT expects all offices near coastal ports or rivers may have towing vessel operators as clients. The following EDT consultants or adjunct staff will be part of the initial response to Subchapter M requests:

Steven Lindholm, PE, PMP. Mr. Lindholm is the TPO Program Manager in the Oakland District Office and lead surveyor. Licensed in the disciplines of Naval Architecture, Marine, and Mechanical Engineering, he has more than 45 years' experience in the marine industry. Mr. Lindholm spent 14 years as a ship surveyor for a major classification society.

Raman Ahuja. Mr. Ahuja is the lead auditor for the TPO Program. Domiciled in Seattle, Washington, Mr. Ahuja reports to the Oakland District Office. Mr. Ahuja has been an auditor of Safety Management Systems and Quality Management Systems since the inception of the International Safety Management (ISM) Code in 1996.

David Williams, P.E., CFEI. Mr. Williams is the District Manager for the Seattle-Tacoma District Office. Mr. Williams has agreed to be a surveyor for the TPO Program under the supervision of the lead surveyor. Mr. Williams was a U.S. Navy submarine mariner for 9 years, becoming familiar with all aspects of a ship. Mr. Williams has extensive experience in combustion equipment, rotating power equipment, controls, and instrumentation.

David Shamrell, M.E., P.E., CFEI. Mr. Shamrell is a consulting engineer in the Seattle-Tacoma District Office. Mr. Shamrell has agreed to be a surveyor for the TPO Program under the supervision of the lead surveyor. Mr. Shamrell worked for 8 years at the Puget Sound Naval Shipyard performing repairs, upgrades, and testing onboard submarines and aircraft carriers. Mr. Shamrell is well versed with vessel-based fluid, mechanical, and electrical systems.

We invite you to become familiar with the information EDT has compiled on our website about the processes of choosing a TPO for your Subchapter M needs and sections distilling the information contained in Parts 140 through 144 of Subchapter M.

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ON THE COVER: Tugboat

ABOUT THE AUTHOR:

Steven Lindholm, P.E., P.M.P.

With 34 years in the maritime industry, being EDT's marine engineer allows Mr. Lindholm to return to his roots while indulging a passion for consulting with EDT's clients who specialize in ship, marine and cargo incidents.

Mr. Lindholm offers consultation in inspection, evaluation, and design analysis of ship construction; stability; propulsion and auxiliaries' ballast water treatment; vibrational analyses; and ship motion. He is well-versed in the application and interpretation of international (International Maritime Organization (IMO), class society, and flag state), United States Coast Guard (USCG/CFR), and regional regulations/guidelines to maritime incidents. Mr. Lindholm has experience in root cause investigation and analysis of mechanical damage to equipment, components, and materials, including fracture analysis and failure analysis, as well as preparation of repair and replace cost estimates for marine, industrial, commercial, and residential systems. He applies the principles of Project Management to monitor workflow of repair/reconstruction activities. Mr. Lindholm also has experience in the design and evaluation of photovoltaic systems.

The History and Significance of Star Bolts

By: Edward M. Deegan Jr., M.S., P.E.

HAVE YOU EVER NOTICED EYE-CATCHING STARS POSITIONED ON THE FRONTS OF MASONRY ROW HOMES IN URBAN AREAS, SUCH AS PHILADELPHIA, NEW YORK, BALTIMORE AND VARIOUS OTHER CITIES? THE STARS ARE NOT JUST ORNAMENTAL; THEY ARE ALSO FUNCTIONAL.

From colonial times through post World War I, many buildings were made of load-bearing brick masonry and timber. Residential buildings of the eras, commonly known as row homes, were made of brick masonry walls and wood-framed floors and roofs. The wood framing, known as joists, often spanned side-to-side of the structures. The ends of the joists were seated in pockets in the masonry walls. Good quality construction also included iron anchors between the joist ends and masonry walls.

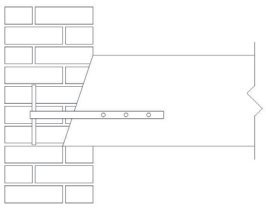

Fig.1- Wood joists pocketed into masonry walls and held with metal anchor

The joists braced the multi-story masonry "party" walls, but the framing configuration left the front and back masonry walls in need of alternative bracing techniques. The bracing techniques were required to overcome the tendency of the multi-story masonry walls to buckle. A common alternative technique included iron anchors similar the those mentioned above, except the alternative anchors were much longer to engage numerous parallel joists. Alas, nothing lasts forever. This holds true for building materials — especially iron encased in masonry that experiences countless cycles of wetting and drying by being an exterior mass wall (that's a topic for another day). Over time, the iron anchors would decay and lose their effectiveness to brace the front and back masonry walls.

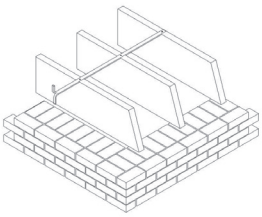

Fig.2- Anchor detail for walls parallel to joists

In the absence of sufficient bracing, the walls will begin to bow or buckle. If the problem is noticed before the buckling wall falls, a new anchor can be installed through the wall. The anchor includes a metal rod/tie, which passes through the masonry wall and engages a series of joists. Given certain constraints and details, wood blocking may be added between the joists to resist the horizontal force from the anchor. A "washer" is installed over the end of the rod that protrudes through the masonry wall. The intent of the washer is to distribute pressure on the brick masonry. A nut is then placed over the washer to tighten the assembly and brace the wall.

Inside the building, the anchor is often concealed in a floor cavity. However, outside the wall, the anchor would be clearly visible. To improve the distribution of pressure on the brick masonry and better brace the wall, a star shape is used. The star shape also serves to increase the visual appeal of the anchor.

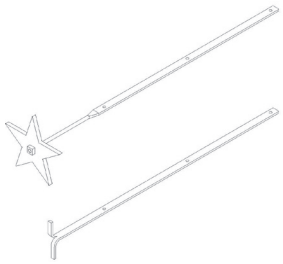

Fig.3- Assortment of anchors, including a star bolt

While the star is actually a washer in this arrangement, the entire assembly is often referred to as a star bolt. The next time you are walking down a city street, watch for a star bolt or two...now you know that they are not just aesthetic; they are also functional.

Glenn M. Armstrong, M.S.M.E., P.E., Recognized By The American Petroleum Institute (API) For 30 Years of Service

By: Mark D. Russell, Ph.D., P.E.

During the 2018 Exploration and Production Standards Conference on Oilfield Equipment and Materials held in Denver, Colorado, Engineering Design & Testing Corp. (EDT) Engineer Glenn Armstrong, M.S.M.E., P.E. was presented with a 30-year award for participation in API standards activities.

Glenn commenced involvement with API standards subcommittees and task groups in 1988 when he found calculation errors in a table that listed the performance properties of drill pipe tool joints in a recently published standard update. Since then, he has participated as an industry expert in the areas of oil country tubular goods (OCTG), drill stem elements and drilling equipment and structures.

In addition to his work with API, Glenn is a 30-year member of NACE International - The Corrosion Society where he participates in specific technology groups for standards related to metallurgy, corrosion, high-temperature applications, and oil and gas production and refining. Glenn is also a life member of the American Society of Mechanical Engineers (ASME) International and long-term member of the American Society of Nondestructive Testing (ASNT) and the American Welding Society (AWS).

Glenn has been with EDT since 1989 and consults on analysis of failures, inspection and testing, and repair of damage in the areas of oil & gas exploration and production, refining, petrochemicals, heavy chemicals, fertilizer, fine chemicals, power generation, industrial gas, and related industrial facilities.

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LONG STORY SHORT

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