



CABLE MANAGEMENT
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Choose an Integrated Cable Management Solution for Upstream, Midstream and Downstream Facilities

By Bob Crain

OVERVIEW



The global oil and gas industry faces a complex set of challenges including multi-national projects with different governmental regulations varying from site to site, climate conditions with extreme temperatures of both hot and cold, and a variety of hazardous conditions such as wet, salty, and caustic environments. To meet these demanding needs, technology and infrastructure design are continually evolving.

This paper considers the various needs for cable management systems at each stage of the process — upstream, midstream, and downstream. While the needs vary at each process stage, we find the best solution to be a fully integrated open cable management system that pairs aluminum ladder for main power circuits with wire mesh tray for branch circuits and control cabling. This proven combination meets the safety, performance, and specific needs at every stage of the petrochemical industry.

UPSTREAM: UNIQUE ENVIRONMENTS REQUIRE TARGETED SOLUTIONS

OFFSHORE DRILLING FACILITIES

Offshore drilling facilities face a unique combination of environmental challenges including extremes of hot and cold temperatures, plus wet, salty, and corrosive conditions. They are subject to hazards from high-frequency vibrations caused by engines and drives, and very low-frequency shock caused by constant wave action. Since floating platforms require three to five pounds of structure for every pound of material it supports, weight is an especially important consideration. Because these facilities are often located far from shore, there is also a heightened need to guard against fire and safety hazards, such as the risks of sparks and lightning.

Aluminum cable tray is particularly well suited to these environments. It performs well in extremes of both hot and cold temperature, offers corrosion resistance equal to stainless steel and hot-galvanized carbon steel, and is half the weight of its stainless steel equivalent. Marine grade aluminum tray is copper free, which dramatically improves corrosive resistance in salt water environments. Although aluminum is physically less durable than steel, it is non-ferrous material, so spark hazard is greatly eliminated.

Components used in offshore facilities must meet the rigorous DNV (Det Norske Veritas) certification requirements for use in applications onboard ships and mobile offshore units. Innovative wire mesh tray made from passivated stainless steel meets these requirements, which include conditions of cold, vibration, impact, temperature rise, shock loading and tests for short circuit and corrosion protection. Stainless wire mesh tray is one of the only cable management types that can meet the multitude of requirements.

ONSHORE DRILLING FACILITIES

Onshore drilling facilities operate much differently than their offshore counterparts. The conditions are more rugged and in many cases the drilling equipment is continually assembled and disassembled for reuse at a new drilling site.

Hot-dipped galvanized carbon steel and stainless steel ladder tray has been a traditional choice in these facilities, since steel is especially durable, its corrosion resistance is good and weight is not generally a factor at these locations.

Reinforced fiberglass cable management systems have also been widely used. Fiberglass offers superior corrosion resistance, but it is less durable than galvanized carbon or stainless steel.

Aluminum ladder tray offers corrosion resistance equal to stainless steel and hot-dipped galvanized carbon steel without the weight. A 20-foot section of steel tray weighs approximately 100 to 120 pounds, while the same length of aluminum tray weighs 50 to 60 pounds. This makes installation much easier, fast and more efficient.

Onshore facilities often disassemble, transport, and reuse components in order to reduce costs. Steel is a good choice under these circumstances because it is durable enough to withstand repeated tear down and set up. The disadvantage is its weight. Fewer installers with less equipment is required for aluminum systems, which results in significant cost savings versus steel.



SHORT-TERM STORAGE TANKS

Short-term storage tanks for crude oil and gas storage at drilling sites must meet the same tough environmental challenges as onshore drilling facilities. These above-ground tanks require cable management systems with specially designed large-radius tray that can handle both the heavy, large-diameter cabling required for powering pumps plus an extensive network of control cabling.

The quickest and most cost effective solution is hot dip or stainless steel wire mesh tray. The ability for the tray to be configured to exactly the needed radius and dimensions onsite makes it the obvious choice. Aluminum or steel ladder tray requires either expensive custom designed radius components or a series of short straight sections with adjustable splice plates that are not very aesthetically appealing.

MIDSTREAM: LONG RUNS, REMOTE LOCATIONS AND CORROSIVE CONDITIONS DEMAND INNOVATIVE ENGINEERING

ABOVE-GROUND PIPELINES

Above-ground pipelines over long, straight runs pose significant challenges to cable management systems due to the severe expansion and contraction inherent in this type of installation. When exposed to 100 degrees of temperature change, 100 feet of steel pipe will expand one-half inch and aluminum tray will expand a full inch. Innovative solutions are required to handle these extremes, including slotted splices and sliding supports that allow for material growth and contraction. Often specially designed bends and turns are utilized that can accommodate many inches of thermal expansion and contraction that occurs. Also the differential between expansion rates is a critical design factor that needs to be addressed. Most often the support structure is steel and the tray is aluminum so additional expansion of the tray needs accommodation.

EXPANSION CONSIDERATIONS WHEN USING BOTH ALUMINUM AND STEEL STRUCTURES

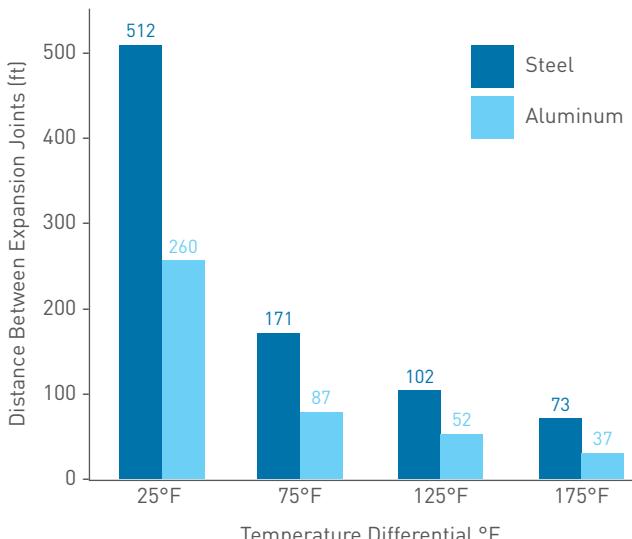
Expansion and contraction due to temperature change must be taken into consideration when planning long sections of aluminum cable tray attached to exposed sections of pipeline or longer exterior cable pathway runs. Table A shows the effect of temperature on the expansion of different materials.

Corrosion resistance must also be taken into consideration when choosing a cable management system since highly corrosive impurities in the unprocessed crude oil and natural gas pose a risk to pipelines and the secondary equipment installed with them, including cable management systems.



■ Table A

MAXIMUM SPACING BETWEEN EXPANSION JOINTS THAT PROVIDE FOR ONE INCH (25MM) IN MOVEMENT



*VE 2-2013, pg.13

MAINTENANCE HUTS & ON-SITE CONTROL ROOMS

Maintenance huts and on-site control rooms have an entirely different set of challenges, which require a very different but equally innovative engineering solution. These enclosures are usually pre-fabricated units located at remote sites. They are very often small, cramped spaces, which are ideally suited for wire mesh cable tray. Wire mesh systems are light weight, easy to configure, quick to install, and integrate seamlessly with aluminum ladder tray. Wire mesh tray with stainless steel finish meets the petrochemical industry's demanding standards for non-corrosion and stable performance at all temperatures.

MIDSTREAM STORAGE TANKS

Midstream storage tanks require cable management systems that can withstand all the temperature extremes and hazardous conditions which challenge long distance pipelines and remote stations. Aluminum ladder tray paired with wire mesh tray meets these demanding needs. In addition, this integrated management system includes heavy duty, large-radius components for large diameter cable, provides flexibility for extensive control cabling, and since aluminum is a non-ferrous material, it meets the safety requirement with secure grounding/bonding capabilities.

DOWNSTREAM: COMPLEX FACILITIES HAVE SPECIALIZED NEEDS FOR SAFETY, LONGEVITY AND CONNECTIVITY

REFINING AND PROCESSING FACILITIES

Refining and processing facilities, many with expected life-spans of 30 years or more, require extra vigilance when it comes to issues of electrical and fire safety. Grounding requirements are especially stringent for these facilities, since tall refinery tanks and vent stacks create lightning hazards. Fortunately, metallic cable pathways offer a redundant ground as an extra level of safety. Aluminum cable pathways are UL approved and have a higher capacity for grounding than other materials, handling up to 2000 amps. Steel cable trays are not allowed as an EGC for circuits with ground-fault protection above 600 amperes. See Table B. to compare the excellent properties of aluminum as a redundant Equipment Ground Conductor (EGC).

■ Table B

METAL AREA REQUIREMENT FOR CABLE TRAY WHEN USED AS AN EGC

Maximum Ampere Rating in Cable Tray System	Minimum Cross-Sectional Area of Metal*			
	Steel Cable Trays		Aluminum Cable Trays	
	mm ²	in ²	mm ²	in ²
60	129.0	0.2	129	0.2
200	451.5	0.7	129	0.2
600	967.5	1.5	258	0.4
1200	—	—	645	1.0
2000	—	—	1290	2.0

* Minimum cross-sectional area of metal (as adapted from NEC table 392.60 (A))

Fiberglass tray is not recommended, since it requires an extra grounding system which makes it more expensive. In addition, pulling cable into fiberglass tray often causes static charge buildup which can have disastrous affects.

Flammability regulations for Class 1 hot work installations must also be taken into consideration when choosing a cable management system. Steel is not recommended, as it requires welding (hot work), which adds time and complexity to the project. Aluminum ladder tray, however, can be field modified without inherent spark risk. Wire mesh is even easier to work with, since it can be cut and modified with bolt cutters. Connections are made by bolting or with innovative, snap-on connectors.

ROAD AND RAIL CROSSINGS

Road and rail crossings are very common at most refining and processing facilities. These require special long-span trays of 30 to 50 feet, which use a common support structure for piping, power and control cabling. It is important to choose a cable management system that can easily link long-span tray with shorter span tray to reduce initial purchase, shipping and installation costs. Long-span tray is a unique design specifically engineered for the occasional roadway or span where support is not available. It is much larger and robust and can weigh up to ten times more than a typical NEMA 20C tray. Cost savings will be significant if specifying long span type trays for just those few locations and utilizing a more standard tray for the fittings and areas leading up to the crossing.

TUNNELS AND TRENCHES

Tunnels and trenches are another commonly used method for providing cabling and piping pathways. These are usually poured concrete construction and include multiple pathways for control cabling, power cabling, fluid piping and compressed air. Flammable fumes tend to sink and settle in these areas, so non-ferrous cabling systems with redundant grounding and spark-free installation practices are required.





THE RIGHT CHOICE:

An Integrated Cable Management System Designed to Meet the Full Range of Industry Needs

At every stage of extracting, transporting, and manufacturing, the petrochemical industry's complex needs require a multi-faceted, fully integrated system approach to cable management. Such a system must include:

- Complete line of cable tray — in multiple sizes, finishes, and load-bearing capabilities
- Broad range of support components—to simplify installation without field modification
- Comprehensive cable security accessories — such as covers and locks to protect against weather, dust, tampering, or other safety/security needs

The components and assemblies must meet rigorous IEC and DNV certification. Because this industry spans the globe, the ideal system should be available on a world-wide basis, with local purchasing sources.

Cable management systems using aluminum ladder tray for main circuit runs combined with wire mesh tray for branch circuits and/or control cabling offer the best overall solution. The newest aluminum tray design features mid-span splicing components that reduce total supports required while maintaining NEMA load class without the need for field fabrication. Wire mesh tray with stainless steel finish meets the industry's demanding needs for non-corrosion and stable performance at all temperatures.

These combined systems are quick and easy to install and modify. They meet rigorous industry certification requirements and are currently being used by leaders in the petrochemical industry across the globe.



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Bob Crain, P.E. is a registered electrical engineer in the state of Illinois with 25 years of experience working for several leading US cable tray manufacturers. Bob is a leading expert on industry standards for the cable tray market. For the past 15 years he has been a member of the NEMA Technical Committee (5CT) and is currently a representative for the North American IEC, focusing on Standard 61537 for cable tray. Over his career, he has lent his expertise to numerous NEC code changes, written articles for industry trade magazines and published many white papers.

For the past 10 years, Bob has worked for Legrand/Cablofil in Mascoutah, IL, and currently holds the position of Director of Marketing/Product Development.