



MOULDED PLUG CABLE ASSEMBLY

AIRCRAFT GROUND POWER

400Hz

HISTORICAL BACKGROUND.

The founder of **Skyko International** has gathered an experience of 30 years in power connection assemblies for aircraft and underwater applications. This experience includes initial concept and design, industrial production and quality control but also an invaluable knowledge of the actual working environment of the product in the field.

The production facility based in Plattsburg NY, USA, is fully integrated with a complete machine shop enabling in-house production of all necessary tooling.

The quality of its products has given **Skyko International** the status of preferred or even exclusive supplier to some major operators in the USA.

PRODUCT GENERAL DESCRIPTION.

The product of **Skyko International** described in this PTI is a **factory-moulded cable assembly** for use of providing 400Hz ground power to an aircraft. The plug is made of a specially formulated rubber compound that mates perfectly with the rubber jacket of the cable.

Factory moulding of the plug directly onto the cable gives the best possible cable assembly with perfect continuity between plug and cable, both in terms of water tightness and of mechanical strength and integrity.

It is also a complete cable assembly offering the quality guarantee from a specialized supplier instead of a combination of different sources of a plug attached to a cable. The quality and reliability of the cable assembly is at the front end of a converter or a GPU, and as such determines the reputation of its manufacturer.

DESIGN OF CABLE ASSEMBLY.

Skyko International Cable Assemblies described in the present PTI are banded Cables, i.e. they are made of separate cables banded together.

Compared with a single-jacketed cable where all conductors are covered by a common outer sheath, the banded cable assembly offers a number of advantages viz. :

- Easier to handle as small diameter cables are more flexible than a single large-diameter one,
- Has a much better heat dissipation for same conductor cross-section,
- Enables easy repair by cutting the damaged part and in-line splicing.

One of the drawbacks often pointed at the banded cable assembly is that it has a higher voltage drop than a so called "balanced" cable such as a concentric "six-around-one", e.g. 7 x 35mm².

Although this statement is technically correct, this difference is particularly noticeable when one considers that all phases are carrying an identical current at maximum value and no current flows into the neutral conductor.

In this case a banded cable assembly could indeed generate an additional 1V drop at 260A on a 10-m long cable, e.g. 3.0V instead of 2.0V for a "balanced" cable of an equivalent cross-section. Besides that this difference could be easily dealt with by the frequency converter, it is a purely theoretical consideration because in the real world the aircraft power consumption is never balanced between the three phases and the consequent gradient between the individual electromagnetic fields of phases and neutral conductors is mitigated.



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To the contrary, a banded cable does not present the drawback of the concentric “six-around-one” single-jacketed cable which has a neutral conductor (often of only half the size of the phase conductors) located in the unfavourable central position.

The neutral in the central position is the shortest of all conductors which are laid in a helix around it. Therefore it is the neutral conductor that takes all the mechanical strain in the cable due to pulling and bending. Rupture of the neutral is not uncommon and the consequences can be catastrophic as the current running through the neutral will then be transferred to the mass of the aircraft.

CABLE CONSTRUCTION.

The cables used by **Skyko International** have been selected for their high performances in current carrying capacity and in the ability to withstand their harsh working environment including abrasion and exposure to chemicals and solar radiation.

The cable is made of a thermoset rubber, chlorinated Polyethylene Elastomer (CPE), that surpasses thermoplastics in flexibility, high temperature, low temperature and mechanical strength.

	AWG #8	AWG #6	AWG #1/0	AWG #2/0	AWG #4/0
Cross Section	8.4 mm ²	13.3 mm ²	53.5 mm ²	67.4 mm ²	107.2 mm ²
Nominal Strands	162 x #30	259 x #30	1056 x #30	1320 x #30	2090 x #30
Outer Diameter	9.8 mm	10.9 mm	16.2 mm	16.9 mm	19.8 mm
Amps per NEC Table 400-5	80 A	105 A	260 A	300 A	405 A
Weight	171 kg/km	223 kg/km	655 kg/km	826 kg/km	1198 kg/km
Voltage Rating	600 V				
Temp. Range	-50°C to +105°C				
Approvals	UL Listed, CSA Certified, RoHS Compliant.				

The cables are banded together every 60 cm, with the first one placed immediately after the plug.

The band is made of a nylon strap that is applied with pressure on the cable insulation material and closed with a stainless steel clip. It is then covered with a heavy duty black heat shrink tubing that holds the band firmly in place. This method ensures that the bands will remain in position and not come loose and gather somewhere on the cable.



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PLUG DESIGN.

The **Skyko International** 400Hz plug exhibits a number of special features.

The most apparent one is the **Comfort Grip®**.

The front part of the plug complies with the MIL specification on the required distance from the face but immediately behind, the conical shape enables an easy grasping the plug. This unique feature reduces the risk of pulling from the cables when removing the plug from the aircraft.

The second feature is the **Hard Nose™**.

The **Hard Nose™** has two functions :

- Being made of a specially formulated material that exhibits outstanding resistance to abrasion, yes shock resilient, it offers a life extension to the cable assembly by enabling a quick replacement when worn out.
- Thanks to its specially dimensioned front part, it enables the full engagement of the plug into the receptacle mounted on an Airbus aircraft. The face of the plug will make contact with the face of the receptacle, enabling the pins and sockets to mate on their full lengths.



Other features specific to the **Skyko International** 400Hz plug are less apparent but nonetheless very important.

These include a strain relief design close to the cable exit area that dramatically reduces the consequences of mishandling the cable assembly.

Another feature is the way the mould is designed to manage the stress incurred by the rubber during the moulding process and the cooling phase.

Finally and critically important is the fact that the **Skyko International** 400Hz plug has a total length that complies with the original MIL Specification design requirement.

To the contrary of the widespread deviance seen on the market in the recent years, there is no addition of supposedly replaceable contacts or replacement nose of whatever colour. All these added "features" have extended dramatically the total length of plugs that have a negative impact on the copper pins of the aircraft receptacle. The increase weight of these "innovations" further aggravate the damage and lead to premature replacement of the on-board receptacle which is a costly operation for the airline.



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LOW INSERTION/WITHDRAWAL FORCES.

The **Skyko International** 400Hz plug has been designed to exhibit low insertion and corresponding withdrawal forces.

The desired amount of force to insert and remove a 400Hz plug into and from an aircraft receptacle, i.e. to insert/remove all pins into/from their respective sockets, must be :

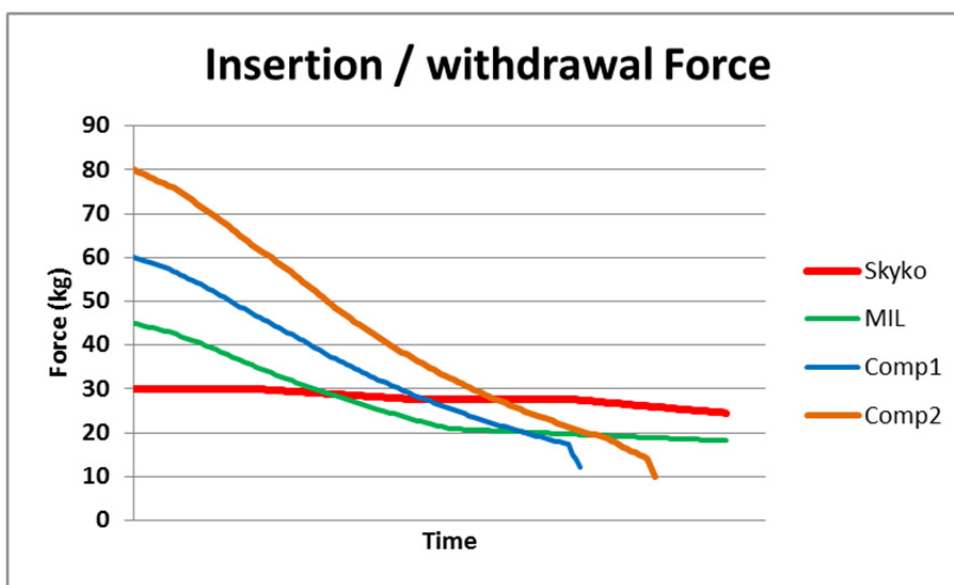
- Sufficient to guarantee a good electrical contact between pins and sockets,
- Sufficient to hold the cable assembly considering its height above ground.

Any additional force provokes additional friction during insertion and removal. That friction is abrasion and generates undue wear of the aircraft receptacle pins.

The misconceived and widespread belief that "*more is better*" is simply wrong. Although the original MIL Specification called for a force of 100 ± 20 pounds, 45 ± 9 kg, most plugs available on the market exhibit insertion/removal forces well in excess of these values, up to being able to withstand the weight of a man hanging on the plug !

These excessive forces are seen only when the plug is new. Indeed the tremendous efforts required to insert this type of plug, typically by wiggling the plug with sideways movements, soon lead to the degradation of the plug by distorting and opening its sockets.

The originally very high and excessive force will soon degrade due to this self-inflicted need to force the plug into and out of the receptacle. The graph below is an illustration of this evolution.



The **Skyko International** 400Hz plug has been designed to have a force of 70 pounds, 30 kg, which is well sufficient to fulfil the two conditions of electrical contact and holding into position.

Moreover, this value is typically the maximum allowed by work regulation for a person to lift or carry.

The force of 30kg only, means that there is less effort required to insert and remove the plug which avoids the mistreatment and consequently increases the life expectancy of the plug and aircraft receptacle.



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CABLE ASSEMBLY FINISHING.

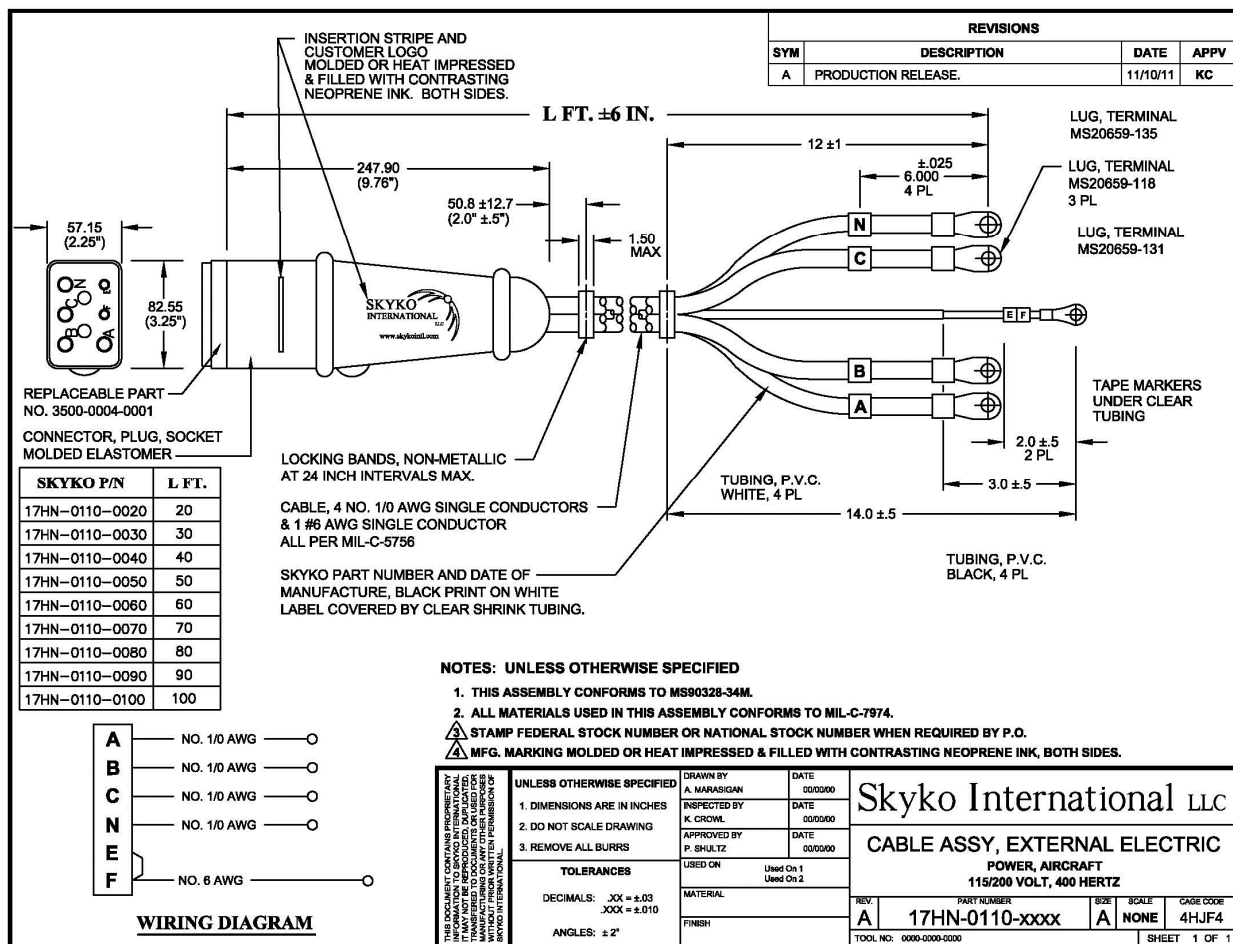
The **Skyko International** cable assemblies are supplied fully finished with cable lugs, optional cable ends trimming and cable marking under a clear heat shrink tubing.



CABLE ASSEMBLY CUSTOMIZATION.

The **Skyko International** cable assemblies are always defined in cooperation with our customers in order to clearly determine all details such as the exact cable length with its tolerances for each conductor and specific cable lug sizes.

All these details are shown on a customer specific drawing, see example below.



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