



# **BAK-14U**

## **RETRACTABLE CABLE SYSTEM**



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## 1 GENERAL DESCRIPTION RETRACT SYSTEM

The SCAMA Retractable Cable System BAK-14U (product designation HK60/R60 registered under NSN 1710-23-114-2511) is designed for installation at runways jointly used by military and civil aircraft. The retracting feature allows for unobstructed passage of military, commercial and private aircraft traffic, passage of snow clearing vehicles, saving of the runway surface etc. When military flight operations require the arrester system the ATC operator remotely raises the hook cable into active position.



*Figure 1 – BAK-14U installed cross the runway*

The BAK-14U is a hydraulically operated retractable cable system for permanent installation. It allows the hook cable to remain connected to the arrester gear and fully pre-tensioned in both retracted and raised position. BAK-14U is fully bi-directional regardless of which type of aircraft arrester system it is connected to.

When activation is demanded from the ATC tower, retract mechanisms instantly raise the hook cable from a channel in the runway. Rubber support blocks mounted on pivoting arms keeps the hook cable in position above the runway surface and forward of the retract channel. The distance between runway surface and cable is nominally 75mm. An accepted minimum distance for the pendant cable to the runway surface is 38mm. Below this distance the likelihood of a hook miss increases (in correspondence with USAF AFI 32-1043). The maximum engagement speed is 190 knots/ 350 km/h or equal to the maximum allowable engagement speed for the hook cable.

The hydraulic unit is equipped with an accumulator, which allows up to five cycles (up/down) without being re-charged. This together with a battery back-up system makes it possible to manoeuvre the retract system in case of a main power failure.

The retract system is remotely activated from the ATC via fiber optics or radio link, and locally at the electrical control cabinet at site. The hook cable position, raised or retracted, is indicated both on the ATC control panel and locally at the Operators panel (HMI) in the electrical control cabinet.

As an option for cold climate conditions, the system can be equipped with electrical heater cables to prevent ice formation.

## 2 LEADING PARTICULARS RETRACT SYSTEM

<u>Type of system:</u>	Hydraulic operated retract mechanisms
<u>Pendant cable diameter:</u>	3/4" to 1 1/4" (19 to 32mm)
<u>Maximum engagement speed:</u> (Hook cable limit)	190 knots / 350 km/h
<u>Recommended maximum taxiing speed over raised cable:</u>	40 knots
<u>Hook cable clearance</u>	70 +10/-20mm
<u>Aircraft compatibility:</u>	All existing hook equipped aircraft.
<u>Runway width:</u>	60m. But no practical limit.
<u>Number of support units:</u>	Depending on runway width. Spacing 2.5m (standard configuration 14 alt 20 boxes)
<u>Raising and lowering time when operated from ATC:</u>	< 5 s
<u>Raising and lowering time when operated at site:</u>	< 2 s
<u>Control stations:</u>	ATC tower and the arrester system site. Fiber optics or radio link.
<u>Cross-runway channel:</u>	Width 54mm.
<u>Ambient temperature operation range:</u> (During freezing conditions heaters are required.)	-40° to +50° C



*Figure 2 – Aircraft testing of BAK-14U retractable cable system*

### **3 DESIGN BASIS RETRACT SYSTEM**

The BAK-14U retractable pendant system is designed to be used with all other types of energy absorbers as it is an independent system.

Based on the hook cable design limit the system is approved for all hook-equipped aircraft with a maximum engagement velocity of 190 knots (350 km/h).

The bi-directional capability of the BAK-14U system permits installation for both over-run and mid-runway engagement.

Time to raised or retracted position of the hook cable is adjustable from below two (2) seconds or longer. For safe operation during freezing conditions the system would require electrical heater cables in the drainage system and heaters in the retract boxes.

The hydraulic system is designed such that the accumulator tank will hold enough pressure for up to 5 activation cycles without recharging. In case of a main power failure a battery back-up system allows the retract system to be safely operated until accumulator is emptied.

To guarantee a reliable system, proven components have been selected. Corrosion resistant materials have been chosen for all critical parts and high-quality anti-corrosion programme is chosen for non-stainless components.

### **4 DESCRIPTION OF FUNCTION AND DESIGN**

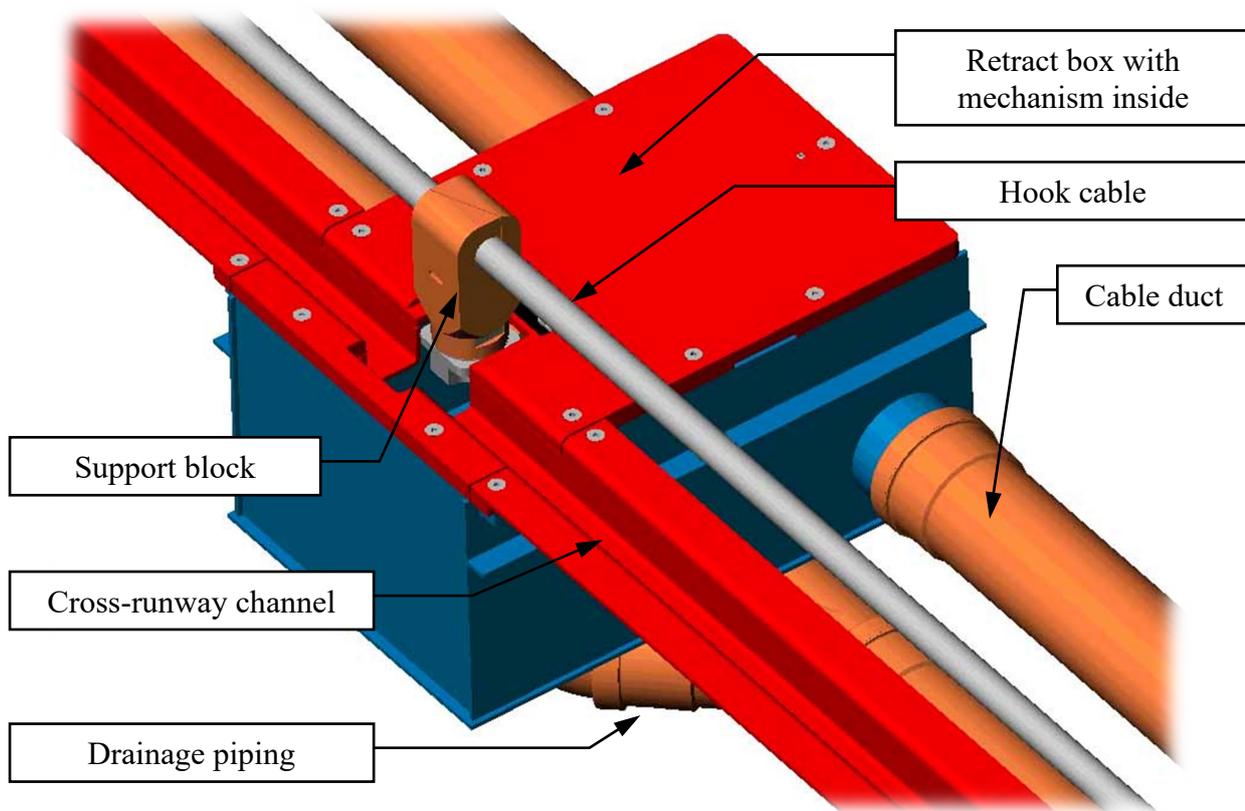
#### **4.1 Retract box and cross-runway channel**

The BAK-14U retract system is designed to support  $\frac{3}{4}$ " up to a  $1 \frac{1}{4}$ " (19 to 32 mm) diameter steel pendant cable.

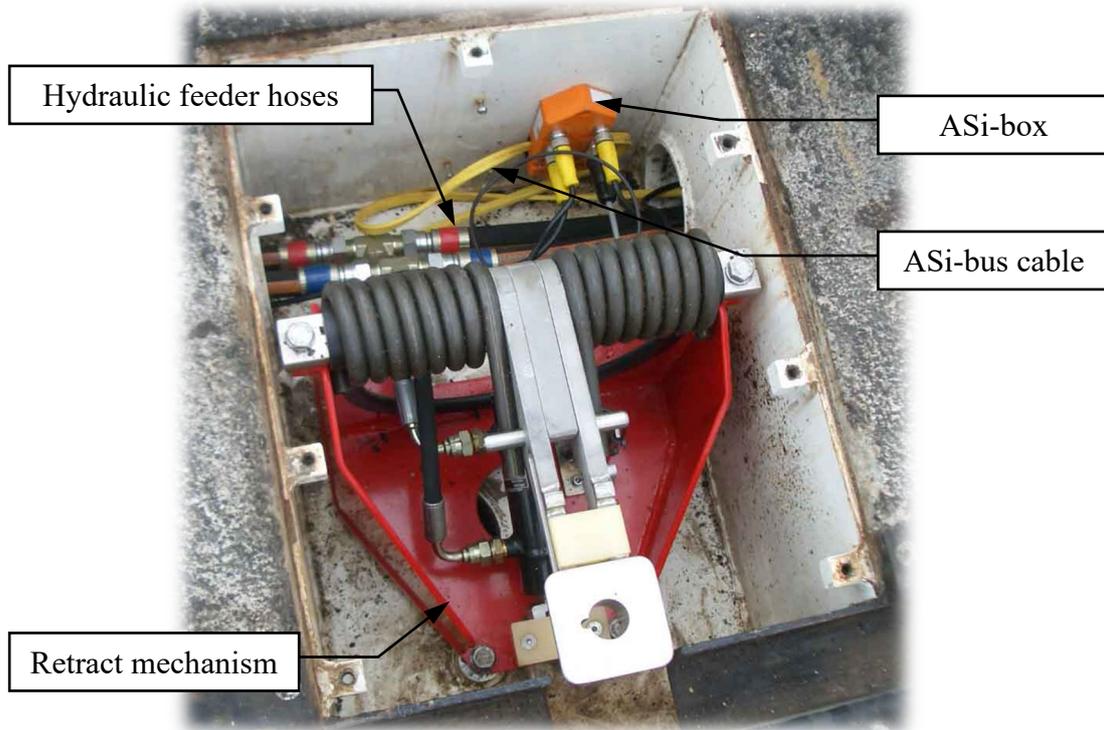
The retract boxes are spaced 2.5 metres across the runway. The retract boxes and cross-runway cable channel are moulded into concrete with the upper surface level with the runway surface.

The retract boxes are drained at the bottom to a drainage pipe located under the boxes and connected to the main runway drainage system.

Electrical cables and hydraulic hoses are placed in a separate ducting between the retract boxes. The equipment has the capability of withstanding aircraft wheel impact loads from any existing aircraft.



*Figure 3 – Retract box design layout*



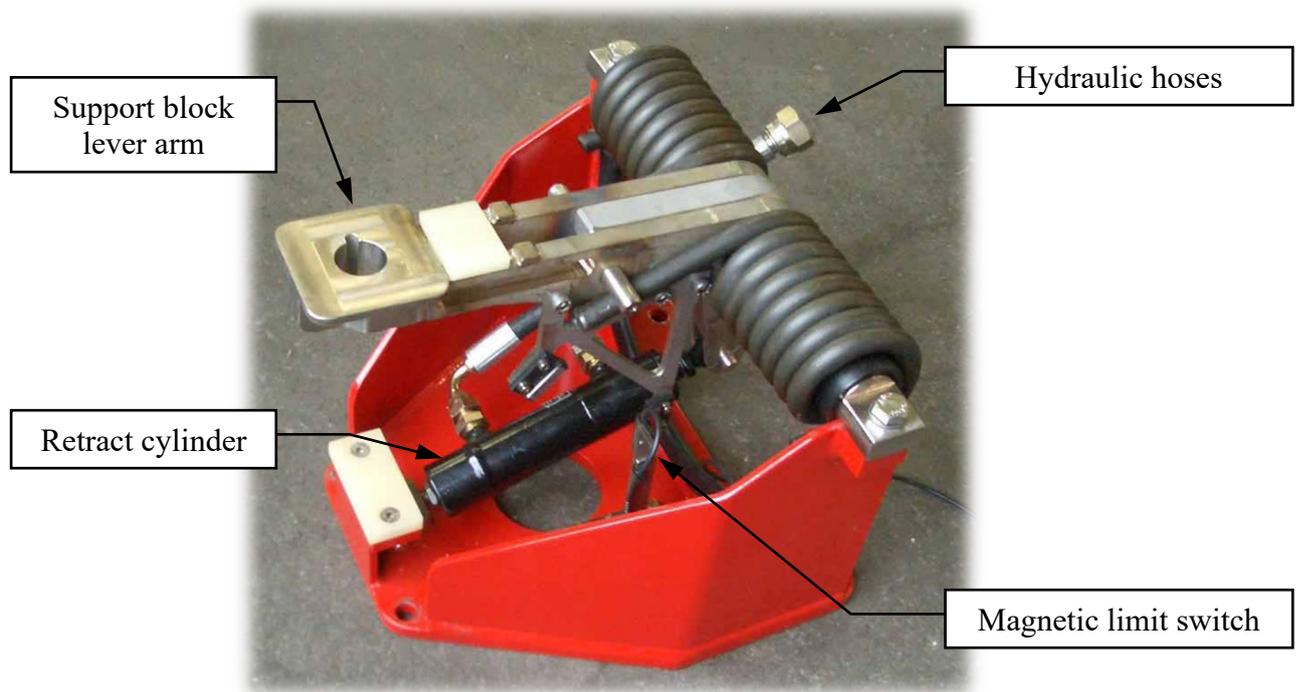
*Figure 4 – Retract box assembly*

#### 4.2 Retract mechanism

The retract mechanism is built as a unit ready to be installed in the retract box. Each retract mechanism contains a double action hydraulic cylinder, a magnetic limit switch and a spring-loaded lever arm holding the rubber support block. The retract mechanism is bolted with 4 screws to the retract box bottom plate. The retract mechanism has two hose connections and one limit switch connection. This allows for easy maintenance and if required the complete retract mechanism can be replaced within 30 minutes.

The limit switch in each retract mechanism is connected to the PLC in the electrical control system through an ASi-bus. This allows the PLC to monitor each individual limit switch for malfunction or failure of the mechanism to reach the desired position.

The spring-loaded lever arm is free to move without affecting the retract cylinder when in raised position allowing trampling of the support block.

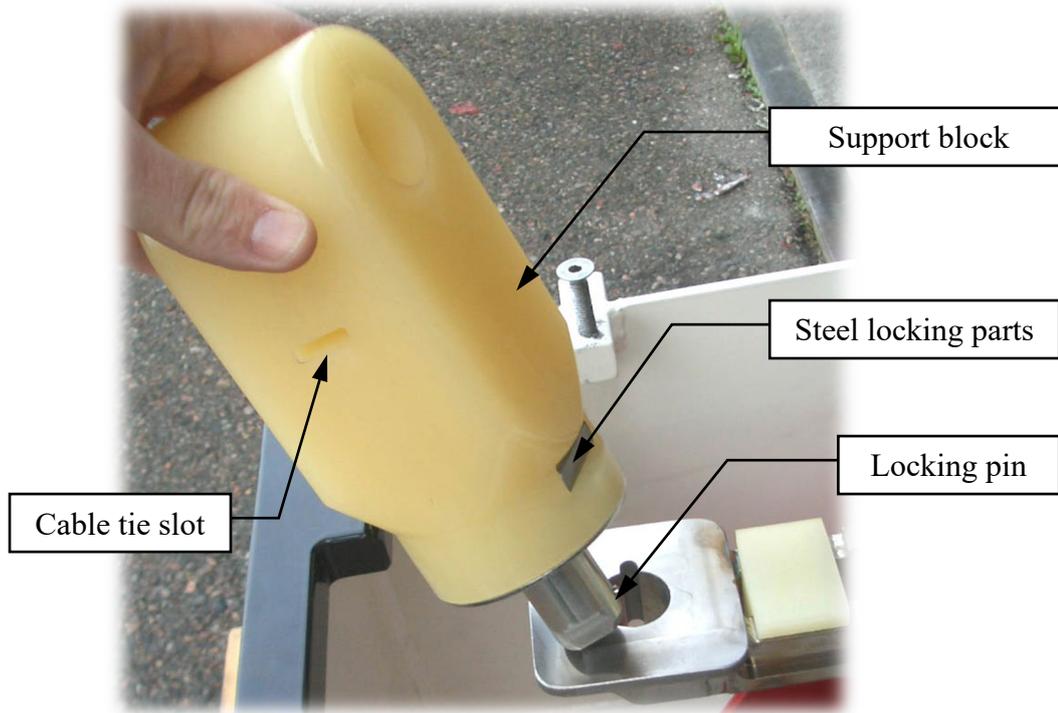


*Figure 5 – Retract mechanism*

### 4.3 Rubber support block

The rubber support blocks are moulded in Polyurethane or special rubber to allow for operation in tropical or polar climate conditions.

The support blocks fits to the mechanism with a bayonet fitting. This quick fitting allows the block to be replaced without any tools within 5 seconds. It is designed to release the cable without damage to the support block.



*Figure 6 - Support block*

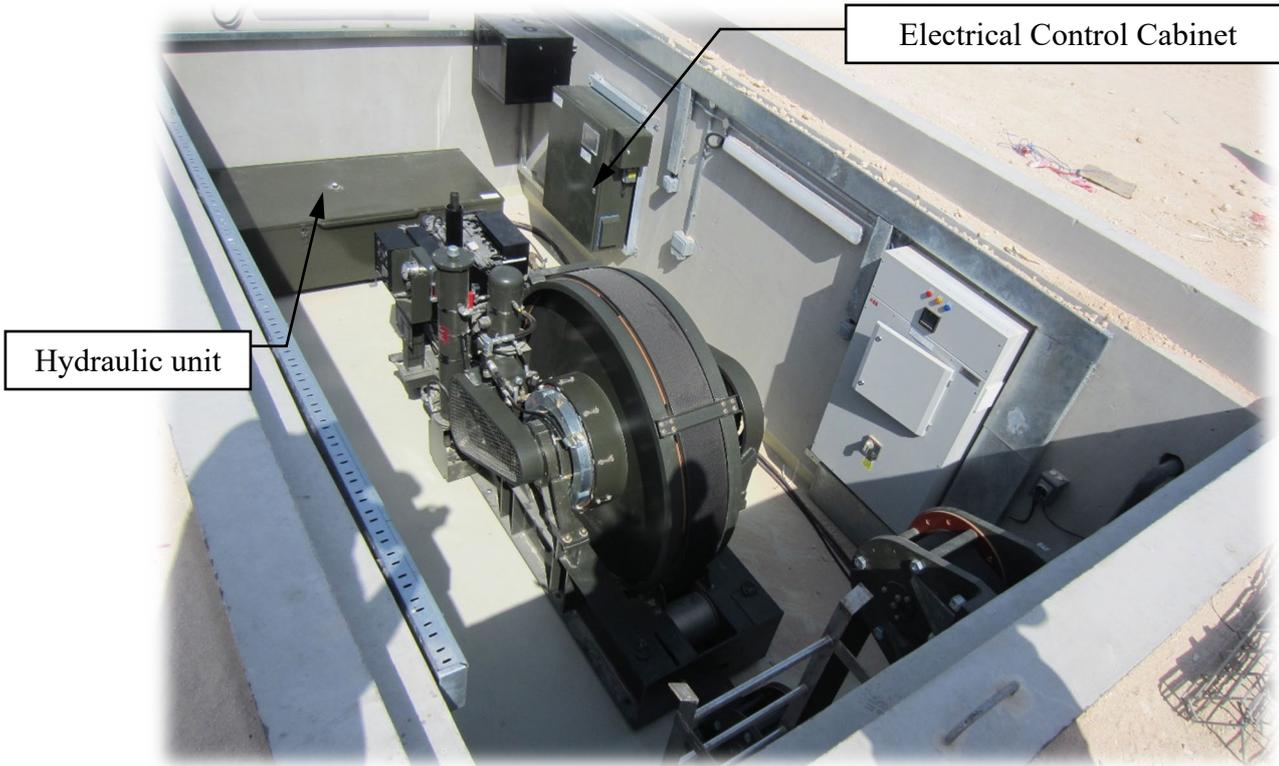
In order to secure the support block from premature releasing of the hook cable at rollover the hook cable is secured to the support block with a plastic cable tie. The cable tie breaks and stays in the support block when the hook cable is pulled out during engagements. The support block is designed to break if required e.g. at a direct hit by the aircraft hook in order to secure that the hook takes the cable.

#### **4.4 Hydraulic system**

The hydraulic system consists of a self-contained hydraulic unit, the hydraulic hoses to the retract boxes and the retract cylinder in each retract mechanism.

The hydraulic system is an accumulator system in that the accumulator is always charged and feeds the cylinders when the retract system is manoeuvred. The unit contains an electric motor driving a gear type pump, the accumulator, one directional valve for up and down operation, a return filter and a high-pressure filter. In cold climate the cabinet is insulated and contains a heater to keep a fair environment for the hydraulic system. The hydraulic system is designed to manage up to 5 manoeuvring cycles (up and down) without recharge of the accumulator in case of pump failure or main power failure.

Operation of the retract system can be conducted locally at system site as well as from the ATC tower.



*Figure 7 - Hydraulic unit and Electrical Control Cabinet*

#### **4.5 Electrical control system**

All functions in the hydraulic unit, alarms and manoeuvrings of the retract system are controlled by the PLC in the system. On the Operator's panel (HMI) all alarms are shown in clear text messages as well as the retract system position.



*Figure 8-9 – Electrical Control Cabinet with HMI and hand-held portable control box*



Figure 10-11 – HMI screen showing status and alarm in clear text