



## The Snow Removal Procedure

The new definition of snow clearing on runways



## Preamble

Since 1994 LIMA has been developing special-purpose machines and innovations.

LIMA special-purpose machines are manufactured by authorised partners guaranteeing a comprehensive service as well as spare part delivery.

Manufactured of field-tested elements looking back on many years of experience, LIMA machines are reliable and long-lasting in continuous operation.

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## Air traffic at onset of winter

In winter, it comes to runway closures again and again if only during the duration of clearing and controlling procedures.

Air traffic is strongly affected provided that temporary runway closures for above mentioned activities last between 10 and 60 minutes. In case of strong onset of winter, flights will be cancelled and in extreme case the complete air traffic will even be stopped.

The temporarily used snow-removal technique and the used machinery can not guarantee running air traffic in winter. Countless incidents have been proving that year for year.

Leaving the runway „unintentionally“ after landing (aircraft overrun) is the most common cause for accidents. 53 % of the accidents occur as a result of slippery and contaminated runways.

Alone in 2008, there were 27 accidents worldwide caused as a result of leaving the runway unintentionally after landing.<sup>1</sup>

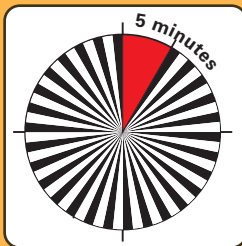
The additional expenditures occurring in addition to that are enormous. In an ideal situation, air strips will be used in summer as well as in winter at full capacity, i. e. air traffic in summer and in winter will be nearly the same.

The patent-registered snow-removal procedure (abbreviated: SRP) executed with snow-removal mobiles is guaranteeing a runway condition, also in case of extreme weather conditions, hardly deviating from the summer conditions of a wet runway.\*

**\*Note: Only the completely integrated snow-removal procedure is guaranteeing the described condition. A permanent clearing action (integrated clearing action in lateral direction) using the runway for approx. 1 minute by an aircraft and then using the runway for approx. 1 minute by the snow-removal mobiles.**

<sup>1</sup> Gerard W.H. van Es, Marc Tauss, Kristjof Tritschler – Development of a Landing Overrun Risk Index, NLR, Netherlands, lecture at EASS of Flight Safety Foundation, March 2009, Nicosia, Cypress

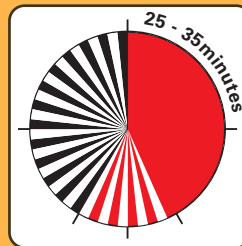
## Comparing the clearing period <sup>1</sup>:



### New: crosswise procedure

When using 10 clearing vehicles one clearing period takes approx. 10 minutes. In case of 20 clearing vehicles, it will take 5 minutes.

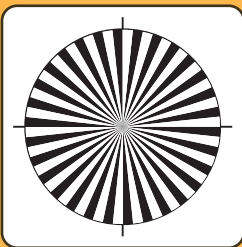
This consequently enables 25 to 27 possible landings per hour.



### Actual state: lengthwise procedure

A clearing period takes approx. 25 to 35 minutes.

This consequently enables 12 to 17 possible landings per hour when using 20 clearing vehicles.



### New: integrated crosswise procedure

With 20 clearing vehicles 4+x clearings will be possible per 60 minutes

Thus, these are 30 landings per hour.

**This corresponds to the air traffic in summer.**



<sup>1</sup> Runway with a length of 4000 m and a width of 60 m.

- runway closed due to snow clearing service
- runway occupied by aircraft
- runway free



## The patent-registered snow-removal procedure

According to the principle of causality the snow-removal procedure (abbreviated: SRP) solves the problem directly at its cause. Contaminations like snow, slush, ice, sleet and hail are no longer cumulated. Now, small amounts of contamination will be removed in short intervals. In so doing, the braking coefficients will be held very high as a result of airstrip specific combination of clearing intervals and segments.

This is achieved by an airstrip specific combination of clearing intervals and clearing segments, an individually coordinated employment of machinery and by an exactly dimensioned working width.

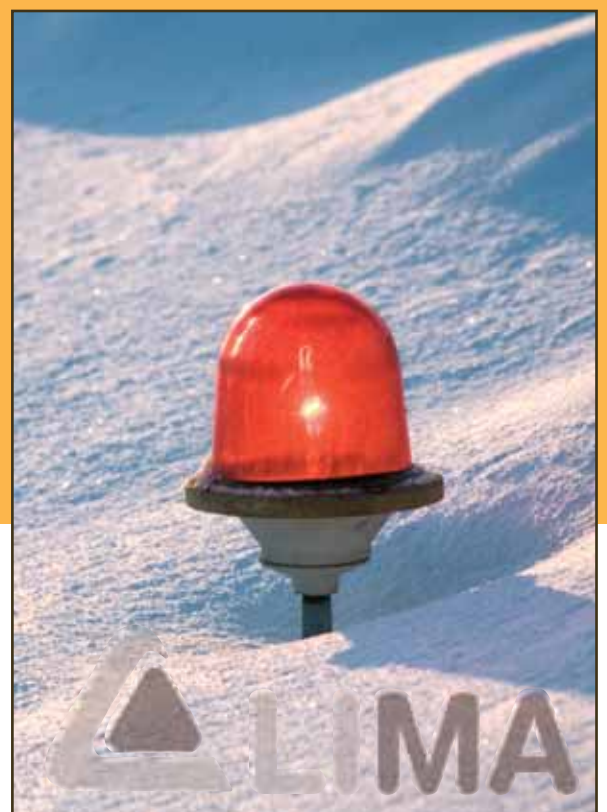
In the snow-removal procedure, airstrips are cleared by means of computerized and satellite-based snow-removal mobiles. The SRP can be executed during the normal take-off and landing without causing interferences. In so doing, the SRP will be adapted to weather conditions, local conditions and air traffic.

Depending on the employment of machinery and cycle time, determined by air traffic, a complete clearing activity for a large runway with a width of 60 m and a length of 4000 m takes 2.5 to 5 minutes.

With the help of the snow-removal mobiles, the SRP enables during the clearing activity to measure the braking coefficient and report it simultaneously to the head office, if requested. With a clearing capacity of 120 m<sup>2</sup>/s the Snow Removal Procedure guarantees an anti-skidding runway free of contamination during the whole air traffic. At any type of weather!

### The SRP shortly summarized:

- SRP can be used without constructional alternations at the airport (in case of clearing activity in longitudinal direction when approaching and leaving via taxiway).
- SRP corresponds to the legal regulations and rules.
- SRP is operating with an exactness of  $\pm 2$  cm fully-automatically, semi-automatically or manually, depending on the needs and equipment.
- SRP provides all relevant data like e.g. clearing capacity, de-icing application per  $m^2$  etc. via GSM. These data are saved as obligation for legal proof. By means of data transfer, the head of operations can follow in real-time the treatment and the braking action of the whole runway and depending on the weather, a continuous adaption is possible.
- Within seconds, the SRP can interrupt any clearing activity in case of emergency and leave the runway immediately.
- SRP is clearing the air strip completely including the runway groofings by brushing (in case of crosswise clearing and integrated crosswise clearing).





## Conversion to the SRP:

A conversion to the SRP is executed as follows:

- 1 data acquisition of air strips, runways, circulation areas
- 2 making out the airport specific clearing concept
- 3 programming the clearing paths in GPS-controlled automatic steering system of the snow-removal mobiles
- 4 SRP in use
  - Complete clearing <sup>1</sup>
  - Integrated procedure <sup>2</sup>

## Integration in your fleet of winter road clearance:

Beginning with an integration period, the SRP can also be used in your current clearance gang.

During the integration period any number of Snow Removal Mobiles, clearing a runway with a length of 500 to 1000 metres in longitudinal directions (without constructional change), will be used.

The integration period offers direct comparison to your current clearing procedure. Depending on the operational condition, you will decide the time period and point of time for using the SRP completely.

<sup>1</sup> clearing activity in longitudinal direction without constructional change

<sup>2</sup> clearing activity in crosswise direction with potential constructional (Integrated path structures depending on taxiways leading to the airstrips)



### Clearing quality:

By means of SRP, the complete runway is kept clean and the braking coefficients are held permanently high.

Large working widths, low sweeping speed between 10 and 15 km/h and power-driven tools enable an effective use of brush.

If required, the areas needed are de-iced chemically. At any time, the de-icing can be adapted to changing weather conditions.

**By means of SRP, snow-covered and contaminated runways are a thing of the past.**

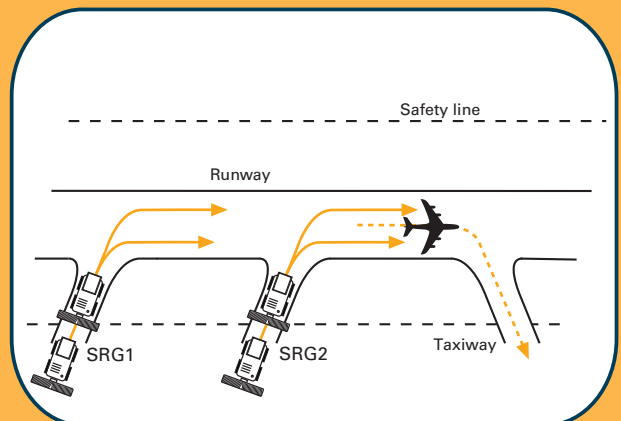




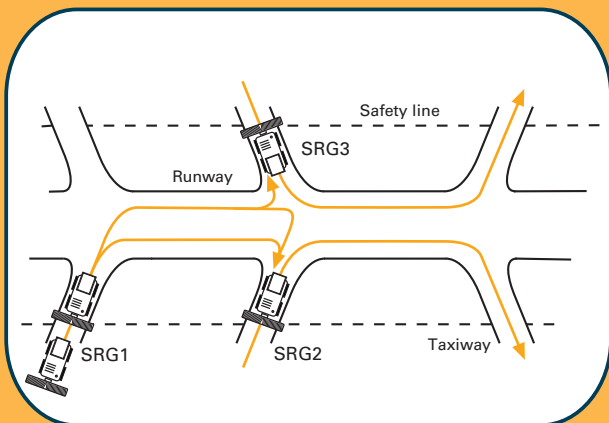
## SRP in use:

### Complete clearing

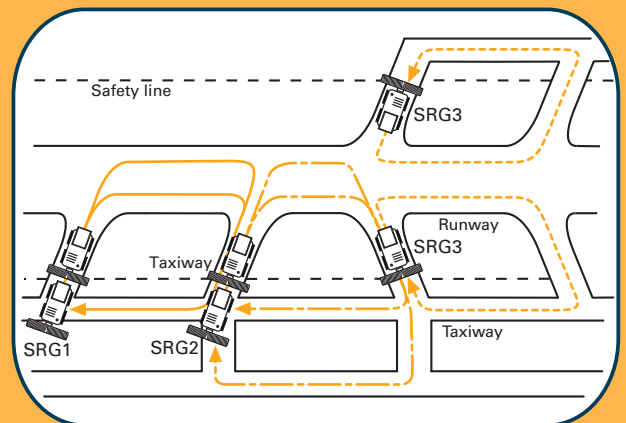
In this operating mode, all airstrip segments between two aircraft movements will be completely cleared, period of time approx. 5 minutes.



The Snow Removal Groups (SRG1, SRG2, etc) are waiting with the same safe distance to the runway as e.g. an aircraft waiting for take-off.



The Snow Removal Groups (SRG1, SRG2 ...) start cleaning the corresponding air strip segments after take-off or landing of the aircraft.



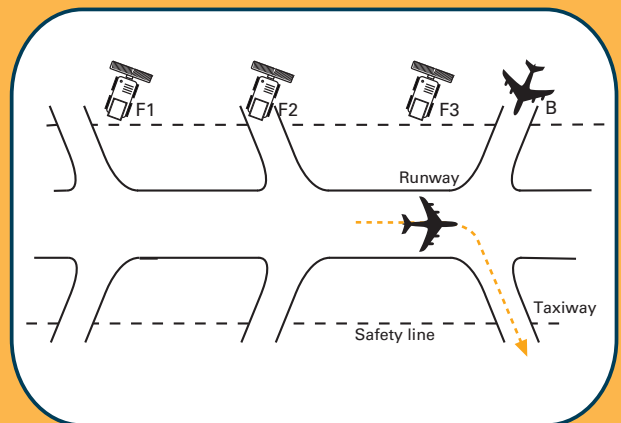


## SRP in use:

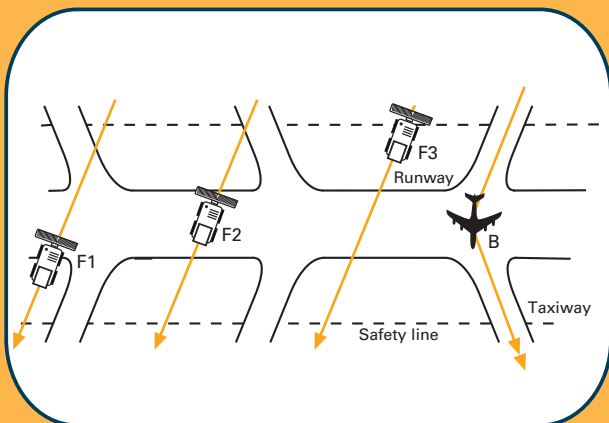
### Integrated procedure

In this operational mode the available wake turbulence separating times are used in scale of seconds and during this period the defined segments will be cleared. In this mode, a runway can be completely cleared during running air traffic up to 4 times per hour.

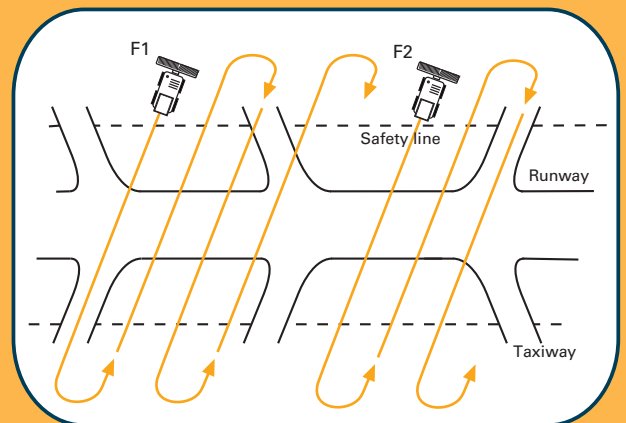
Depending on the local condition, weather conditions and estimated time window, the crossings and clearing movements are variable.



Snow-removal vehicles are waiting on the service path with the same clearance distance to the runway like an airplane (B) waiting for crossing.



After the landing aircraft passing by, the aircraft (B) crosses the runway and the snow-removal mobiles exempt the runway from snow, ice, water and foreign substances and drive on the service path of the opposite side.





## The patent-registered snow-removal mobile

With a clearing width of up to 30 m and a clearing capacity of up to 120 m<sup>3</sup> per second, the snow removal mobile quickly offers a contamination-free area.

The snow-removal mobile consists of a power unit and a tool unit. It is possible to decouple the tool units within few minutes and to replace them by further work units. For example, the power unit can be used to clear snow and to remove rubber abrasion.s

These units are manufactured by companies having a great reputation. Moreover, the units have been tested in practice for decades and they proved worthwhile.

### Technical data:

#### Power unit:

- Pulling work, steering, control
- Drive of sweeping unit
- Additional equipment depending on requirement

#### Working unit:

Field of activity: Snow clearing, de-icing:

- Working width of 6 to 30 m
- Equipment: sweeping brush
- Excavation: up to 150 cm, depending on requirements
- Spraying device for chemical de-icing
- conveyor elements

## Multi-purpose applications:

The power unit can cover the following fields of activity:

- Winter road clearance (sweeping, clearing, cleaning, milling, loading, transportation etc.)
- Vast measurement of braking coefficient
- Runway clearing and removal of foreign substances also during summer months
- Removal of rubber abrasion
- «Tow & Push» of aircrafts
- Cargo transport
- Maintenance of green areas
- Water logistics for fire-fighting and maintenance of extinguishing capacity in case of emergency
- Excavation duties in the off-road area
- Defence of bird strike
- Special application





## Financial aspects

Despite excellent clearing quality and an enormous surface performance, the SRP with the snow-removal mobiles is cheaper compared to usual machinery for the winter road clearance. As the snow-removal mobile can be used multi-functionally, savings in different areas of operations may be realized. The price per working width is defined by the calculated working width of sweeping units and the number of towing vehicles.

### **Make profit by leasing:**

The power unit of the snow-removal mobiles can be used outside the airport during summer months. LIMA GmbH & Co. Betriebs KG will rent your power unit at fixed operating hour rates. In so doing, you have the possibility to generate considerable savings.

### **Advantages of the airport operator and the airlines:**

For airport operators and airlines, the SRP is realizing enormous savings due to the fact that with the help of the new Snow-Removal Procedure the winter traffic is running smoothly.

### **Advantages of the airport operator:**

- very good cost effectiveness
- proportionally lower overheads and running costs
- the friction measurement can be improved in connection with the SRP, the clearing quality and data transfer
- by means of the SRP, sudden air port closures can be avoided



### Advantages for airlines:

- No unnecessary aircraft de-icing
- No unnecessary fuel consumption for airlines with winter schedule. For the airlines, this means approx. 10 % fuel cost savings during the winter months and in addition to that less expenses for CO<sub>2</sub> shares
- No expenses as a result of cancelations and unpunctuality





## 25 advantages of the SRP shortly summarized

1. not any unnecessary purchases, transports or consumptions of fuel as a result of holding patterns due to the fact that a stable approach planning can be guaranteed as it is done during the summer months
2. no unload of freight and passengers at the port of departure as a result of irregular payload reductions as a consequence of additionally necessary fuel loads
3. reduction of expensive holding patterns and consequent operating hours
4. keeping to schedules, approaching sequences, arrival and departure times etc.
5. maximising the runway availability for the air traffic also in case of heavy snowfall
6. minimising the risks of accident owing to the optimisation of runway conditions and minimisation of contamination
7. avoiding diversions due to onset of winter
8. avoiding unplanned passenger stays on stopover airports at the expense of the airlines or at the expense of the passengers as well as avoiding luggage and freight irregularities
9. avoiding bottlenecks regarding fuel supply on alternates not equipped for several super jumbo jets
10. avoiding bottlenecks regarding de-icing on alternates not equipped for super jumbo jets
11. avoiding bottlenecks regarding loading capacity
12. avoiding double de-icing of aircrafts due to expired hold-over times caused as a result of bottlenecks regarding taking-off capacities
13. avoiding exceeding working hours and prolonging working hours of crew
14. avoiding consequential costs like handling, technique, flight security, flight planning, replacement crews, transfer charges to hotel and accommodation for crew and passengers, replacement flights due to alternative landings
15. avoiding increase of delays e.g. LVO (low visibility operation) and snow removal
16. avoiding accumulations of snow masses etc. and consequent decision difficulties when a runway has to be closed for safety reason to clear it

17. avoiding of partially cleared runways and solving the conflict that in case of slippery runway in winter less runway lengths and cleared runway width is available but runway width and length are needed exactly in this situation in winter
18. no bigger security discounts by worse grip of the airplane tyres in winter than in summer
19. no sudden runway closures e. g. as a result of pilot reports as a consequence of contaminated runways and minimisation of workload in these situations for air traffic controllers. The air traffic is the "master" the winter road maintenance is the "slave" and not the other way round. The SRP uses the time window the winter road maintenance is assigned to. Owing to the permanently high breaking coefficient and to low accumulations of contamination the time windows can be moved in the defined frame without risk
20. minimising the runway occupation time of the aircrafts by improving the delay coefficient and shortening long

braking distances of the landing aircrafts

21. no unnecessary go-arounds of subsequent aircrafts
22. minimising the risk of accident by means of steadily secure grip
23. avoiding engine damages as a result of overheating caused by unnecessary reversal pushdown to the standstill of the aircraft
24. maintenance of reliability and security of the air traffic also in case of heavy snow fall
25. avoiding foreign object damage (FOD) e.g. bird strike, damages by foreign substances to the aircrafts





Weidener Straße 6 • 93057 Regensburg

Tel.: + 49 - (0)9 41- 60 48 85

Fax: + 49 - (0)9 41- 60 48 4

[www.limagmbh.com](http://www.limagmbh.com)