IFR

Enroute Clearance

The **enroute clearance**, often also called IFR clearance, is usually the first clearance that an air traffic controller gives to any departing IFR pilot. As the name suggests, it contains important instructions for the flight route the pilot is cleared for.

Fortunately, the structure of an enroute clearance is always the same. It consists of the following elements:

- Clearance Limit
- Departure route
- Clearance of the route
- Initial Climb
- Transponder code

These elements will be explained in more detail below, followed by phraseological examples at the end.

Clearance Limit

The so-called clearance limit indicates the waypoint / airport up to which the enroute clearance is valid.

At this point, we briefly need to talk about different flight plans. While IFR and VFR are commonly known, the two more exotic flight plan types Y and Z are mostly unknown.

Flugpläne

I	IFR flight plan	• The entire flight is conducted according to instrument flight rules. • **Example**: EDDM to EDDN - Route: AKINI • Delivery must issue an enroute clearance.

V	VFR flight plan	• The entire flight is conducted according to visual flight rules. • Delivery is only responsible for the VFR startup clearance if necessary (regulated in the SOP of the respective airport).
Z	ZULU flight plan *VFR -> IFR*	• Take-off with visual flight rules, IFR will be flown from a certain point enroute. • **Example**: EDDM to EDDN - Route: WLD UPALA/N0120F070 • In this example, the pilot departs VFR from Munich and wants to fly IFR from UPALA. • As the flight departs VFR from Munich, Delivery treats this flight as a normal VFR departure. The fact that this flight wants to fly IFR later is not relevant.
Y	YANKEE flight plan *IFR -> VFR*	• The flight takes off according to instrument flight rules and flies VFR from a certain point enroute. • **Example**: EDDM to EDDN - route: INPUD Y102 UPALA VFR • In this example, the pilot flies IFR from Munich via INPUD and then to UPALA on airway Y102. From UPALA, the pilot wants to fly VFR. • As this flight is an IFR departure from Munich, Delivery must issue an enroute clearance.

Briefly summarized: For VFR and Z, Delivery must issue a VFR startup clearance (if necessary depending on the airport). For IFR and Y, Delivery must issue an IFR enroute clearance.

But why is all this in the Clearance Limit section?

With **IFR flight plans**, the pilot flies completely IFR up to the destination airport, which is why the IFR route clearance must also extend to the destination airport. The clearance limit for IFR flight plans is therefore always the destination airport.

With **Y flight plans**, however, the pilot only flies IFR up to a waypoint, VOR, NDB, etc. IFR. The clearance limit for Y flight plans is therefore not the destination airport, but the last waypoint before the pilot switches to VFR according to the flight plan

Phraseology

The clearance limit is expressed by the phraseology **CLEARED TO** (clearance limit). In our example for IFR flight plans, we would therefore say

> CLEARED TO NÜRNBERG

In our example for Y flight plans (route: INPUD Y102 UPALA VFR) we would say:

> CLEARED TO UPALA

Departure Route

In the second part of the IFR route clearance, the pilot is told which departure route to take off on. We deal with two different cases in the S2 training:

Standard Instrument Departure (SID)

The SID is the most common and probably best-known departure procedure for instrument flights. A valid flight plan always contains the end point of a SID as the first waypoint like for example AKANU in Nuremberg and MERSI in Munich. From this point onwards, the pilot has various airways and waypoints listed in the flight plan that will ultimately take them to the destination aerodrome. If the airways are regarded as highways, the SIDs would be the highway access points, i.e. routes from a connection point (airfield) to the highways (airways). The published SIDs depend on the airport's operating direction and contain information on flight direction, altitude and speeds. An easy way to access the corresponding charts is offered by the provider Chartfox, where you can easily log in with your VATSIM account. Follow this link and take a look at the departure routes of runway 26R in Munich for the MIQ, GIVMI and RIDAR waypoints.

Vectored Departure

Sometimes it is not possible to assign a SID. There can be various reasons for this: Some airfields require certain aircraft equipment (e.g. GPS) for certain departure routes, sometimes the pilot has problems with their FMS and therefore cannot fly the SID. A third reason that occurs from time to time is pilots who want to fly so-called IFR patterns. These are often flown during landing training. After departure from the approach, the pilot is guided to the ILS via vectors and then handed back to the tower. After the touch and go, the pilot is handed back to APP and the game starts all over again. With such procedures, it makes no sense to release the pilot to a SID, as this is designed to bring the pilot into the airway system. With IFR patterns, however, the pilot does not want to go to an airway, but to remain at our airfield.

A vectored departure must ALWAYS be coordinated with **Approach** or the **Center** station above. If you control Delivery, the Tower also needs to be informed.

Example of coordination:

> EDDN_TWR: Approach, Nürnberg Tower
> EDDN_APP: Go ahead
> EDDN_TWR: Request vectored departure DLH414 for IFR Pattern
> EDDN_APP: Approved, on RWY Heading climb FL070

Phraseology

- **SID:** The SID is cleared by simply stating the SID's name and the addition 'departure'. In the example of the GIVMI departure in Munich from runway 26R:

  > *VIA* GIVMI1N DEPARTURE

  The word **via** is optional. It is not necessary to specify the runway in this case, as the SID GIVMI1N only starts from runway 26R. If the pilot knows their SID, they therefore also know their runway. However, there are also SIDs that can be flown from several runways (e.g. in Frankfurt for runway 25C/L). In this case, the runway must be defined in the enroute clearance unless the departure runway is obvious due to the ATIS

- **Vectored Departure:** After Approach has told you how they want the departure, you must pass on the relevant information to the pilot:

  > *VIA* VECTORED DEPARTURE RWY 28, CLIMB ON RWY HEADING FL70

The **tower controller** must then also be informed of the vectored departure so that they know where the aircraft is going to fly initially.

Clearance of the route

After the first two items of the clearance, we have told the pilot up to which point their route clearance applies and how they should fly to the first waypoint in the flight plan. What is still missing, however, is how they should fly from the first waypoint or the SID endpoint to the clearance limit.

In many cases, this is supposed to happen via the route filed in the flight plan. We express this with the following speech group:

> FLIGHT PLANNED ROUTE.

Initial Climb

Even if every SID has a permanently assigned initial climb in the charts or in the AIP, since 2020 this has had to be explicitly mentioned in every IFR enroute clearance. The initial climb is the altitude up to which the pilot may climb independently after take-off without further clearance.

There are, however, two different versions of this speech group:

There are SIDs that have neither altitude nor speed limits. Here we use:

> **CLIMB** TO *ALTITUDE* 5000 FT

There are SIDs that have either altitude or speed limits or both. Here we use:

> **CLIMB VIA SID** TO *ALTITUDE* 5000 FT

In the case of a vectored departure, this speech group is omitted, as the altitude instruction is already given when the flight route is communicated (e.g. ON RWY HEADING CLIMB TO FL70).

The word *Altitude* or *Flight Level* is optional. However, it is recommended, especially in the case of altitude, to avoid misunderstandings with the "*to*" ("Climb ***to four*** thousand feet" vs. "Climb ***two four*** thousand feet").

Transponder code

Last, but not least, the transponder code. The purpose of this is to uniquely identify an aircraft on radar.

The transponder code is simply added after the word SQUAWK, e.g.

> SQUAWK 2001

Each digit is pronounced individually, unless the transponder code consists of full thousands. In this case, the code must be pronounced as follows: SQUAWK 1000 = *SQUAWK ONE TOUSAND*.

Phraseology examples

If we bring these items together we can create our first IFR enroute clearance.

As an example, let’s assume a flight from Nuremberg to Munich with the route AKANU from runway 28. The transponder code is 1000. We assume that there is little traffic and therefore also issue the startup clearance. The callsign is DLH414.

The complete transmission is:

> DLH414, **STARTUP APPROVED**, **CLEARED TO** MÜNCHEN, ***VIA*** AKANU8K **DEPARTURE**, **FLIGHT PLANNED ROUTE**, **CLIMB TO** FL70, **SQUAWK** 1000, (additional information or instructions)

The words printed in bold are always the same, the words in normal print must be adapted to the respective flight.

The phraseology for a Vectored Departure is:

> DLH414, **STARTUP APPROVED**, **CLEARED TO** MÜNCHEN, ***VIA* VECTORED DEPARTURE RUNWAY** 28, CLIMB ON RWY HEADING TO FL70, **FLIGHT PLANNED ROUTE**, **SQUAWK** 1000, when airborne contact München Radar 129.525.

Perhaps you are now wondering why the departure frequency is mentioned in the Vectored Departure. Well, all SIDs in Nuremberg state on the charts that the pilot should call 129.525 after take-off, so if a pilot is cleared for the AKANU8K, for example, they are also instructed to call 129.525 after take-off. For a vectored departure, however, there is no chart on which the pilot can find this information. We must therefore give them this instruction separately with the enroute clearance.

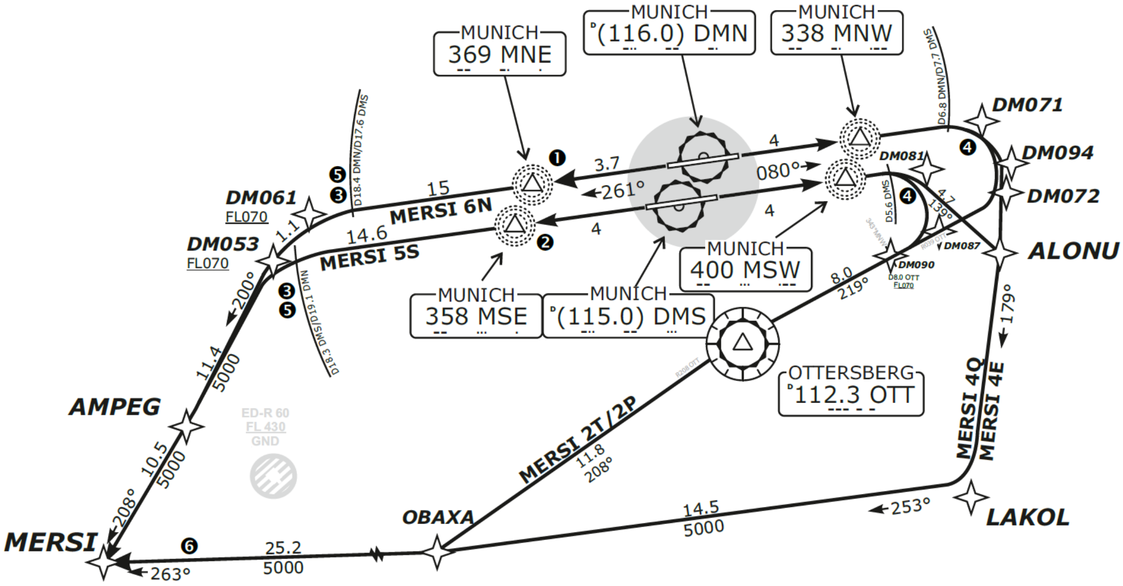
SID - Standard Instrument Departure

In order to connect airports with the airway system for IFR flights, predefined departure routes (Standard Instrument Departure - SID) are used. These lead from the respective runway via waypoints and/or conventional navigation facilities such as NDBs and VORs to the first waypoint entered in the flight plan. Nowadays, many SIDs can no longer be flown using conventional radio navigation equipment, as flight routes are becoming increasingly complex, particularly due to noise abatement measures. Their waypoints usually only exist as virtual coordinates. In many cases, therefore, area navigation (RNAV) equipment is required, which every modern airliner is equipped with.

The name of a SID consists of:

- Basic Indicator: Last waypoint of a SID or first waypoint in the flight plan
- Validity Indicator: The Validity Indicator is a number that is incremented as soon as there are minor changes to a SID (e.g. change of variation)
- Route Indicator: The Route Indicator is a letter that can be used to distinguish between different SIDs that lead to the same waypoint. These can differ, for example, due to different runways, routings, altitude restrictions, etc. An example is MERSI6N from runway 26R and MERSI5S from runway 26L in Munich, as shown below.

Example for naming: MARUN6M



Route of the MERSI SIDs in Munich

Route

With the clearance of a SID, the following instructions should generally be clear to the pilot:

- departure runway in conjunction with the ATIS,
- initial climb clearance
- route to be flown with possible restrictions (e.g. speeds or altitudes).
- frequency change after take-off. In Germany, the frequency change after take-off is part of the SID procedure at many airports. You should therefore always check whether you may/should change frequency independently before take-off. In this case, the tower will not give any instructions, as the frequency changes are indicated in the SID and/or ATIS.

This information can be found in the SID or its charts.

Noise Abatement

In Germany, for noise abatement reasons, controllers are only allowed to issue directs or vectors from certain altitudes when departing via a SID. Any speed and/or altitude restrictions may also only be lifted above these altitudes. These altitudes are:

- 5000ft AGL for JET-powered aircraft
- 3000ft AGL for PROP-powered aircraft

Classification of Instrument Approaches

Segment of an instrument approach

Arrival Segment: This segment represents a transition from the enroute phase to the approach phase of the flight.

Initial Approach Segment: This segment begins with the Initial Approach Fix (IAF) and ends at the Intermediate Fix (IF)

Intermediate Approach Segment: This segment usually begins at the Intermediate Fix (IF) and ends at the Final Approach Fix (FAF) (non-precision) or Final Approach Point (FAP) (precision).

Final Approach Segment: This segment normally starts at the FAF/FAP and ends at the Missed Approach Point (MAPt).

Missed Approach Segment: This segment begins at the MAPt and usually ends in the published holding procedure at the IAF. It is intended to provide protection against obstacles during the entire missed approach procedure.

> Final Approach Fix or Point? During a Precision Approach, it is called a Final Approach Point, during a non-precision approach, it is called a Final Approach Fix.

Classification

There are several ways to conduct approaches under instrument flight rules.

The purpose of the various approaches is to guide traffic to the runway as efficiently and precisely as possible in line with local circumstances and depending on weather conditions. Some approaches require specific equipment on the ground, while others are solely dependent on the aircraft's equipment. All available approaches are published in the respective airport charts.

In addition to the larger commercial airports, various small airports with an RMZ also have such approach procedures to enable IFR traffic there.

A basic distinction is made between two-dimensional (2D) and three-dimensional (3D) approach procedures.

2D approach procedures only include lateral guidance, while 3D approach procedures also include vertical guidance.

Note: lateral and vertical refers to the guidance provided by either:

- a ground-based radio navigation aid or
- computer-generated navigation data from ground-based, space-based, autonomous navigation aids or a combination of these.

Examples of 2D approach procedures:

- LOC Approach (Non-precision approach (NPA))
- VOR approach (NPA)
- NDB Approach (NPA)
- RNP Approach (RNAV(GPS)) without vertical guidance (NPA)

Examples of 3D approach procedures:

- RNP Approach (RNAV(GPS)) with Baro VNAV or SBAS (Approach with vertical guidance (APV))
- ILS Approach (Precision Approach (PA))
- GLS Approach (PA)
- PAR Approach (PA)
- RNP approach argumented with SBAS CAT I (PA)

Note: Visual approaches do not belong to any of these categories!

ILS approach

The ILS approach is the most widely used approach procedure in Germany and accurate enough to be considered a **precision approach**. ILS stands for Instrument Landing System and consists of a landing course transmitter (LOC - shows the deviation to the left and right of the extended centerline) and a glide path transmitter (GS - shows the deviation from the ideal altitude for the approach). The combination of these two components guides the pilot precisely onto the runway, even in poor weather conditions, and in some cases also enables completely automatic landings. In order to use this approach procedure, the airport must be equipped accordingly.

RNP/RNAV approach

RNAV(GPS) approaches, since a renaming also called RNP approaches, use GPS for correct guidance. In contrast to an ILS approach, this approach is **non-precision approach**. These approaches are usually flown when the ILS is not operational for some reason. Due to the various possible combinations, this approach also offers low decision altitudes. Possible combinations are, for example: **LNAV only** (lateral navigation only), **LNAV + VNAV** (lateral and vertical navigation) or **LPV** (Localizer performance with vertical guidance). For the controller, the different options make no difference in handling.

VOR approach

Sometimes no ILS/RNAV is available at the destination airport or the expected runway. A somewhat outdated method is the VOR/(DME) approach. This approach is considered a **non-precision approach** as well.

The challenge here is that the pilot aims at a fixed radio navigation station on the ground and follows its radial.

It is important for the controller to know that this approach procedure is rather imprecise compared to the ILS. The pilot might deviate noticeably to the left or right of the extended centerline. They fly the approach to the missed approach point (MAPt) or until the runway is in sight. As there is no vertical guidance for this approach, the decision height is relatively high. It is therefore not worth flying a VOR approach in bad weather.

NDB Anflug

The NDB approach is the last point in the approach list. This approach is by far the least accurate and therefore also classified as a **non-precision approach**. In contrast to a VOR, which transmits a clear radial, the NDB transmits signals in all directions simultaneously. With a VOR approach, the pilot recognizes directly whether he is correctly aligned. This is not very easy with the NDB approach due to its inaccuracy.

Alignment to the extended centerline of the runway is not based on a radial, but on a QDR (magnetic bearing from the station) transmitted by the station. The descent is started from a defined point and is similar to the VOR approach, as there is no vertical guidance here either.

Vectoring to Final

- During a **precision approach**, the pilot should fly **straight and level for 1 NM** before intercepting the glide slope. E.g. FAP at 10 NM -> glide slope intercept at 11 NM
- With an **RNP or RNAV(GPS)** approach, the pilot shall fly **straight and level for 2NM** before passing the final approach fix. E.g. FAF at 12 NM -> intercept at 14 NM
- If the RNP or RNAV(GPS) approach includes a course change at the FAF, the pilot should be cleared directly to a waypoint on the initial approach. E.G. RNP X RWY 25L (EDDF)

- For NPAs, the pilot must be given information about their position when they are guided to the final approach by vectors. E.g. "DLH123, you are 15 NM southwest of FFM VOR, cleared VOR Approach runway 25L"
- If an aircraft is vectored to the intercept of the final approach, the pilot must be instructed to report "established". "DLH123, cleared ILS approach runway 25L, report established." This does not apply if an independent feeder is used.

Visual approach

Frequently requested in good weather conditions: The visual approach. Although there are many airports in real life where such an approach is no longer permitted for noise protection reasons, it could certainly be used more often on the VATSIM network. This is not a flight rule change, so the aircraft is not VFR, but on a visual approach for IFR traffic.

Requirements

The following conditions must be met for a visual approach to be carried out:

- Pilot requests or accepts the Visual Approach
- Aircraft is below the ceiling, which is above the MVA or the pilot confirms that the visibility conditions are sufficient for the approach
- Pilot has the airport and the traffic ahead in sight

A visual approach must always be coordinated with the tower.

Clearance

If the above conditions are met, an IFR inbound can be cleared for a visual approach. The pilot is then responsible for obstacle clearance. However, the APP controller is still responsible for the separation.This responsibility can be delegated to the pilot with the remark that the pilot needs to maintain separation to traffic ahead autonomously.

As there is no published missed approach procedure for a visual approach, this must be communicated to the pilot together with the clearance.

Station	Phraseology
ATC	DLH123, Runway is at XX o'clock, Range XX Miles, advise able (to accept) visual approach RWY XX
Pilot	DLH123, able (to accept) visual approach RWY XX
ATC	DLH123, cleared visual approach Runway XX, in case of missed approach (missed approach procedure)

Slots

A slot generally refers to a specific time window. In aviation, these are mainly used for times when an aircraft must be in the air or, as a result, when it is allowed to leave its parking position.

Slots are mainly used when there is a high volume of traffic and helps the airport or air traffic controller to continue working as efficiently as possible. Each aircraft or individual aircraft can be allocated certain times.

Departure Slot

VATSIM offers the **vACDM tool** for certain airports, which takes a lot of the work out of departure control. Details can be found in this book. If the tool is not available or the controller does not use it for some reason, the capacity of the airport must be controlled manually.

For outbounds, this is best controlled via the aircraft's startup clearance. The number of aircraft cleared for startup may not be greater than the airport’s total capacity. All other airplanes must wait their turn accordingly.

> An airport with only one runway for take-off and landings has a capacity of around 20 to 30 aircraft movements per hour, depending on the ratio of inbounds to outbounds.

It is important to know the **airport's capacity** and to recognize the current bottleneck. If, for example, the airport has several independently usable runways and there is only congestion on one of them, it makes little sense for all aircraft to be allocated a slot. Outbounds that can take off from a runway without delay using normal procedures should not have to wait unnecessarily. The same applies to different departure routes, etc.

Queues at the holding point cannot be avoided even with the best systems. How they are processed and which traffic follows them are the most important considerations here.

To maintain an overview, the **TSAT** (Target Startup Approved Time) should be noted in the **scratchpad**.

If the workload for a controller and thus the waiting time for the pilots becomes too much, a **coordinator** can work with the controller on the Delivery position.

Example for 30 outbounds per hour

An airport runway has a capacity of **30 outbounds per hour**. On average, this means a **departure every 2 minutes**. If more than these 30 outbounds want to take off per hour or if they all request the startup clearance at the same time, it is time to act. The easiest way to do this is for Delivery to give startup clearances to outbounds on this runway every 2 minutes. The enroute clearance can also be given in advance, but only at 2-minute intervals startup clearances are issued and the aircraft are sent to ground/apron.

If there is another runway that can be used independently and has free capacity, the 2 minutes do not have to be used for outbounds via this runway.

It is also important for Delivery to have an overview of the holding points. If the holding point threatens to run empty, appropriate countermeasures should be taken and the start release of individual outbounds should be prioritized. The **taxi out time** for the individual aircraft should also be taken into account! The same applies to a situation where many departures have already been cleared for take-off via the same SID. Here it can be helpful for the tower controller if they can slot additional departures with other departure routes in between in order to reduce the necessary separation.