Sports airplane scale model for REFLEX XTR²

Bölkow Bo 208 / M.F.I. MFI-9 "Junior"

Small and simple, but powerful and versatile

It's a »square tin box that has been taught to fly«, as well-known aviation author *Richard Bach* wrote in his [review](#) (nice reading), and it's even a rather small box, but you would be surprised at how well it learnt to fly.

The Junior is actually an amateur-build design, even if *Björn Andreasson,* its designer, was a professional. Obviously, he had a talent to find simple but effective solutions. He enhanced his original design after the test flights, developed it further when he was back in Sweden, and later Bölkow in Germany got a license and built 210 of them.

This picture was borrowed from (now defunct) www.HB-UPC.ch and shows this nicely restored Swiss-registered Junior supposedly with the happy restorer in the pilot's seat. Look how small this two-seater is after all!

Look at the big propeller spun by a 100 hp engine and at the quite thin wing airfoil in the picture above, and you'll know that this is a fast flying airplane. Look at the cambered airfoil and the big flaps in the plan below, and you'll also know that this airplane is as well able to fly slowly and land shortly. You might even imagine that it is able to do basic aerobatics, even if positive-g only due to the wing struts. These abilities will all show on a scale model.
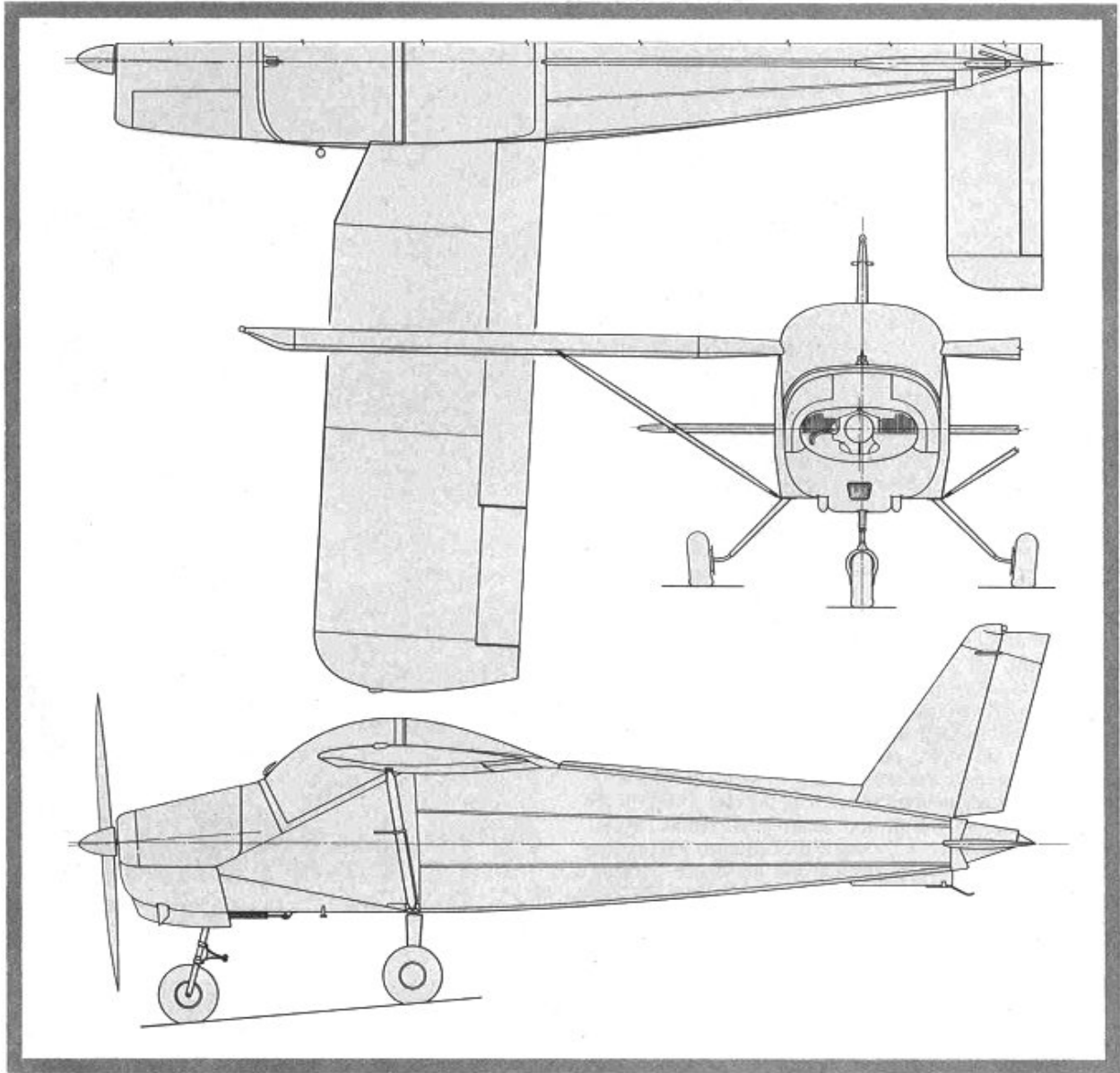
Some unique features of the original are not relevant for a model. The forward swept wing is even beveled to the canopy and is on eye-level so the pilot has full visibility above and below the wing. The full-flying horizontal stabilizer has an additional anti-servo tab to give the pilot some stick force and feeling. The rudder is thickened at the trailing edge for better effect (what even makes for some hiss in flight). These features are built into a model only to make it true-to-scale.

Other features just have to be copied in the model. Especially functional wing struts are needed because the wings are too thin to be strong enough with the spars only.

Anyway, you may expect an interesting scale model, at least due to the unique look of the Junior. But besides its look, its talent as a glider tug is amazing. Equally scaled as the glider, it's quite small and inexpensive. It's able to tow lightweight slow gliders and heavy fast gliders as well. It climbs and descends quickly and needs only the towline's length for landing. And you may just have fun knocking it around and flying simple aerobatics. And you may have most of all that– just except the tow itself – in REFLEX.

Sources

There's the comprehensive website www.Boelkow-Junior.de where several available reviews and articles are collected and presented, most of them in English. Nearly all information I have about the Junior is from there.

The (no longer available) website www.HB-UPC.ch had not only pictures but also manuals (in German) of the original aircraft (C version).

Contributions

Herbert and Janning Quint recorded the sound of a well-muffled Zenoah ZG 38 gas engine and published it on RC-Sim.de. This sound is assigned to some of the bigger model versions.
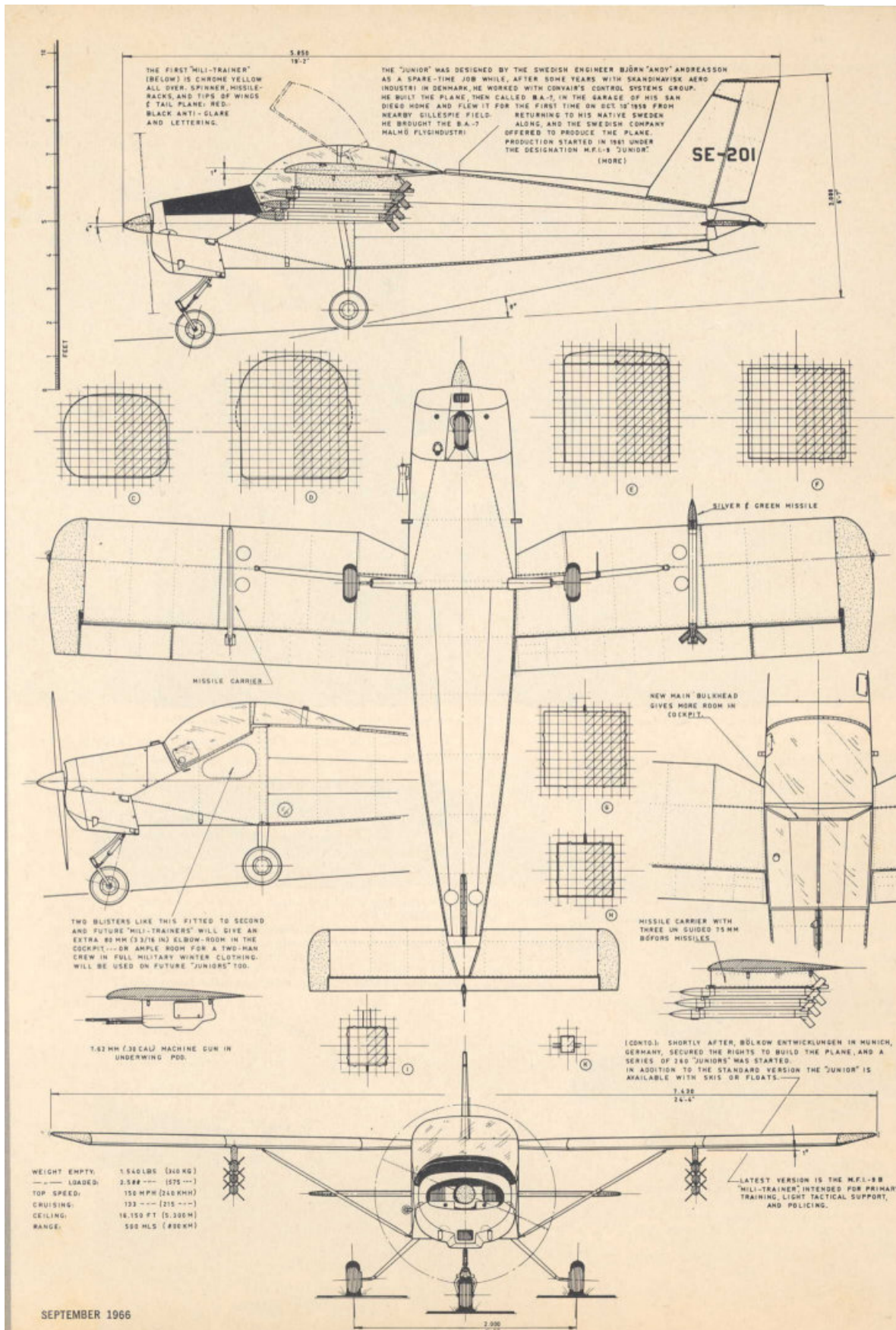
Rich Noon reviewed the Zenoah G20ei gas engine with the stock muffler for RC Groups and provided a video from which the sound was extracted. This sound is assigned to the smaller model versions.

Shape and Appearance

Though the REFLEX model is painted like the Swiss Junior in the picture above, it is not shaped after this aircraft and the drawing above. Instead I used the drawings from an *Air Progress* magazine article presented on the website www.Boelkow-Junior.de. During production time the aircraft was modified several times. There are three main versions named A, B, and C, and sub-versions to each of them.

The drawing above might show the B version. Bölkow later extended the wing tips to have more wing area. As shown here, they widened the fuselage and set the main bulkhead a bit further back to have a roomier cabin. The drawings below supposedly show the Bölkow A version or better the original Swedish Junior and the military trainer version built by M.F.I. (Malmö Flyg Industri, later SAAB) as MFI-9 (which became famous in the Biafra civil war).

THE "JUNIOR" IS PAINTED WHITE WITH RED, LIGHT BLUE, YELLOW, OR LIGHT GREEN TRIM WITH A NARROW BLACK BORDER LINE. (BLUE TRIM HAS RED BORDER LINE). PROPELLER IS SILVER WITH MATT BLACK BACK AND YELLOW TIPS.

SKI-EQUIPPED "JUNIOR"

BÖLKOW-BUILT "JUNIOR"

VENTURI TUBE (OPTIONAL)

SE-EFE

"JUNIOR" EQUIPPED WITH SKIS OF M.F.I'S OWN DESIGN.

TOP VIEW OF SKI.

M.F.I. "JUNIOR" WITH FLOATS. (PEE-KAY MODEL 1500 A)

SE-EFE

RED

SILVER

RED

TWO-BLADE MC.CAULEY PROPELLER.

THE FIRST "MILI-TRAINER" (BELOW) IS CHROME YELLOW ALL OVER. SPINNER, MISSILE-RACKS, AND TIPS OF WINGS & TAIL PLANE: RED. BLACK ANTI-GLARE AND LETTERING.

THE "JUNIOR" WAS DESIGNED BY THE SWEDISH ENGINEER BJÖRN "ANDY" ANDREASSON AS A SPARE-TIME JOB WHILE, AFTER SOME YEARS WITH SKANDINAVISK AERO INDUSTRI IN DENMARK, HE WORKED WITH CONVAIR'S CONTROL SYSTEMS GROUP. HE BUILT THE PLANE, THEN CALLED B.A.-7, IN THE GARAGE OF HIS SAN DIEGO HOME AND FLEW IT FOR THE FIRST TIME ON OCT. 10 1959 FROM NEARBY GILLESPIE FIELD. RETURNING TO HIS NATIVE SWEDEN HE BROUGHT THE B.A.-7 ALONG, AND THE SWEDISH COMPANY MALMÖ FLYGINDUSTRI OFFERED TO PRODUCE THE PLANE. PRODUCTION STARTED IN 1961 UNDER THE DESIGNATION M.F.I.-9 "JUNIOR". (MORE)

SE-201

SILVER & GREEN MISSILE

MISSILE CARRIER

NEW MAIN BULKHEAD GIVES MORE ROOM IN COCKPIT.

TWO BLISTERS LIKE THIS FITTED TO SECOND AND FUTURE "MILI-TRAINERS" WILL GIVE AN EXTRA 80 MM (3 3/16 IN.) ELBOW-ROOM IN THE COCKPIT---OR AMPLE ROOM FOR A TWO-MAN CREW IN FULL MILITARY WINTER CLOTHING. WILL BE USED ON FUTURE "JUNIORS" TOO.

MISSILE CARRIER WITH THREE UN-GUIDED 75 MM BOFORS MISSILES.

7.62 MM (.30 CAL) MACHINE GUN IN UNDERWING POD.

(CONT'D.) SHORTLY AFTER, BÖLKOW ENTWICKLUNGEN IN MUNICH, GERMANY, SECURED THE RIGHTS TO BUILD THE PLANE, AND A SERIES OF 260 "JUNIORS" WAS STARTED. IN ADDITION TO THE STANDARD VERSION THE "JUNIOR" IS AVAILABLE WITH SKIS OR FLOATS.

WEIGHT EMPTY:	1.540 LBS (340 KG)
LOADED:	2.5## --- (575 ---)
TOP SPEED:	150 MPH (240 KMH)
CRUISING:	133 --- (215 ---)
CEILING:	16.150 FT (5.300 M)
RANGE:	500 MLS (#80 KM)

LATEST VERSION IS THE M.F.I.-9 B "MILI-TRAINER" INTENDED FOR PRIMARY TRAINING, LIGHT TACTICAL SUPPORT, AND POLICING.

SEPTEMBER 1966

The airplane's controls – including the flaps – are so simple that there's no problem to render them correctly on a model. The same is true for the landing gear. By the way, it's not possible to correctly render the ski landing gear in REFLEX. The floats may be rendered correctly but they are not working correctly because no floating and planing effects are simulated. Finally, there's no tow release and no glider tow at all in REFLEX.

All main parts of the aircraft have only simple curvature because they are made from simply bent sheet metal. More complicated are only the wing and empennage tips and the engine cowl front. They are made from fiberglass on the original and could be on a model as well, but also carved blocks of light balsa would do fine.

The B and C versions are more complicated in several details and that's why I preferred to render the A version in REFLEX. Especially details on the model and in its cabin are made after pictures found on www.Boelkow-Junior.de.

Painting was done following the pictures on www.HB-UPC.ch, but not strictly. I used (had only) different fonts for the registration on wing and fuselage and for the type name on the engine cowl. The Bölkow logo is correct since it was copied from one of the original manuals downloaded from the website.

A photo of the aircraft's instrument panel was usable for a better scale look. The lower part is not rendered but you won't see it, anyway. The Y-shaped yoke is shown in REFLEX as well as some seat upholstery. Later, a pilot figure was borrowed from REFLEX (the Grunau Baby model) and put into the left seat.

By the way, when running the simulation look into the cabin and watch the yoke while moving the elevator stick on your transmitter (a gadget).

The model's propeller is a wooden Master Airscrew, mainly because I had it, but also because a wooden propeller is well suited to the gas engines used. The original aircraft has grey or black colored metal propellers. The spinner is aluminum colored just because I like that more than a yellow one.

The exhaust pipes shown are those of the original. The gas engines used in the model would have different exhausts, but it would be excessive to render all the different model engine exhausts of the different versions.

The drawings show important values, which are used not only to shape the model in REFLEX but also to set the parameters. These are wing dihedral and incidence (both 1 degree), wing sweep (-3 degrees), and propeller right and down thrust (1.5 and 4 degrees).

Setup

As usual, I took the geometry from the drawing and put it into *Blaine Beron-Rawdon's* excellent Plane Geometry spreadsheets (see the [overview on his website](#)) to get most of the physical parameters. The airfoil and wing coefficients were calculated in an own spreadsheet. All calculated values and the values from the drawing were simply transferred to REFLEX. The model worked right away, so no tweaking or fudging was done.

The airfoil coefficients had to be estimated. The original has a NACA 23008.5 airfoil, which means 8.5% thickness, 1.9% camber, and a rather forward point of maximum camber (16.6% of chord length). This airfoil was chosen for its thinness to get a fast flying plane. The forward camber was chosen to have airfoil moments counteracting the effects of the low center of gravity and make do with a small tail. The same reasons hold for a model so the same airfoil could be used, particularly because it translates well into the small model Reynolds numbers.

Unfortunately, there are no measurements available, least of all low-Re measurements. But the JavaFoil program by [Martin Hepperle](#) is able to approximate the airfoil coefficients, at least if the *Eppler* algorithms for boundary layer and stall are used. It turns out that a HQ airfoil (by *Helmut Quabeck*) of similar thickness and camber may be used as well. And by the way, the forward camber of the NACA airfoil gives the drooping wing leading edge you may see in the drawing and maybe on the REFLEX model, too.

The center-of-gravity (C/G) was set by calculation and trial. In the Plane Geometry spreadsheets, about 12% static margin was chosen because that proved to give a pleasant balance for level flight with 50% to 70% power. It's in the original's weight-and-balance envelope as well so the model is really true-to-scale. For full-power flight, simply trim a bit down elevator, like in a real aircraft. The model is then almost neutrally stable.

Control deflections were set in a pragmatic manner. Rudder deflection is set to 30 degrees just because that's customary. The all-flying elevator has only 8 degrees deflection to avoid unstable flying conditions (though the rudder bevel allows for 15 degrees). 30 degrees, a nice round number, was set for the ailerons, together with 20% differential. No exponential rate was set. Maximum flap deflection is 30 degrees to have a decent climb with flaps fully deployed (the original has 35 degrees). All these settings turned out to be adequate for normal and safe flying.

There is very little adverse yaw left, at least with flaps retracted. But there is still some rudder needed in some situations, at least it's advisable. Therefore you might just as well set smaller (10%) or no aileron differential and fly aileron-rudder coordinated, anyway. In this case, you should also remove propeller right thrust because that as well can be correct only in some situations and will be inconvenient in all others.

The REFLEX model was set up for three different scales and in each scale with three different drives. My favorite scale is 1:3 in which the model has 2.48 m / 97.5" wingspan and a typical weight of 11 kg / 24 lb. Many modern "scale" glider models are scaled 1:3 and the Junior is a pleasantly small but powerful tug. An already more traditional scale for glider models is 1:3.5, in which the Junior model has only 2.12 m / 83.5" wingspan and 8 kg / 18 lb typical weight. This handy size is just neat! Only for comparison, the model is scaled also 1:2.5 with still only 2.97 m / 117" wingspan and 16 kg / 35 lb typical weight.

For me, these weights are typical for the respective *size* of the model (not *scale*). They would allow building a real model not especially weight-saving and using the quite heavy (but cheap and reliable) magneto-ignition Zenoah gas engines. So these weights are not especially low and the aircraft is not a STOL one. But it has a quite big wing area (low aspect ratio) and a cambered airfoil to carry the weight. And it has (simple but) big flaps for low speed and short landings. It's all quite well thought-out by the designer.

A small tug means the engine has to haul less tug airframe and more power is left to haul the glider. So the smaller tug needs a smaller engine than a bigger one. Additionally, a tug should use a small-pitch propeller because high speed is not needed but big thrust, which is then obtained with an even smaller engine.

It turns out that a ZG 45 is typical and sufficient for the 1:3 tug. The ZG 62 is brute force for this small model as it gives a 1.1 thrust/weight ratio, but you may like it. If the model is used only for sports flying including basic aerobatics, even a ZG 26 is enough and will give nice scale-like flying. This is worth considering because this engine is cheap compared to the ZG 45 and ZG 62, which both need the Hydro Mount System by Toni Clark for vibration and noise reduction.

The 1:3.5 model might do with the ZG 26 even for towing. A ZG 20 may be used for sports flying and a ZG 38 for very good towing performance. Cheap engine and cheap model for towing many if not most of today's scale gliders – very interesting! Compare a 1:3.5 Wilga: 3.20 m / 126" wingspan, 16 kg / 35 lb weight, ZG 80. The Junior is the scale tug for the cheapskate.

The 1:2.5 model will need the ZG 62 for towing and will well take a ZG 80 for even better performance, but at substantially higher cost. It even needs the already quite expensive ZG 45 for sports flying and is therefore in a higher class than the smaller scale models. That would be a possibility for only few model tug pilots who in this case would probably prefer a "better" and "nicer" type of airplane, anyway.

The propellers for the different versions were chosen as recommended by Toni Clark. For each drive the lowest-pitch propeller was chosen. Static thrust was specified on these web pages in some cases and in the other cases was estimated using ThrustHP Calculator. Maximum engine rpm and

propeller pitch were used to estimate the maximum flight speed. Engine torque was specified for all engines.

The true-to-scale propeller diameters are 21" (1:3), 18" (1:3.5), and 25" (1:2.5), respectively. It turned out that in each scale the medium-sized engine (ZG 45, ZG 26, ZG 62, respectively) uses exactly this propeller diameter. For me, that is an indication to see these engines as the typical ones for the respective scale. That's in addition to my feeling these engines are just right, even if you might prefer the bigger ones. But also consider that only the even smaller engines give a "scale-like" flying.

Flight Characteristics

The Bölkow Junior is a smooth and safe flying utility airplane.

The model is balanced for take-off and climb, and for slow flight with only 30% to 50% power. For cruise flight with 50% to 70% power simply trim a bit down elevator, like in a real aircraft, and even more at full power. The model is then pretty neutrally stable. With the standard trim and full power, it will climb at considerable speed and at a decent rate.

This flight regime is used for towing fast and heavy gliders, for instance aerobatic gliders with their high wing loading and low-cambered wing airfoil. The Junior has an even higher wing loading but that is compensated by a slightly more cambered airfoil, so it's a perfect match.

Slow and lightweight gliders, for instance thermal gliders, are best towed with flaps 10 degrees down. These flaps are reaching to 70% of the wing span, and even though they are very simply shaped they have a huge effect. 10 (original: 8) degrees deflection just substantially increases lift without noticeably increasing drag. So tug and glider are again perfectly matched.

10 degrees flaps may also be used for short take-off and steep climb, if and when needed. But there is no normal landing and no landing at all (except emergency) without flaps. Even though the original has variable flap deflections up to 35 degrees, for the model I would prefer simply three positions: 0, 10, and 30 degrees. More than 30 degrees is not needed but might be even dangerous. It would not give more lift but progressively more drag. The big flaps at 30 degrees and the big fuselage cross-section give well enough drag for a steep approach and short landing.

You'd wonder how fast and long landings could be with less than 30 degrees flaps. The increased lift is just needed to compensate the rather high wing loading. But as always when using highly effective flaps, a bit practice is needed to make really good landings (which are even scored in glider tow competition). It's best to maintain a moderate pitch angle (attitude) during landing approach (the flaps make for a lower angle-of-attack). Pulling the model's nose too high reduces speed only marginally but increases drag and therefore sink rate substantially. Once the model sags it's nearly too late to

recover, and that's possible only with more power (giving more speed) and not with more elevator, which would let the model just plop down hard.

Junior landings are not hard; they are just different, due to both the big flaps and the all-flying horizontal stabilizer. If you are used only to a 5 ft wingspan and 6 lb weight pattern model you'll have to practice. But after mastering the right technique, you will land the 8 ft / 24 lb Junior just as slow and short as the much smaller pattern plane. Can't believe? View the demo flight! (Hit F9 in REFLEX, select "Bo 208 Junior".)

There you'll see some aerobatics, too. The basic maneuvers loop, roll, and stall turn may be flown just for fun, even if not in perfect shape. Inverted flight should be possible but no inverted maneuvers due to the wing struts (the original is rated for +4.4/-1.7 g load factor). Spins or even flick (snap) rolls are not possible because the Junior doesn't really stall (both original and model). What you may notice at high angles-of-attack might be some directional instability caused by the forward sweep, but I don't know for sure.

You may notice no real stall and a refusal to spin, though. That's even true-to-reality since the airplane was certified for spinning but only the factory test pilot managed to do it (see here at last page). Try his trick in REFLEX – it will even work! »The airplane will spin out of the second turn of a spiral dive upon application of full rudder and opposite aileron with stick full back.« Stunning! Only recovery is much simpler than in reality.

For comparison, there's an "expert" setup of the big version with the ZG 45 (because it's closest to the real thing), with 35 degrees flap deflection and 15 degrees elevator. This setup spins without any trick and may be fully flared for landing. But you may notice that you really have to be an expert (or practice) to do this properly. The picture shows full flaps and full up elevator as well as the paint scheme used for the first airplanes built in the 1960s.

Glider Towing

There's one point left to discuss: Many of you won't believe such a small and weak model could be a tug at all. But the Junior model would be a good tug even with the mid-size engines. How I know? That's simple, just physics. Only for the incredulous there are now a few setups for REFLEX so you may try yourself and see. (The early original paint scheme is applied because the Junior was often used for glider towing in Germany. D-EGNA was the demonstrator brought to the USA and test-flown by *Richard Bach* and others for their reviews and looked roughly like that.)

And to forestall any objections here's how the parameter setup was done: Let's assume the 1:3.5 Junior with the ZG 26 engine has to tow an equally scaled MDM-1 Fox aerobatic glider. Junior's wingspan is 2.12 m, that of the Fox is 4 m. Weights are 8 and 7 kg, respectively. The propeller has to haul both airplanes now and the thrust/weight ratio is 6.5/(8+7)=0.43 in contrast to 0.8 without the glider. The parasitic drag of both airplanes is added up, as are the wing drag coefficients. The parasitic (fuselage) drag is increased by only 10%. The Fox's coefficients are converted to relate to the Junior's wing area what is about doubling the wing drag, though.

Unfortunately, just in slow flight (towing) the wing (induced) drag is rather big, but then again the drag doesn't use up much of the thrust. Most of the engine's power is left to lift the weight, now that of the tug-glider combination. While the 0.8 thrust/weight ratio of the Junior alone is too much for scale-like flying, the 0.43 ratio is just right for the combination though it's still bigger than in reality. Models do need more thrust than real airplanes, there's just a lot of exaggeration today.

Now set 1/3 (10 degrees) flaps and let the Junior take a run! The Fox has a much lower wing loading and will keep up. The model will need quite a bit of runway and barely take-off. You'll have to help with some elevator, but resist pulling the elevator after that. The model is trimmed correctly and will gain speed for best climb. Just cancel out the propeller torque with a bit aileron and watch the combination climbing. That's vigorous, scale-like towing!

You may have noticed that this case-study tow was with flaps even though the Fox is a fast aerobatic glider. If you'd have to tow a *really* heavy and fast glider, for instance the Fox loaded to even 9 kg weight, well, then you might prefer to tow with flaps retracted. Now you'd need a higher-pitch propeller and maybe even the ZG 38 engine. Both cases are prepared as parameter setup for you to try. Again, resist pulling elevator for better climb - it won't work. I wouldn't say it's vigorous towing any more, but I insist it's scale-like towing – even though there are no such heavy gliders in reality! (A 5.6 kg Junior and a 5 kg Fox would be more true-to-scale.)

Finally, just for a change, a special tug version scaled 1:3 was made with a different paint scheme and with a different engine. The Saito FA-300T flat-twin four-stroke spins the same 21x10" propeller as the ZG 45 but is even more powerful. It's a precious engine with a full sound, and hopefully the sound of the smaller FA-90TS (borrowed from Horizon Hobby) is similar. The paint scheme was borrowed from the real aircraft D-EEAB (omitting some details) that is shown on several pictures at www.Boelkow-Junior.de.

This simple but effective paint scheme matches the simple but effective design. White wings and empennage and red fuselage emphasize the stout fuselage and the stubby wings. Together with the sound, that makes for resemblance to a fat bumblebee. Don't you believe this is a good tug?

Floats

There's actually no water in REFLEX and no floating and skimming effects. There's no buoyancy and no drag, but instead there is elasticity and friction. Yet a lake in a REFLEX scenery may look rather similar to water if set up properly. I learned that only after I made the floats version of the Junior. It looked so nice and interesting on the drawing (see page 4 above) that I just couldn't resist making it. Now that I have it I really like it and find it even a bit useful for practicing.

The drawing tells the floats are the quite popular PK floats, model PK 1500 A. The paint scheme was obviously used by the original manufacturer M.F.I. *and* its licensee Bölkow. It was available in different colors, but obviously red with black pinstripes was preferred. Even though the drawings specify red for the float-plane, I found that yellow with blue pinstripes better fits a Swedish airplane and particularly a float-plane. The blue tinted canopy matches this paint scheme. Please note that the float-plane is an M.F.I. Junior (MFI-9), not a Bölkow Junior (Bo 208), since only M.F.I. built some.

The amphibious version is pure fantasy. Already having the floats version, I badly wanted to know how such a vehicle would handle. Though many am-phibious floats have a nose wheel on each float tip, I preferred a single nose landing gear as used today for very light airplanes (like here), which is ren-dered in REFLEX without any problems. The paint scheme uses orange color just to be different.

The float-planes were set up as the 1:2.5 (2.97 m / 117" wingspan) version with ZG 45 engine because this is closest to the real thing. Flap deflection is restricted (to 30 degrees) as usual for float-planes because the floats' drag is rather big. Full elevator deflection (15 degrees) is needed to prevent the airplane from going nose-over on the water. For better in-flight feel, some exponential is set for the elevator. Junior's horizontal tail is small, anyway, and actually too small for a float-plane, but it just works.

The vertical tail seems to be too small for a float-plane as well. Obviously, M.F.I. added a ventral fin to the float-plane demonstrator. This fin is shown on pictures (see below and the blog link in the History section) but not on the drawings (see page 4 above). Anyway, the ventral fin has been added also to the float-plane models for REFLEX. The vertical tail area is enlarged by about 30% giving somewhat better directional stability and damping.

Of course, the floats add weight and drag. I assumed typical fiberglass round-top floats as made by a (now defunct) [special manufacturer](). Weight is specified as 56 oz and I assumed 2 kg / 4.4 lb for the whole installation, even 2.5 kg / 5.5 lb for the amphibians. Now the plane weighs 18 kg / 39.7 lb or even 18.5 kg / 40.8 lb. The center-of-gravity was lowered and moments-of-inertia were increased accordingly (estimated). The floats' drag and moment arm were entered into the landing gear parameters, and even though there is no true landing gear this has a pitching-down effect in flight. To compensate for this, the elevator has -0.5 degrees negative incidence. The amphibians do have a true landing gear, and thus the drag parameters would not be effective when the gear is retracted. So I had to include the floats drag in the fuselage drag and left the elevator incidence at zero.

As described [here](), amphibious floats are more of a makeshift than a good solution. The airplane stands high over the ground on the wobbly undercarriage. No sharp turns and no hard landings are allowed on penalty of toppling over or broken landing gear. And leaving the gear down when landing on water would be [fatal]() at least in reality, but fortunately we are in a simulator.

Take-off and landing are a bit different with the amphibians. All wheels are narrow and will sink in soft ground. Because the float steps have to be below the center-of-gravity, the main wheels are quite far behind the C/G. Yet take-off is easy because the flaps (which are absolutely needed) lift the aircraft off the ground. Full flaps are needed for landing to keep the pitch angle low. The nose wheel should be just over the ground on touchdown or it will plop down and may be damaged.

By the way, sometimes the nose landing gear will break even when you just start the simulation in REFLEX. Some starting positions in the sceneries are especially bad in this respect. In such a case, the broken landing gear won't be intact after restarting the simulation with the "Del" key. Just hit the "Del" key several times consecutively and the model should come back intact. If this doesn't help choose another (better) starting position.

Handling on water looks more realistic than I had expected. Granted, friction is independent of speed so the plane completely stops at idle power and it doesn't drift sideways. With power, the propeller thrust tilts the plane onto the float tips even with full up elevator. On landing the float drag is high and full elevator with some propwash is needed. The amphibious plane may be taxied to the shore where the gear is retracted and the plane is slipped into the water, vice versa after landing on water. The float-plane is as well able to slip on *terra firma*.

For take-off, a bit flap deflection (8 to 10 degrees) is absolutely needed! Then just apply full up elevator and full power. When the plane gets easy on the floats, gently release the elevator and let the plane climb to a safety altitude. Then retract the flaps and let the model gain some speed. Now you may slightly reduce power (to 60% - 80%) for cruise flight. But keep in mind

that the flight speed of a float-plane is rather low due to the huge drag. The Junior has a low-aspect-ratio wing which additionally produces huge induced drag in the low-speed turns. Setting full power before commencing a turn and reducing to cruise power before ending it will help immensely. By the way, the ZG 45 engine of the REFLEX model spins a low-pitch propeller that gives decent thrust at low speed. Landing is easy, with or without flaps deployed. Just see that the model's nose is high and pull full elevator on touchdown. A bit power for propwash will help but is not really needed.

The float-plane model will work in the water sceneries for REFLEX that were published on RC-Sim (here, here and here) even though they were made for float-planes with wheels hidden in the floats. These are actually not needed in REFLEX, though, and *any* seaplane will work on properly set-up "water", even if bigger (heavier) planes will sink in more than smaller (lighter) ones. You will see this effect when trying the smaller 1:3.5 (2.12 m / 83.5" wingspan) float-plane version that was made for comparison. It shows that neither the floats' displacement nor pressure on the supported area determine the force that carries the airplane. Instead it's only the elastic force of a "soft" ground acting on those parts of the floats that are looming down into the "water". I made a usable "water" for REFLEX and included the parameter set in the Junior package. You may import and use this "water flying" material ("Wasserflug" in German) in the REFLEX scenery editor RSK.

There are other water aircraft for REFLEX. Look here or even better here for an amphibious boat seaplane, and here for nice helicopters on floats (they are great for learning, by the way). If you want to build your own float-plane you may use my floats or amphibians as objects in the REFLEX model editor RMK. Look for the files named "PK 1500 A floats.mod" and "PK 1500 A amphibians.mod" in the "Objekte" folder. There is a version "… 2" of these two files with smaller water rudders. The true-to-scale rudders are supported too much by the elastic "water" so the model would rest nose-down on the water. With the smaller rudders the model stands like the original. And when your model is completed you should absolutely use the "Options – Optimize model" function in RMK or your model would behave funny in the simulator.

Skis

There's also no real snow in REFLEX, but we're pretending, anyway.
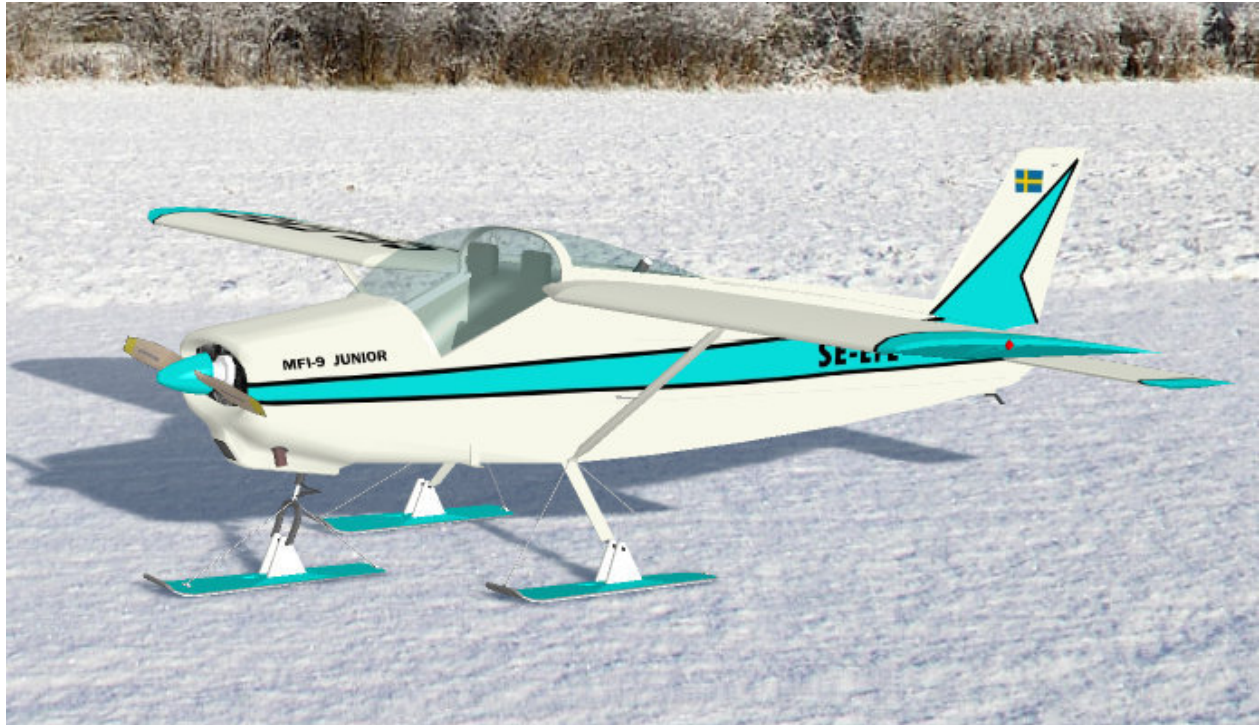
Obviously, M.F.I. also offered skis for the MFI-9 Junior. They are shown on the drawing (see page 4 above) and look just as interesting as the floats, so they had to be made as well. In the winter, these skis would *replace* the wheels if the airplane is operated in a cold northern country (like Sweden). There are trestles on the skis that are put on the wheel axles to maintain the airplane's ground clearance. There is another kind of skis used in mountain-ous countries (like Switzerland) to operate from snow-free runways in valleys but to land on snow on mountains. These skis are in *addition* to the wheels, and they are lowered below the wheels to land on snow and retracted other-wise. It's not possible to render that in REFLEX so there is only this ski ver-sion without wheels.

The original Junior paint scheme was offered also in blue what matches a ski plane and is used here. The drawing doesn't specify the ski colors so I made the top side blue as well. The ski soles are grey with three grooves and alu-minum edge bars on each side. The trestles are white like the rest of the air-plane. In reality, the skis pivot on the wheel axles to lie flat on the ground or to be aligned with the flight direction. This movement is limited by two rigid straps, one on each end of the ski. In flight, an elastic strap pulls the front end upwards. It's not possible to render that in REFLEX, though.

Otherwise, these skis are rendered nearly perfectly. After all helicopter skids are rendered perfectly as long as REFLEX exists, and in fact the skis are treated like skids. Unfortunately, skis are a bit different so the rendering is only nearly perfect. Of course, there's no real snow in REFLEX, especially no compacting of snow and no tracks. If a surface in the scenery is set as soft and deep, the skis will just sink in and get invisible. Only a surface as hard as concrete supports the skis so much that their upper side is still visible. Nevertheless the ski ends sink in when they slip over wavy ground. Making the landing gear soft in taxying direction only approximates the necessary pivoting. Bigger (heavier) planes will sink in more than smaller (lighter) ones. You will see this effect when trying the smaller 1:3.5 (2.12 m / 83.5" wingspan) ski plane version that was made for comparison.

Flying the ski plane is not different from flying the wheels version, but ground handling is, of course. On the slippery hard snow, cornering grip is low despite the grooves and edge bars. The plane will drift sideways when turned with too much speed. At low taxiing speed, ground handling is satis-factory. Though ground friction may be zero, ground waviness and elastic sink-in make for some drag or friction so the landing distance is not longer than on wheels.

The ski plane model will actually work in any REFLEX scenery, but there are even a few winter sceneries published on RC-Sim (here, here, here and particularly here). These try to show the snow as true-to-reality as possible (except the ice scenery) so the skis will sink in the quite deep and soft snow. We need compacted, hard snow (or just ice) to let the skis look realistic in REFLEX. So I made a suitable "snow" for REFLEX and included the parameter set in the Junior package. You may import and use this "snow hard" material ("Schnee hart" in German) in the REFLEX scenery editor RSK. By the way, remove the waviness and reduce the cornering grip and you'll have ice.

There are no other ski aircraft for REFLEX, but water aircraft may fly on snow as well. As already said above, look here or here for an amphibious boat sea-plane, and here for nice helicopters on floats (on the slippery snow they are even better for learning). If you want to build your own ski plane you may use my ski as object in the REFLEX model editor RMK. Look for the file named "MFI ski.mod" in the "Objekte" folder. This ski is very detailed. Make sure to use an insertion point that belongs to an existing landing gear leg ("Gear component") and is located in the middle of the wheel axle. And make sure to move the "Deepest point of … gear" to the ski's sole below the axle (and adapt the landing gear parameters). When your model is completed you should use the "Options – Optimize model" function in RMK even though that's not absolutely needed for skis.

Sceneries

The Junior models will work in any REFLEX scenery, but of course some are better suited than others, especially to the floats and skis versions.

When the Junior model was published on RC-Sim I made that a search for a home for poor little Junior. At the same time, *Horst Lenkeit* was working on his marvelous MFC Coesfeld scenery. He immediately offered it as a home for Junior, and this peaceful and warm July scenery gave rise to a sense of well-being for Junior. Thank you very much!

For the floats and the skis versions I used two nice sceneries made by *Harald Bendschneider* when the REFLEX scenery construction program RSK still was brand-new. Even then he made these water and snow sceneries even though there is no real water or snow in REFLEX. But having the Junior on floats and skis, I was not far from the sudden inspiration how to make at least sort of water and snow. By trial and error I developed the material characteristics mentioned above and modified the scenery light and shadow to my liking.

Harald Bendschneider was kind enough to adopt my modifications and to re-publish the sceneries on his website www.Szenerien.de. The water scenery is called "Baggersee" what literally translates to "excavated lake". Other translations are "flooded quarry" or "gravel-pit lake". The snow scenery renders his club airfield "Aero-Club Bad Oldesloe in December". Thanks a lot as well!

If you have downloaded and installed these three sceneries as well as *Harald's* newer "MBG-Bargteheide" scenery (and the Junior package, of

course), you may view the demo flights for the different Junior versions. Hit F9 in REFLEX, select the "Bo 208 Junior", "MFI-9 Junior on floats", "MFI-9 Junior amphibious", or "MFI-9 Junior on skis" demo flights. Happy viewing!

There are even more great sceneries for the special Junior versions. *Paul Dürr* created the challenging water flying scenery "Rheinbrücke Hartheim", under a bridge over the river Rhine. *Ronald Bankert* complemented his nice "Fischen im Allgäu" summer scenery by a just as nice winter scenery, which has additional moonlight (see picture, but now even with working position lights) and night flying versions. *Thomas Roden* made an ice flying ("Eisflug") scenery on the frozen Lake Constance. Happy trying!

History

Some information about the history of *Björn Andreasson's* BA-7 EAA prototype, his production version MFI-9, and the license-produced Bo 208 Junior is found at the www.Boelkow-Junior.de website. In addition to the articles presented there, a presentation of historic pictures by test-pilot *Ove Dahlén* is latently available there. As far as I know, the last picture shows Ove Dahlén, *Björn Andreasson*, and *Rudolf Abelin*, founder of M.F.I. The presentation was made 2008 on the occasion of the 50th anniversary of the BA-7 maiden flight in 1958, which took place near San Diego in California. This is how it looked:

There's even an article (in English) by *Björn Andreasson* in the July 1959 issue of Sport Aviation, but it's available for EAA members only.

A Swedish blog about M.F.I. aircraft shows several nice pictures of various versions of the aircraft, including pictures of the original and further floatplanes, as well as successor types and Björn Andreasson's other designs (here, here, and here).

There are two videos about the "Biafra Babies", the MFI-9B militrainer version used by Carl Gustaf von Rosen 1969 in the Biafra civil war in Africa (video 1, video 2).

And there's an 8mm film movie about the MFI-9 showing the BA-7 prototype in flight (here).

Conclusion

The Junior would be a great tug as a scale model. Still simply constructed even if built true-to-scale, it will come out quite lightweight and can take a more heavy gas engine, which is reliable and easy to operate. The model is small compared to a glider in the same scale what means some economy. And the model is able to adapt its speed to different gliders, lands rather slow and short, and may even perform basic aerobatics.

While the wheels version is perfectly rendered in REFLEX, the float and ski versions won't satisfy a critical user. Nonetheless they are quite nice and interesting airplanes, and even though their ground handling is not quite realistic, we greatly appreciate to see them in motion in their natural sur-roundings.

Enjoy!

Burkhard Erdlenbruch

mailto:Burkhard@Erdlenbruch.de
http://time.hs-augsburg.de/~erd/Modellflug/textReflex.html

More REFLEX models and the latest versions are on my page
http://time.hs-augsburg.de/~erd/Modellflug/textDownloads.shtml

© 2007-2018
written Nov 2007
upgraded Mar-Jun 2008
upgraded Jan, Jun 2010
amended Feb 2014
corrected Jan 2018
corrected June 2019

P.S.: For some jokes about the English pronunciation of the name Bölkow with the German "O-Umlaut" in it, see the various English articles on www.Boelkow-Junior.de. And here's how I pronounce it: Boelkow.wav