DURABILITY FOR WELDED CONSTRUCTIONS

HiFIT

High Frequency Impact Treatment

THE REVOLUTION FOR WELDED CONSTRUCTIONS:
POST-WELD TREATMENT WITH HIFIT

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REVOLUTION FOR WELDED CONSTRUCTIONS: THE HIFIT POST-WELD TREATMENT

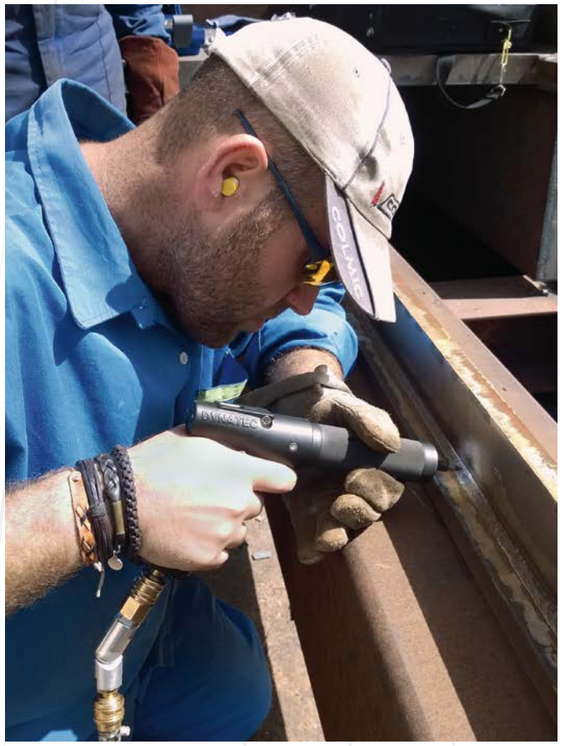
THE HIFIT METHOD
HIGH FREQUENCY IMPACT TREATMENT
is a high frequency impact treatment method that significantly increases the durability and service life of dynamically loaded, welded steel constructions via the targeted post-treatment of weld transitions.

The HiFIT method can be used universally and requires very little in the way of additional equipment. HiFIT nevertheless delivers results that are highly reproducible and allows for quality control. In the joint research project funded by the German Federal Ministry of Education and Research (BMBF), the HiFIT method was investigated in extensive fatigue tests and has proven itself to be particularly efficient. The HiFIT hammer was developed by the company DYNATEC Gesellschaft für CAE und Dynamik mbH.

HiFIT is a high frequency impact treatment method. In German-speaking areas, it is also known as "HFH" and in English-speaking areas as HFMI for "high frequency mechanical impact". Numerous international studies have proven the way of working and the effectiveness of the HFMI method. The "REFRESH" joint research project funded by the German Federal Ministry of Education and Research was able to present impressive results.

The International Institut of Welding published the recommendation for HFMI in 2016 to regulate post treated weld joints for assessment and quality control.

APPLICATIONS



Welding is the most commonly used method for joining steel. Many parameters must be complied with to create a suitable weld. Constant loads are tolerated to a certain extent. However, the component will fail with the same load if the load is repeatedly applied. In the case of what are known as cyclical loads, local cracks form that increase with time and lead to failure.

Billions of euro are spent every year combating the fatigue of dynamically loaded components and constructions. Crack formation with subsequent crack growth is often due to the notch effect at weld transitions. In many cases, this limits the service life of the components and constructions. Added to this are changes in the conditions of use that it was impossible to take into account at the design stage, such as longer service times, higher loads and the desire for longer use. In new welded constructions, higher-strength steels cannot be efficiently used, as the welded joint is often decisive for a reduced service life.

Long-established mechanical methods such as grinding, shot blasting or remelting (TIG dressing) improve the fatigue resistance but are difficult to reproduce and less effective.

THE HIGH FREQUENCY IMPACT TREATMENT HIFIT IS BY CONTRAST

Efficient
Reproducible
Reliable

AREAS OF APPLICATION

Steel bridges
Construction machinery
Cranes
Load handling devices
Wind power plants
Roller coasters
etc.





ADVANTAGES

The advantages of HiFIT post-weld treatment are impressive and result in an enormous increase in the economic efficiency of your welded constructions. Below you will find the summary from the REFRESH project:

80% TO 100% INCREASE IN WELD FATIGUE LIMIT

– The weld transition is geometrically rounded.
– The weld transition is plastically deformed and strengthened via local reshaping.
– Internal compression stresses prevent crack formation and crack propagation at the surface.

5- TO 15-FOLD INCREASE IN WELD SERVICE LIFE

Over 1000 tests have shown a multiple increase in the service life.

APPLICATION WITH SAME EFFECT EVEN FOR EXISTING CONSTRUCTIONS

– If existing constructions are renovated in a timely manner, there is almost no difference to the service life of new treated welds. The use of existing constructions far beyond the previous service life is thus possible.
– Where no macroscopically detectable cracks are present, HiFIT is a very suitable repair tool. If cracks are present, the welded joint must be professionally repaired. HiFIT can then be used with a high level of efficiency.

USE OF HIGHER-QUALITY STEELS MAKES ECONOMIC SENSE THANKS TO HIFIT

The higher the yield strength of the selected material, the more effective the HiFIT method. This makes it possible to build weight-optimized constructions.

EXTREMELY USER-FRIENDLY

– Thanks to mobile compressed-air units, the HiFIT hammer can also be readily used outside of manufacturing sites. No additional power source is required.
– The compact design and low weight make it possible to access difficult-to-reach locations. The space required is only slightly more than that for a welding torch.
– Robust LED lights in the tip of the hammer ensure optimal illumination even under difficult work conditions.

PROCESS RELIABILITY

– The treated area can be checked via a visual inspection. The treatment trace is measured using a special template.
– A digital display of the working pressure allows the user to check the supply pressure at all times.

80% to 100% increase in weld fatigue limit

5- to 15-fold increase in weld service life

Application with same effect even for existing constructions

Use of higher-quality steels makes economic sense thanks to HiFIT

Extremely user-friendly

Process reliability

EFFECTIVENESS OF THE METHOD

Hammering is so effective because it combines geometric (rounding), material (strengthening) and load-related (residual compressive stresses) aspects. The ball-shaped tip of the HiFIT pin results in a reshaping and rounding of the weld transition by means of a defined impact. The plastic deformation of the surface generates residual compressive stress in the peripheral layer that can be verified to a depth of 2 mm. The superimposition of the introduced residual compression stresses with the acting loads stop microcracks and/or prevents them from developing in the first place. A uniform, end-to-end hammer trace is visible at the weld transition as a result.

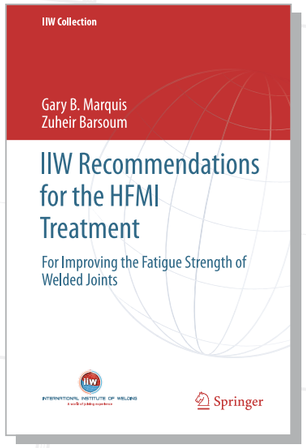
VERIFICATION PROCEDURE

There are currently three verification procedures:

– Nominal stress concept
– Structural stress concept
– Notch stress concept

Test setup for fatigue tests as part of the REFRESH project at TU Braunschweig.

IIW GUIDELINE FOR HFMI TREATMENTS



Prof. Gary Marquis, Prof. Zuheir Barsoum and colleagues have undertaken a large number of investigations and publications on this topic that consistently demonstrate the reliability, effectiveness and user-friendliness of post-weld treatments via high frequency mechanical impact. During this time, Commission XIII of the International Institute for Welding (IIW) presented 46 documents that verify the improvement in welded constructions.

The IIW Guideline for HFMI describes the method, its application and quality inspection. All benefits of the HiFIT method can thus be leveraged. The guideline shows that the FAT classes of the welding detail are increased by the HFMI method depending on the yield strength of the material used. In the current regulations, the S-N curve slope is specified as m = 3 for untreated welded joints. After the HFMI method, the slope is increased to m = 5. Flatter S-N curves result in huge improvements for the construction with regard to the weld fatigue limit and weld service life. The guideline also provides informative design examples, two of which are shown here.

DESIGN EXAMPLES

EXAMPLE 1

A welded joint made from a material with f < 355 MPa is classified as FAT class 63.
The max. load range is 63 MPa for 2 x 10^6 load cycles (see Fig. 2).
Via the HiFIT method, the FAT class increases by 4 levels (see Fig. 1, blue arrow) to FAT 100, the permissible load range is now 100 MPa.
This is an increase of approx. 60%!
For the same load range (63 MPa), the service life is increased from 2 m to 40 m load cycles! This is a factor of 20! (See Fig. 2)

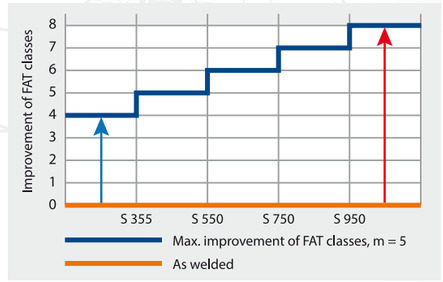


Fig. 1: Max. improvement of FAT classes via HiFIT method (as per IIW Guideline for HFMI)

EXAMPLE 2

The same welded joint is now made in a material with f ≥ 950 MPa. If the construction is not subjected to the HFMI method, nothing changes with regard to the load range and number of max. load cycles (load range 63 MPa for 2 x 10^6 load cycles) (see Fig. 3). Merely the use of a high-strength steel grade does not result in an improvement. Due to the HiFIT method, the FAT class now increases by 8 levels (see Fig. 1, red arrow) from 63 to 160 MPa. The load range is now 160 MPa @ 2 million load cycles. This means an improvement of approx. 150%! For the same load range (63 MPa), the service life increases from 2 m to over 100 m load cycles! The component will probably never fail! (See Fig. 3).

(For the sake of convenience, no effects were taken into account in the examples that result in possible reductions in the FAT class, such as higher R-values, thickness effects, etc.)

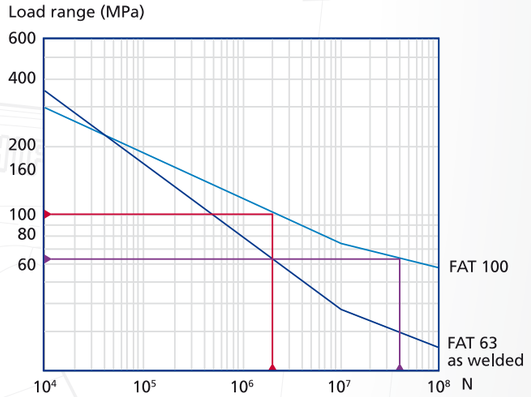


Fig. 2: S-N diagram for fy < 355 MPa; R ≤ 0.15 (as per IIW Guideline for HFMI)

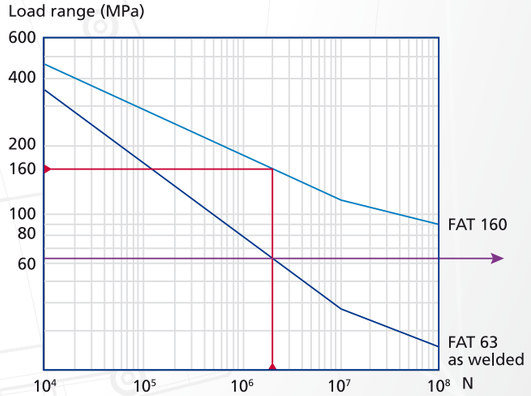


Fig. 3: S-N diagram for fy ≥ 950 MPa; R ≤ 0.15

THE HIFIT DEVICE

FEATURES

- Robust and compact design for difficult-to-access locations
- Low weight
- High performance
- Long service life
- Easy to guide
- Integrated pressure indicator
- Integrated illumination with outstanding luminosity
- Easily replaceable wear parts
- Weld splatter is effortlessly removed at the same time
- Work result is highly reproducible

Due to the high impact frequency of up to 300 Hz, components can be finished with very quick processing times. In robot-guided applications, feed rates of over 20 mm/s (120 cm/min) have already been implemented without problem. The HiFIT hammer has a compact design and is highly suited for constricted application situations in which the post-weld treatment is to be carried out.

TECHNICAL DATA

Compressed-air supply:	6 to 8 bar
Power supply (battery):	3.7 V, 950 mAh
Dimensions (L x W x H):	288 x 46 x 170 mm
Weight:	1.8 kg
Storage temperature:	0 to +60°C
Pressure indicator:	0 – 12 bar
Display deviation:	±0.2 bar
Required airflow rate:	Min. 400 l/min
Impact frequency:	180 – 300 Hz

(Subject to technical changes)

GENERAL/BASIC INFORMATION

The HiFIT hammer is a pneumatically operated hand-held device; all it needs is a compressed-air supply of 6 – 8 bar at the hammer and an airflow rate of at least 400 l/min. No additional electrical power supply is required. Depending on the intensity setting, the impact frequency is between 180 Hz and 300 Hz. The intensity is set via a special adjustment mechanism, not via the supply pressure, and is thus coordinated with the material of the parts to be treated.

HANDLING

The HiFIT method is controlled via the result obtained. The reshaping position and the achieved deformation travel facilitate the documentation of the measure. The hammer setting is determined via the result at the workpiece rather than via abstract presettings.

CARRYING OUT HIFIT TREATMENT

Similar to welding, the high frequency mechanical impact method is one of the "special processes". The requirements with regard to the
– manufacturer
– customer using the hammer
– personnel qualifications
must therefore be fulfilled. The following description is not a substitute for the training of the employees who will use the HiFIT hammer.

PROCEDURE:

- The impact intensity of the HiFIT hammer must be set before use in relation to the material and air pressure.
- The setting must be checked by means of a test specimen and corrected if necessary.

For optimal effectiveness, the hammer must
- be used at an angle of between 60° and 80° relative to the base material (see Fig. 1) and 70° and 90° in the feed direction (see Fig. 2).
- be guided precisely along the fusion line at the weld at a feed rate of 3 to 5 mm/s. Higher speeds are possible; however, this is often difficult due to the weld geometry or the visual traceability. Only one pass is usually required.

PROCESSING INSPECTION

Visual inspection:
- The treatment trace must be clearly recognisable at the defined weld transitions.
- The line identified as the start of weld (fusion line / penetration) must no longer be visible.

Measuring test:
- The indentation depth of the treatment trace must be approx. 0.2 mm (see Fig. 3).
- This is checked by means of the template provided (see image below).

Fig. 1)

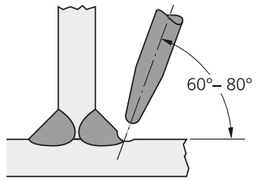


Fig. 2)

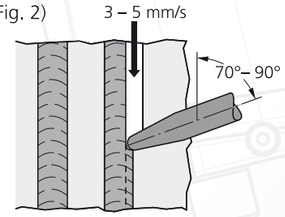
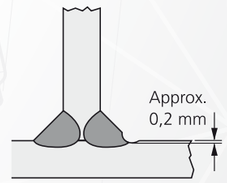


Fig. 3)



SCOPE OF SERVICES

HiFIT is a holistic solution for extending the service life of welded constructions.

AVAILABILITY
The HiFIT hammer and the associated spare parts and accessories are sold worldwide via the company HiFIT Vertriebs GmbH.

SPARE PARTS SERVICE
Rapid availability of wear and spare parts goes without saying for us. If a HiFIT hammer needs to be repaired or serviced, we will provide you with a replacement hammer for this period.

SERVICE
We are also happy to undertake projects for which the purchase of a hammer does not make economic sense. Our competent and experienced employees will process your welded construction quickly and reliably with our equipment. You have the welded construction, we will do the rest!

CONSULTING SERVICE
In cooperation with our colleagues at DYNATEC Gesellschaft für CAE und Dynamik mbH, we offer you the opportunity of improving your construction and evaluating various potential solutions together. Special analysis procedures are available for this purpose.

TRAINING
The HiFIT hammer belongs in the hands of experts. We highly recommend that users undergo specific training to ensure safe, efficient and effective work. Although the tool is easy to use, all users should be informed about the high frequency mechanical impact method in order to achieve the best possible results for the welded construction. We also train the quality assurance employees who ultimately have to evaluate the component to verify flawless treatment. Our training comprises the following areas:

THEORY
- The internal stress of welded components
- Theory of the high frequency mechanical impact method, the way it works and its effectiveness
- Safety briefing
- Requirements for successful HiFIT treatment
- Preparation and execution of HiFIT treatment
- Quality assurance

PRACTICAL EXPERIENCE
- Handling the HiFIT hammer
- Using the HiFIT hammer with intensive exercise units
- Tool maintenance and cleaning the HiFIT hammer

HiFIT

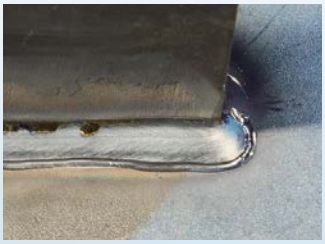
APPLICATION EXAMPLES

Visit our homepage to see the HiFIT hammer in action under the heading “Application Examples”. Here you will get a proper impression of the rapid and astonishingly simply handling of the HiFIT hammer. HiFIT is suitable for robot-guided applications. System-optimised solutions are available for this purpose.

Since the development and launch of the HiFIT hammer over 10 years ago, the device has undergone constant further development. Benefit from our valuable experience and professional employees. This is demonstrated by our impressive references in the following areas:

AREAS OF APPLICATION
- Mechanical engineering
- Automotive manufacturing
- Construction machinery
- Bridge construction
- Crane construction
- Special applications

WWW.HIFIT.DE



Before / after: Thanks to the HiFIT method, the weld fatigue limit is improved by 80% to 100%!

HIFIT – THE HIGH FREQUENCY IMPACT TREATMENT IS

- **Efficient**
- **Reproducible**
- **Reliable**

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