## Introduction of Product

# Introducing AC Servo Press H1F Series Machines (High-speed Version of Dedicated Servo Press Controller SIT)

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*Since it was introduced into the market in 2002 as a pioneer general-purpose servo press, the hybrid AC servo press H1F series machines are enjoying a high reputation in the market for their high precision and high productivity.*

*A dedicated servo press controller SIT4 that enhances these features has been developed and equipped in the H1F series machines as m/c machines introduced into the market as reported below.*

***Key Words:*** *Hybrid AC servo press, H1F series, Servo press dedicated controller SIT4, Free motion, Digitization of machining information, Visualization of servo effects, Servo press safety standard*

## 1. Introduction

The hybrid AC servo press H1F series is a new concept press machine featuring high precision and high formability of servo presses of the direct acting type, as well as high productivity of general purpose mechanical presses. As such, the machines in the series have steadily gained market acceptance and have established a solid position in the market since their introduction as a new category in the metal machining press field.

This trend has not been confined to the domestic market, but is spreading to the overseas market as well among Japanese companies which have moved their production sites off shore and among overseas manufacturers of precision parts. The number of machines sold overseas is exceeding machines sold in Japan.

On the other hand, competitor manufacturers have also been introducing their general-purpose servo presses in the market one after another as the market for general-purpose servo presses has expanded. This trend has prompted the H1F series to further enhance and differentiate the product features.

Against this backdrop, Komatsu has introduced into the market m/c machines of the H1F series that can demonstrate the servo effect further (**Photo 1**).


**Photo 1** H1F series machine

## 2. Aim of Development

Four years have passed since the new model development was launched ahead of the other manufacturers. One advantage a pioneer in the market can gain is use of the abundant evaluation data of users that is available to it. Evaluation data obtained as a pioneer was sorted and analyzed and the following results were obtained from this data.

Many customers who have purchased the machines have reported servo effects and application techniques. The development of the machining techniques is expected to accelerate further (**Table 1**).

**Table 1** Results of analysis of user evaluations 1

| Effect | Respondent customers |
|---|---|
| • Increased production, enhanced rate of utilization and short initial setup time | 51 |
| • Stable marking, enhanced drawability and less machining fluid consumed | 51 |
| • Enhanced precision, longer die life and fewer inspections made | 112 |
| • Fewer processes wider prototyping range | 53 |
| • Lower noise and vibration during machining | 94 |

Total 245 respondent customers

On the other hand, users and Komatsu are still going through trail and error on free motion machining, which is the largest characteristic of the servo press. An important task to enhance the evaluation and market recognition of the servo press is to establish the effect and verification method (**Table 2**).

**Table 2** Results of analysis of user evaluations 2

| Request and Comment | Respondent customers |
|---|---|
| • Effects of servo are not fully demonstrated, servo is not utilized fully | 43 |
| • Support for machining technique is desired | 15 |

Total 245 respondent customers

This m/c machine was developed under the following concepts focusing on servo control that can demonstrate servo effects further while the current special link configuration of the drive unit that features a high efficiency was retained.

1) Enhanced free motion response
2) Enhanced operability
3) Digitization and visualization of machining information
4) Incorporation of most recent servo safety guidelines and compliance with overseas standards

## 3. Accomplishment Means

1) Enhanced free motion response

(1) Increased maximum speed and short acceleration and deceleration time

The largest feature of the servo press is free motion that allows free speed change and free start and stop during motion and the servo press can accomplish various effects in press machining.

To maximize this feature, the selection and operating range of the servo motor were optimized, to increase the maximum speed and to significantly reduce the acceleration and deceleration times.

This has increased the productivity by a maximum 40% in "continuous" production and maximum 25% in single processing of "one safety process" and in alternating-operation production with a feeder. The productivity of the m/c machine enhanced further while the motion in the machining region was the same (**Fig. 1**).

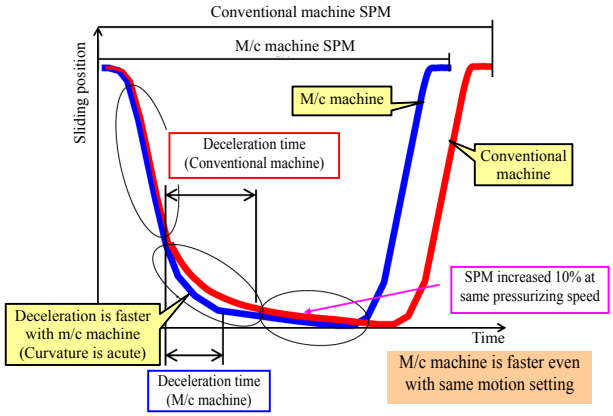


**Fig. 1** Comparison at same motion setting

(2) Power regenerating system is adopted in all machine types

All the machines adopt the power regenerating system as the servo power supply, allowing the return of energy regenerated during free motion operation to the user power source as an energy saving feature.

Thus, all the machines in the series are eligible for the energy saving preferential tax system (**Fig. 2**).

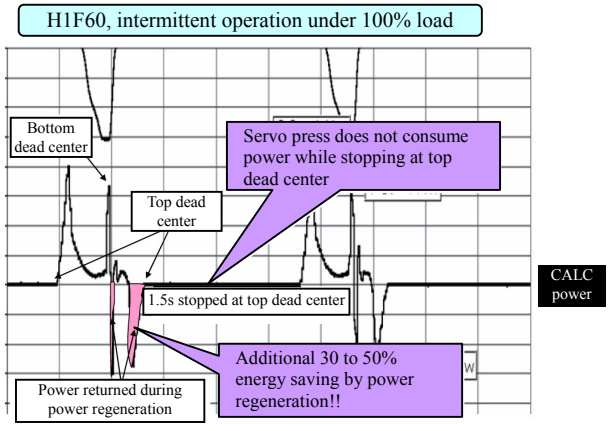


**Fig. 2** Power waveform during power regeneration

2) Enhanced operability

(1) Adoption of large color monitor screen

Compared with conventional mechanical presses, sliding motion has to be set and confirmed with the servo press more frequently on the monitor screen. Thus, good visibility of the monitor screen greatly contributes to enhanced operability of the servo press.

The newly developed controller SIT4 is adopted with a large 8-inch TFT liquid crystal color monitor screen, prominently enhancing both visibility and operability (**Photo 2**).

(2) Shorter initial setup time and adjustment time

The time required for initial setup such as changing the die has been reduced by adding an initial setup stop function to stop sliding in a preset position when the die is changed in addition to the normal and reverse rotation select switch for sliding which is equipped as a standard specification (**Fig. 3**).

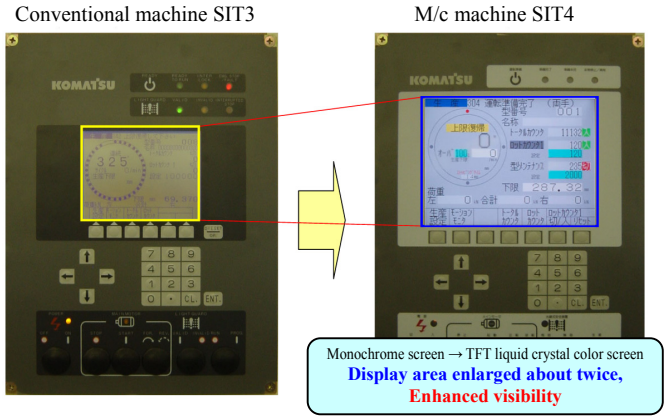


**Photo 2** Comparison of monitor screen

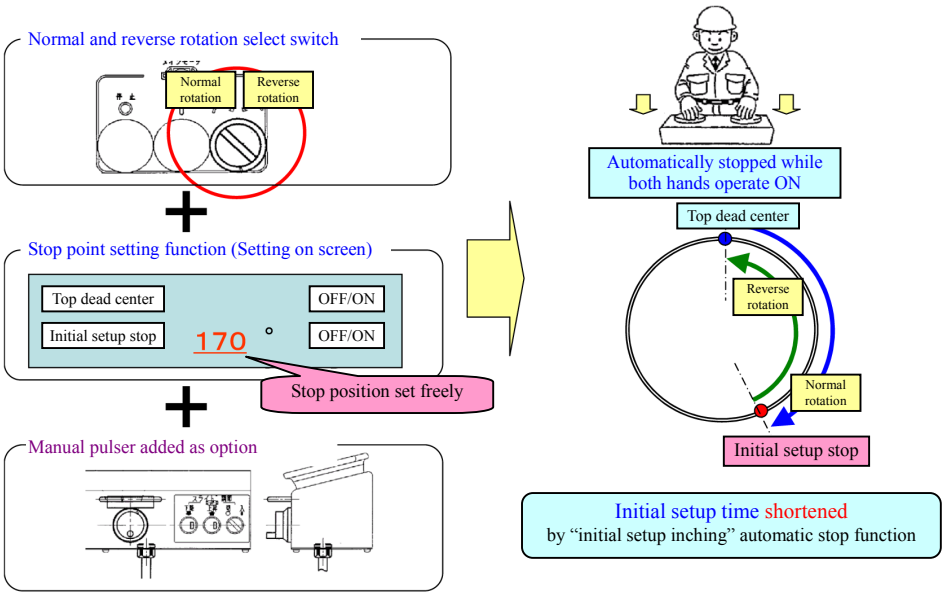


**Fig. 3** Top and bottom dead center change function and initial setup stop function

The manual pulser function has been prepared as an optional function for work that requires delicate adjustment (**Fig. 3**).

The "override" function allows regulating the overall motion speed in an operating condition. For example, this makes possible for test operation at a low speed on start and at end of production (**Fig. 4**).

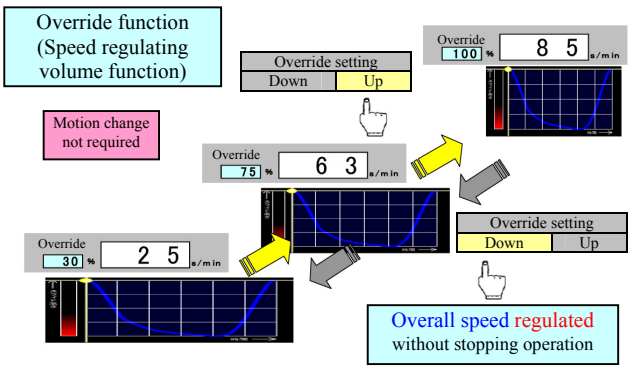


**Fig. 4** Override function

(3) "Dual-language monitor screen selector" function for globalization

At overseas production plants, different languages are often used among production engineers, maintenance personnel and operators, causing a bottleneck in overseas production.

The new controller allows a change in the display language on the monitor screen by operating an external operation switch while maintaining the on-going press operation status such as operation, stop and emergency. This enables easy free motion setting and problem check to be performed by supervisors and operators, effectively reducing the time required for checking and problem restoration (**Photos 3** and **4**).


**Photo 3** Monitor display in Japanese


**Photo 4** Monitor display in Chinese

3) Digitization of machining information and visualization of servo effects

The newly developed dedicated controller SIT4 for servo presses centrally controls all press machines including servo controls, achieving centralized collection of machining information, which could not be achieved by the distributed control system.

A function to communicate with an external personal computer serially or through Ethernet has been added, enabling detailed analysis of fetched machining information by a personal computer (**Fig. 5**).

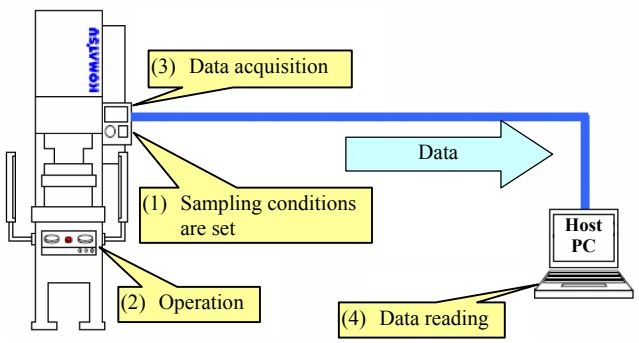


**Fig. 5** System configuration

The new function allows adjustment and confirmation work in press machining that has depended on the experience and knack of skilled operators and inspection of works can be collected and analyzed as digital information, thereby greatly varying quality control techniques.

This means that prototyping by the research and technical departments in Japan can be easily reproduced and checked at production sites, greatly reducing the time required for initial setup at production sites from prototyping to high volume production. Quality control in subsequent processes can also be achieved easily. This feature will be useful especially at production sites overseas where personnel cannot be dispatched easily (**Fig. 6**).

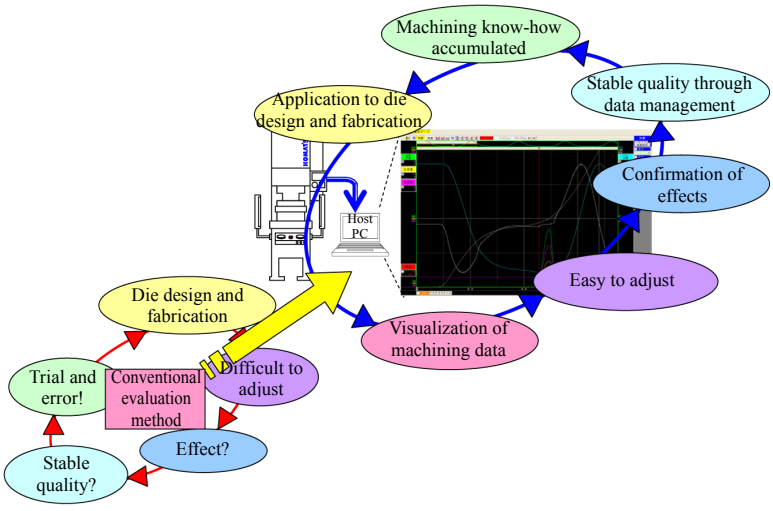


**Fig. 6** Effect of visualization of machining data

The newly developed functions for digitization of machining information and visualization of servo effects are described in detail hereunder.

(1) "Visualization" of sliding operation in motion setting function

The "read" function enables reading of current motion data on the motion display screen. Based on this data, variations in motion settings, sliding positions and speeds, estimated cycle count and other items can be confirmed on a personal computer. The "write" function allows writing motion setting data modified on the personal computer screen on the press side again.

This function allows simulation of optimum motion settings on a desk and greatly shortens the time required for prototyping and adjustment (**Fig. 7**).

(2) Visualization of machining state in sampling function

The sampling function allows detailed analysis of machining performed in one cycle.

Sliding position, load, angle, states of input and output signals and other press machining states can be checked in the same graph based on the digital information collected under specified conditions. This allows a clear presentation of changes made in machining conditions and results of such changes, thereby avoiding a continuation of trial and error as in the past (**Fig. 8**).

Settings such as low noise motion setting that requires delicate adjustment to decelerate and stop sliding immediately before material rupture can be set relatively easily.

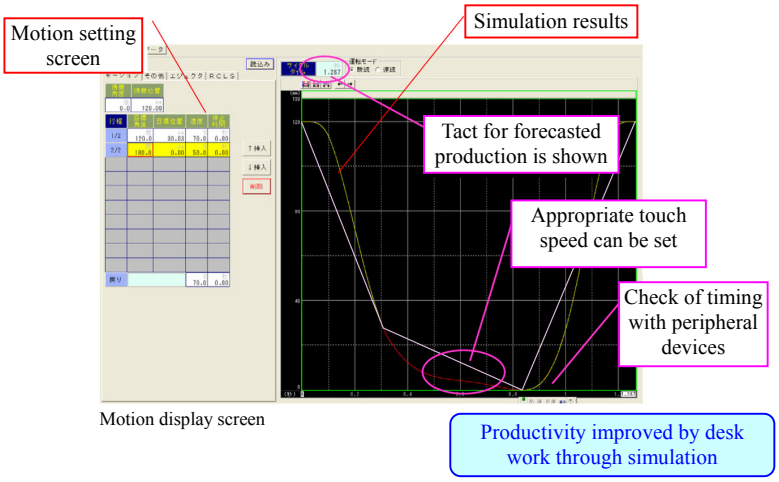


**Fig. 7** Motion display screen

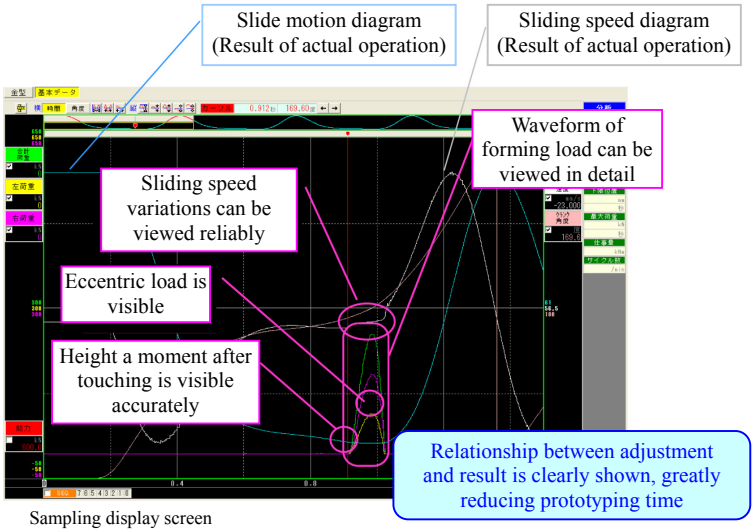


**Fig. 8** Sampling screen. Verification of adjustment results

Using the sequence monitoring function, the output state of interlock timing signals of a feeder and misfeed detection device can be checked accurately tuned to the machining condition, allowing easy setting of optimum timing. This in turn allows stable production and a sure increase in production quantity (**Fig. 9**).

In high volume production, machining information of accepted parts collected in advance and current machining information are compared and quality control indicators can be set.

(3) "Visualization" of changes in machining conditions by trend function

On the trend screen, changes in machining conditions can be fetched and analyzed every several tens of minutes to every several hours.

Thermal deformation of the machine and die that occurs during continuous production can be checked in time series as variations of the sliding position and load so that die damage and wear can be estimated easily.

This feature allows monitoring of inspection, which depended on inspection of produced works, through digital information on graph display, saving inspection time. Furthermore, numbers of defects can be checked on the graph screen and 100% inspection of works performed in the past can be eliminated (**Fig. 10**).

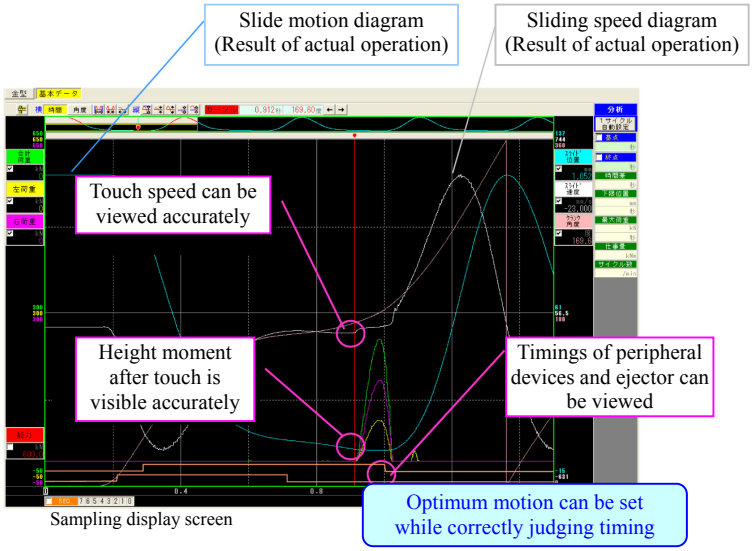


**Fig. 9** Sampling screen. Setting of timing

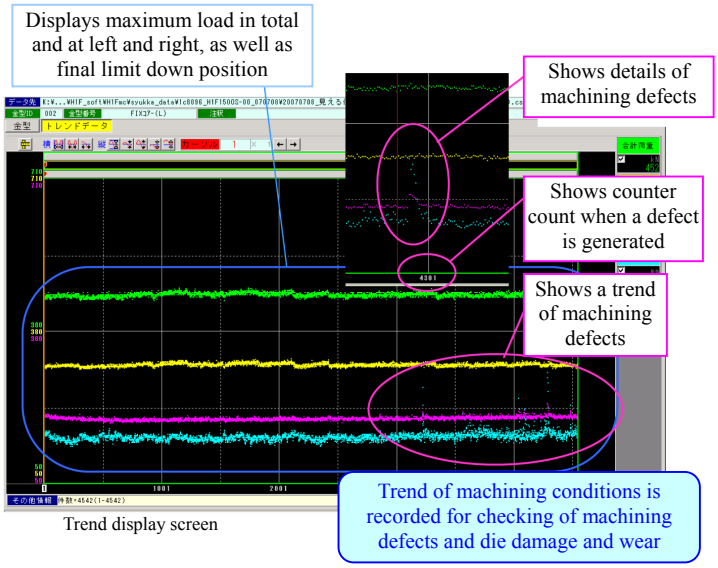


**Fig. 10** Trend display screen

(4) Management of multiple presses through Ethernet connection

The newly developed controller SIT4 is equipped with the Ethernet function and press machining information of multiple presses can be monitored and managed collectively in one place through Ethernet (**Fig. 11**).

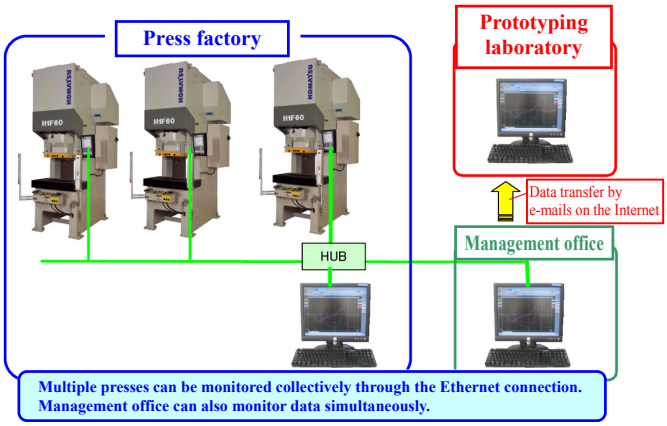


**Fig. 11** Management of multiple presses through Ethernet connection

4) Incorporation of most recent servo safety guidelines and compliance with overseas standards

(1) Trend of safety standards for servo presses and additional safety measures

In March 2006, the Japan Forming Machinery Association issued an industry standard "Servo Press Safety Requirements and Safety Measures (JFMA TI 103)" for the first time for servo presses. Following this standard, standardization of safety requirements for servo presses is expected to spread throughout the world on a full scale (**Fig. 12**).

During the development process of the new controller, a risk assessment was undertaken in accordance with JFMA TI 103 and the following was adopted in the controller as safety measures.

- Brake that outputs a torque meeting the safety requirements was adopted.
- Brake actuation conditions meeting the safety requirements were adopted.
- Addition of torque check function
- Photoelectric safety device of Safety Category 4 was adopted.

(2) Compliance of new servo press controller SIT4 to overseas standards

The new controller SIT4 has acquired certification under the UL standard, as well as the CE mark.

The acquisition of these certifications allows the controller to be shipped to the markets in Japan, China, Asia and the United States, to which shipments of the controller have already been made, and additionally to the European market.

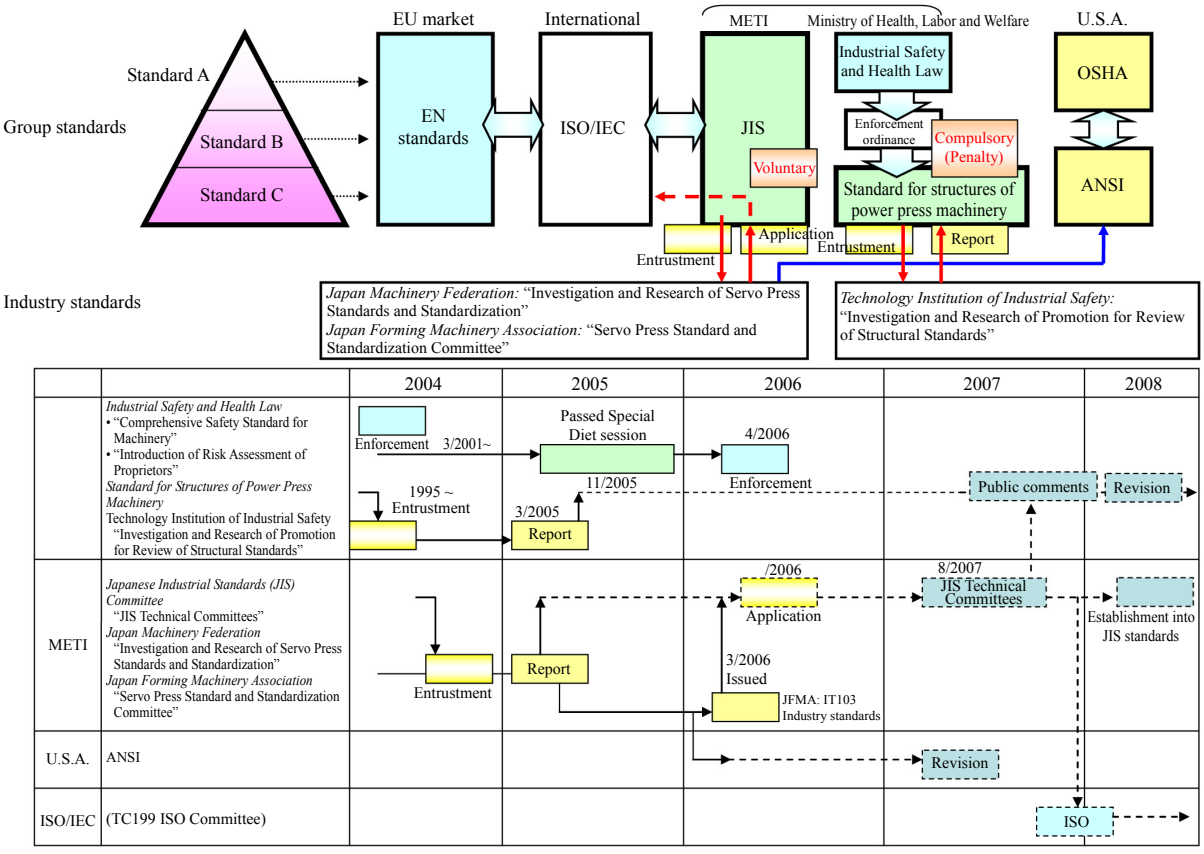


**Fig. 12** Trends of safety standards for servo presses

## 4. Future Plans

Five years have almost passed since the market introduction of the H1F series.

The new development ushers in digitization of press machining including the servo effect.

We intend to forthwith collect and analyze market needs of the servo press including a wealth of machining information generated in the market and to develop new machining processes and functions in order to perfect products that always meet market trends.

**Introduction of the writer**


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**[A few words from the writer]**

Many people have provided their cooperation in collecting user evaluation questionnaire sheets in the development process of the new controller. Analysis of each of these questionnaire sheets has boosted the confidence of the authors in the great potentiality of servo presses and has emphasized the degree of customer expectations. The development efforts will be continued in the future to live up to these expectations.