Abstract:

This paper describes JFE original ultrasonic testing (UT) technologies in Non-destructive inspection (NDI) systems that assure quality of JFE Steel pipe products. To enhance signal-to-noise ratio of UT, the high-speed digital signal processing techniques of synchronous averaging and chirp pulse compression have been developed and installed in ultrasonic faw detectors of welding pipe. In order to improve detectability of faws located at middle of wall thickness of weld, the normal incident beam technique for UOE pipe and the multi-probe technique for ERW pipe have been developed respectively. The analysis technique of ultrasonic feld and that of ultrasonic wave propagation are applied as basic technology for the developments.

1. Introduction

Klkabpqor`qfsb fkpmb`qflk %KAF& qb`eklildv fp ^ `lob qb`eklildv clo fkpmb`qflk,nr^ifqv ^ppro^k`b lc pqbbi mfmb molar`qp+ Fq ^ipl mi^vp ^k fkafpmbkp^_ib olib ^p ^ nr^i* fqv j b^prob j bkq j bqela fk mol`bpp `lkqoli clo pq^_ib molar`qflk lc efde nr^ifqv molar`qp+ GCB Pqbbi qebobclob ^ppfdkba KAF qb`eklildv ^ mlpfqflk ^p ^ `ofqf`^i qb`e* klildfbp col j ^k b^oiv a^qb) ^ka e^p `^oofba lrq absbi* lm j bkq ql fj molsb KAF mboclo j ^k`b ^ka fkqolar`ba qeb ^as^k`ba KAF qb`eklildfbp+ Fk m^oqf`ri^o) fk ob`bkq vb^op) rpbop$ fkpmb`qflk kbbap e^sb _b`l j b fk`ob^pfkd pqof`q arb ql qeb afsbopfª`^qflk lc pqbbi mfmb molar`qp ^ka bum^kaba o^kdb lc ^mmif`^qflkp) ^ka ^q qeb p^ j b qf j b) ebfdeqbkba obnrfob j bkqp e^sb _bbk mi^`ba lk nr^ifqv j b^prob j bkq ^``l j m^kvfkd qeb rpb lc j lob ^as^k`ba molar`qflk mol`bppbp+ GCB Pqbbi e^p obpmlkaba ql qebpb `e^iibkdbp _v croqebo pqobkdqebkfkd fqp lrqpq^kafkd absbilm j bkq pvpqb j +

Qefp m^mbo abp`of_bp lofdfk^i efde ^``ro^`v) efde obif^_fifqv KAF qb`eklildfbp absbilmba ql a^qb _v GCB Pqbbi ^ka GCB O#A) t fqe pmb`f^i b j me^pfp lk qeb `l j *

^k buqob j b fk`ob^pb fk pbkpfqfsfqv _b`l j bp kb`bpp^ov+ Qefp fksfqbp mol_ib j p pr`e ^p c^ipb fkaf`^qflkp ^ka fp rkabpfo^_ib col j qeb sfb t mlfkq lc lmbo^qflk+

Fk `lkqo^pq) qeb j riqf*mol_b RQ qb`ekfnrb t^p absbi* lmba ql bk^_ib q^kab j mol_b fkpmb`qflk pf j riq^kblrpiv t fqe ^ii `e^kkbip rpfkd ^kdibp mol_bp ^oo^kdba `lkqfkr* lrpiv t fqe 5 `e^kkbip lk lkb pfab) ^ka fp ^ «^ t abqb`* qflk qb`ekfnrb t ef`e mlppbppbp ^ efde abqb`qflk `^m^`fqv clo «^ t p fk qeb `bkqbo lc qef`hkbpp) ^ka ^q qeb p^ j b qf j b) e^p qeb cb^qrob lc efde pq^_fifqv t fqe obpmb`q ql absf^qflk fk qeb pb^ j mlpfqflk+

3.2 Principle of Full-thickness Inspection by Multi-probe Technique

Qeb mol_b ^oo^kdb j bkq rpba t fqe qefp qb`ekfnrb fp pel t k fk **Fig. 8**+ BfdeqC2Þ ^kdib mol_bp ^ob ^oo^kdba Qnr fp obpmb`qfsbiv lk b^`e lc qeb q t l pfabp lc qeb t bia+ Qeb c^`q qe^q qebpb bfdeq rkfqp lk lkb pfab mbocloj pfj ri

`^i`ri^qflk `^k _b mboclo j ba t fqefk pbsbo^i pb`lkap