Salmonella Diagnostics

DIAGNOSTICS WITH PASSION



Agglutination for professionals

Salmonellosis is a classic food contamination. The serovar *S*. Enteritidis is spread primarily in eggs or food and preparations containing eggs that have not been adequately heated, particularly if these foods contain raw eggs, e.g. ice cream. *Salmonella* are also often spread via raw meat or meat products that have not been heated or heated only inadequately (e.g. poultry, minced meat) (www.rki.de).
The genus *Salmonella* is a member of the *Enterobacteriaceae* family. All *Salmonella* are obligate pathogens. *S*. Typhi and *S*. Paratyphi (A, B, C) induce cyclic infectious disease. These typhoid *Salmonella* are rare in industrial countries and are generally imported infections. In contrast, non-typhoid *Salmonella* are one of the most common causes of bacterial gastroenteritis in humans. The infection is caused by ingesting the pathogen by mouth.

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Introduction

Guidelines for laboratory diagnostics

This brochure provides you with practical information for using the products as well as the necessary scientific background.

Cultivation

The samples must be cultivated on culture media appropriate for the material being tested. For some test materials, enrichment on selective or non-selective culture media may be required.

Biochemical identification

Biochemical identification of colonies with suspect morphology on cultivation
Polytropic differentiation medium, e.g. Kligler, or commercial identification systems

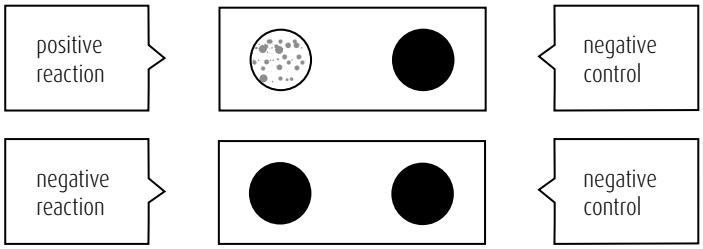
Before starting the serotyping, it is necessary to biochemically confirm the group to which the isolate belongs. For this purpose, alternative procedures (e.g. MALDI mass spectroscopy: MALDI-TOF) can also be used, presuming that the suitability of the procedure has been verified.

Test material and methodology

The test material is streaked on non-selective culture media such as Nutrient Agar or Blood Agar and incubated for 16–20 hours at 35...37 °C.
A little bacterial mass is taken from a suspect colony and rubbed into a drop of test reagent (about 25 µL) on a slide to form a homogeneous, slightly milky suspension. The slide should be placed against a dark background. It is held and moved around in front of a light source against a black background and the results are read with the naked eye.
In exceptional cases, selective culture media may have a negative effect on the agglutinability of the bacteria. By removing the Nutrient or Blood Agar and the Kligler culture medium, this problem is avoided.
To exclude spontaneous agglutination, a negative control must be carried out using physiological saline instead of the test reagent.

Evaluation

The test can only be evaluated if the negative control remains milky-opaque



Positive: visible agglutination after the sample has been tilted back and forth less than 20 times. In a strongly positive reaction, agglutination (coarsely or finely flocculent) appears as soon as the bacterial mass is mixed in. In a weakly positive result, agglutination only appears after the slide has been tilted back and forth 10-20 times.

Negative: if the suspension remains milky-opaque or the reaction begins to occur only after the slide has been tilted back and forth more than 20 times, the result is negative.

Advantages of monoclonal antibodies

- Monoclonal antibodies are each made up of an absolutely uniform antibody population; the population is uniform in terms of the immunoglobulin class, specificity, avidity and heat stability. These very extensively investigated properties of the particular monoclonal antibody remain unchanged throughout all the manufacturing steps.
- They can be standardised and adjusted to a precisely reproducible antibody concentration whereby a consistent quality across different batches is guaranteed.
- The monoclonal antibodies from sifin diagnostics gmbh lead to rapid and significant agglutination for all the serovars that have the homologous antigen, regardless of other antigens or partial antigens that may be present.
- Monoclonal antibodies are free of additional antibodies.
- The production of monoclonal antibodies is independent of immunoserum donors. They are produced using biotechnology by harvesting cell culture supernatants containing antibodies.
- Antibody specificities that cannot be produced by polyclonal means e.g. O:3, O:13, H:1, H:e, H:*ℓ*, H:n) can also be isolated as monoclonal antibodies.

Salmonella Diagnostics

Principles

Salmonella are ubiquitous Gram-negative, rod-shaped, oxidase-negative, facultative anaerobic, non-sporulating bacteria that usually form colonies with a diameter of 2 to 4 mm on solid culture media.

Biochemical tests enable differentiation of the two species *Salmonella enterica* and *Salmonella bongori* with *S. enterica* further divided into 6 subspecies:

- *Salmonella enterica* ssp. *enterica*
- *Salmonella enterica* ssp. *salamae*
- *Salmonella enterica* ssp. *arizonae*
- *Salmonella enterica* ssp. *diarizonae*
- *Salmonella enterica* ssp. *houtenae*
- *Salmonella enterica* ssp. *indica*

The internationally authoritative foundation used to classify Salmonella is the White-Kauffmann-Le Minor scheme. The WHO Collaborating Centre for Reference and Research on *Salmonella* at the Institut Pasteur in Paris is responsible for regularly updating the 'Antigenic formulae of the *Salmonella* serovars' which forms the basis of the allocation of the serovar names and antigen formulae to isolates of *Salmonella* species.

Salmonella laboratory diagnostics, typhoid and non-typhoid Salmonellae

The following instructions apply only to direct pathogen detection tests.

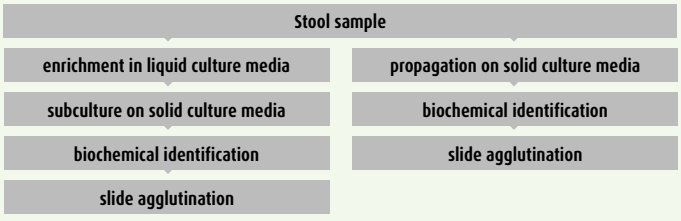
Test material

- Specimens of faecal origin
  stool, rectal swab
- Specimens of extraintestinal origin
  blood, urine, liquor, punctates, swabs, lymph nodes, bone marrow
- Other specimens
  vomit, food leftovers

Cultivation

Example for stool samples

CULTIVATION



Biochemical identification

Before starting the serotyping, it is necessary to biochemically confirm the group to which the isolate belongs. For this purpose, alternative procedures (e.g. MALDI mass spectroscopy: MALDI-TOF) can also be used, presuming that the suitability of the procedure has been verified.

Serotyping

The *Salmonella* genus is characterised by exceptionally high serological diversity. There are currently more than 2600 serovars known. Identifying the serovar (*Salmonella* with an individual combination of several antigens) is considered very important because this provides information about the diagnosis of the pathogen (e.g. *S*. Typhi, *S*. Paratyphi), the frequency and distribution of the serovars and the sources of infection and transmission routes.

The serotyping is used to identify the presence or absence of specific O antigens, H antigens and the Vi antigen in an isolate that has been confirmed as *Salmonella*. Generally, the O antigens are first identified followed by the H antigens. For biphasic strains, both H phase antigens must be identified. If only one phase can be identified, the swarming inhibition method must be used to induce the second phase. For optimum formation of the Salmonella H antigens, swarm agar is suitable (see phase induction).

If the Vi antigen is present, it may mask evidence of the presence of O antigens. To detect O antigens, it may therefore be necessary to heat an antigen suspension of the isolate for 60 minutes at 100 °C or 15 minutes at 120 °C. This leads to destruction of the capsular antigen.

The serovars are classified on the basis of the White-Kauffmann-Le Minor scheme.

Important antigens for serotyping

O antigens

The O antigens are localised in the cell wall of the bacteria and are a component of the lipopolysaccharide (LPS). The LPS is made up of the lipid A, the core polysaccharide and the O-specific chain that represents the O antigen. The O antigens are made up of repeating units of oligosaccharides (3 to 8 monosaccharides). They are usually heat stable. The individual O antigens differ in their sequences and the type of bonds between the individual monosaccharides.

Amongst the O antigens there are group-specific antigens that give the O group its name (e.g. O:2, O:4, O:9) and O antigens that may exist in addition to the group-specific antigen and that further characterise the corresponding serovar (e.g. O:5, O:27, O:20). The serotyping is always started by identifying the O antigens: the antigen characteristic for the group is first identified and then other O antigens follow if necessary.

H antigens

The *Salmonella* have, with few exceptions, peritrichous flagella and are thus motile. These flagellae are made up of a protein (flagellin) and are the H antigens. Due to their proteinaceous nature, they are heat labile. The specificity of the many H antigens is determined by the amino acid composition and sequence as well as the tertiary structure. Most *Salmonella* can form flagellar proteins with two different structures (biphasic strains) that are referred to as phase 1 H antigens and phase 2 H antigens. Both phases may be present in one culture or only one of the two may be more pronounced. In general, the H antigens develop best on swarm agar. The serotyping of a *Salmonella* serovar is only complete once both H antigens (applies to biphasic strains) have been identified. If, however, only one phase can be detected, the strain must be 'forced' to form the other phase. The methods used to achieve this are described in the chapter on using the H test reagents.

Vi antigen

The capsular antigen of the *Salmonella* species is the Vi antigen, which is only present in *S*. Typhi, *S*. Paratyphi C and very rarely in *S*. Dublin. The Vi antigen is a polysaccharide but it is heat labile due to the presence of acetyl groups.

The special feature of this antigen is that it can mask the O antigen because it is a capsular antigen. Only the destruction of the capsular antigen by boiling enables O agglutination of the corresponding strain. The H agglutination is not inhibited by the capsular antigen. It must be carried out on the native strain without boiling.

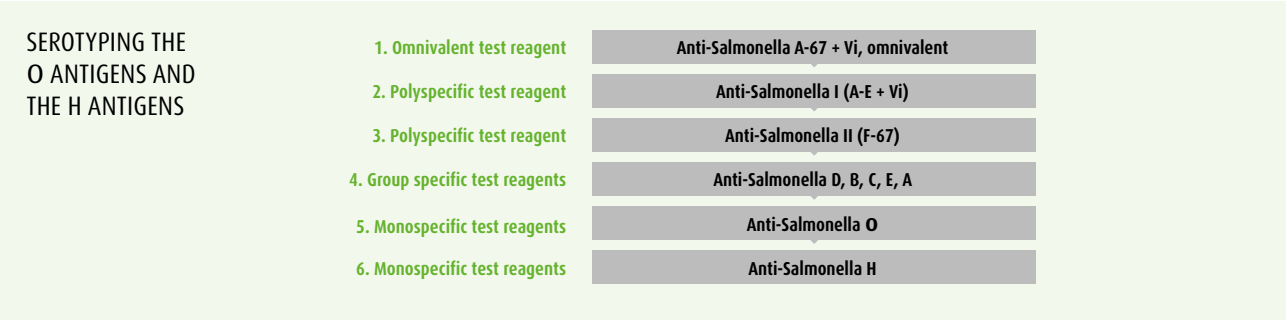
Test reagents for serotyping

The serotyping has been carried out for decades using a range of polyvalent, group-specific and monospecific test reagents. The antigen analysis using antisera with known antibodies is referred to as the Gruber test and is carried out qualitatively on a slide (slide agglutination test). These test reagents are still prepared around the world based on animal immunosera (pAb).

Since 1994 sifin diagnostics gmbh has produced a number of test reagents for serotyping *Salmonella* based on internally developed monoclonal antibodies (mAb). sifin diagnostics gmbh currently has more than 118 mAb for preparing Anti-Salmonella test reagents: 75 mAb Anti-Salmonella O for 66 products and 43 mAb Anti-Salmonella H for 28 products.

Carrying out the serodiagnostics

Flowchart for the serotyping



1. The Anti-Salmonella A-67 + Vi test reagent is used for serological evidence of Salmonella O antigens using the slide agglutination test for the confirmation of *Salmonella* spp.
2. The Anti-Salmonella I test reagent is used to classify isolates that agglutinate with the omnivalent test reagent into groups A to E.
3. The Anti-Salmonella II test reagent is used to classify isolates that agglutinate with the omnivalent test reagent but not Anti-Salmonella I into groups O:11 (F) - 67.
4. The Anti-Salmonella D, B, C, E, A group-specific test reagents are used to identify the serogroup of *Salmonella* that agglutinates with the omnivalent test reagent and/or the polyspecific test reagent Anti-Salmonella I. They exclusively agglutinate *Salmonella* of the declared serogroup.
5. The Anti-Salmonella monospecific test reagents are used either to identify the group-specific O antigens and thus to allocate an isolate to the appropriate group in the White-Kauffmann-Le Minor scheme or to detect additional O antigens if they are required for identifying or verifying the serovar.
6. For serotyping *Salmonella*, it is necessary to identify the H antigen(s) as well as the O antigens. For biphasic strains the H antigens of both phases must be identified. The Anti-Salmonella H test reagents are used to identify or verify the H antigens or H antigen complex of *Salmonella* strains according to the White-Kauffmann-Le Minor scheme with the help of the slide agglutination test. It enables identification of the serovar.

Test reagents used for the confirmation

Test material

For the slide agglutination test using polyvalent, group-specific and monospecific test reagents, start with a subculture of the suspect colony or colonies, preferably on non-selective or Kligler Agar, alternatively for screening also on selectivity level 1 and 2 agar.

Before starting the serotyping, it is necessary to confirm biochemically that the isolate belongs to the *Salmonella* genus. For this purpose, alternative procedures (e.g. MALDI mass spectroscopy: MALDI-TOF) can also be used, presuming that the suitability of the procedure has been verified.

Anti-Salmonella A - 67 + Vi, omnivalent

The test reagent is used for the confirmation of bacteria in the *Salmonella* genus. It must rapidly and significantly agglutinate all *Salmonella*, that is, a negative result must indicate the absence of *Salmonella* with a high likelihood. Due to this high requirement for sensitivity, limitations on the specificity are unavoidable. Non-specific positive results are possible due to antigen relationships or identities.

Many cross-reactions based on an antigen relationship may be excluded by using monoclonal antibodies. Antigen identities, however, are also detected if monoclonal antibodies are used. This includes, e.g. certain serovars of *E. coli* and *Citrobacter* spp., some *Proteus* spp. and occasionally *Hafnia alvei* strains. The *Salmonella* antigens O:30, O:35, O:43 and O:50 are known to cross-react with *E. coli* O antigens and the *Salmonella* antigens O:4, O:7 and O:8 cross-react with *Citrobacter* O antigens. *E. coli* strains can generally be differentiated from *Salmonella* due to the lactose fermentation and the lack of formation of H_2S. The exceptions are the lactose-negative *E. coli* strains.
Lactose-negative *Citrobacter* strains that form H_2S often cannot be differentiated from *Salmonella* by means of their colony morphology. They can also be agglutinated by the omnivalent test reagent as a result of an antigen relationship or identity. Biochemical methods such as the PYRase, lysine decarboxylase or KDN tests must be used for differentiation. Cross-reactions with all serovars of *Shigella flexneri* and with *Shigella sonnei* (S and F form) are excluded.

Procedure: slide agglutination | Storage: 2...8 °C | Preservative: sodium azide 0.9 mg/ml

Art. No.	Product	Description	Liquid | Lyo.	Packing
TR1101	**Anti-Salmonella A - 67 + Vi, omnivalent**	A mixture of monoclonal antibodies in the form of cell culture supernatants. Contains all antibodies against the group-specific Salmonella O antigens. Detects all *Salmonella* in groups A to 67 and the Vi antigen. Used for the confirmation of *Salmonella* spp.	liquid	1 ml
TR1101-01			liquid	5 ml

Anti-Salmonella I (A - E + Vi)

The test reagent is used to classify isolates that agglutinate with the omnivalent test reagent into groups A to E.
For isolates from human test material, it can be used instead of the omnivalent test reagent as an orienting examination of suspect colonies for the presence of bacteria in the *Salmonella* genus because about 98 % of the *Salmonella* serovars isolated from humans can be allocated to groups A to E. Due to antigen identities or relationships, cross-reactions with Anti-Salmonella I, e.g. with *Citrobacter* spp., *Proteus* spp., *E. coli* or *Hafnia alvei*, are possible.

Procedure: slide agglutination | Storage: 2...8 °C | Preservative: sodium azide 0.9 mg/ml

Art. No.	Product	Description	Liquid | Lyo.	Packing
TR1111	**Anti-Salmonella I (A - E + Vi)**	A mixture of monoclonal antibodies in the form of cell culture supernatants. Agglutinates salmonellae of the groups O:2 (A) to O:1,3,19 (E_4). *Salmonella* from groups O:11 (F) to O:67 are not agglutinated.	liquid	1 ml
TR1111-01			liquid	5 ml

Anti-Salmonella II (F - 67)

The Anti-Salmonella II test reagent is used to classify isolates that agglutinate with the omnivalent test reagent but not Anti-Salmonella I into groups O:11 (F) - 67.

Due to antigen identities or relationships, cross-reactions with Anti-Salmonella II, e.g. with *Citrobacter* spp., *Proteus* spp., *E. coli* or *Hafnia alvei*, are possible.

Procedure: slide agglutination | Storage: 2...8 °C | Preservative: sodium azide 0.9 mg/ml

Art. No.	Product	Description	Liquid | Lyo.	Packing
TR1121	**Anti-Salmonella II (F - 67)**	A mixture of monoclonal antibodies in the form of cell culture supernatants. Agglutinates salmonellae of the groups O:11 (F) to O:67. Does not contain any antibodies against Salmonella from groups O:2 (A) to O:1,3,19 (E_4). The test reagent is ready-to-use after dissolving in 1 ml or 5 ml distilled water.	lyophilised	1 ml
TR1121-01			lyophilised	5 ml

Anti-Salmonella Poly-H Phase 1 & 2

The test reagent is used for serological evidence of the presence of the H antigens of *Salmonella* strains.

Cross-reactions with other genera in the *Enterobacteriaceae* family could not be demonstrated with this test reagent.
Positive serological results alone are not evidence of the presence of *Salmonella*. Allocation to the *Salmonella* genus by biochemical means is therefore necessary. A negative result does not exclude the presence of *Salmonella* with absolute certainty.

Procedure: slide agglutination | Storage: 2...8 °C | Preservative: sodium azide 0.9 mg/ml

Art. No.	Product	Description	Liquid | Lyo.	Packing
TR1141	**Anti-Salmonella Poly-H Phase 1 & 2**	Contains antibodies covering H-antigens or complexes: a, b, c, d, E, G, i, k, L, r, y, z, Z_4, z_6, z_{10}, z_{29}, z_{35}, z_{38}, z_{41}, H:1. Antibodies that detect complex antigens, such as Anti-H:E, -H:L or -H:1, detect all combinations of the antigens H:e, H:ℓ or H:1.	liquid	1 ml
TR1141-01			liquid	5 ml

Antigen detection for A - 67 + Vi, A - E + Vi, F - 67

Test Reagent	Agglutination of a *Salmonella* isolate	
Anti-Salmonella A - 67 + Vi, omnivalent	+	+
Anti-Salmonella I (A - E + Vi)	+	–
Anti-Salmonella II (F - 67)	Examination not required.	+
Result	**Group A-E**	**Group F-67**
Frequency	common	rare

Coverage of O-Group Pools

O-Group Pool test reagents (alternative to Anti-Salmonella I or Anti-Salmonella II)

O group pool test reagents can be used as an alternative to Anti-Salmonella I or Anti-Salmonella II for initial allocation of suspect *Salmonella* isolates from test material of human or other origin (e.g. food or environmental samples) to seven different O group pools. If the isolated strain has a *Salmonella* antigen corresponding to the detection range of the O group pool test reagent, this is bound to the specific antibody when they are mixed together. As a result of the antigen-antibody reaction, significant visible agglutination of the strain is observed.

Testing with the O group pool test reagents Anti-Salmonella OMA and Anti-Salmonella OMB, which detect about 98 % of the Salmonella, is then carried out. If a strain does not agglutinate with these two test reagents, it should be tested with the Anti-Salmonella Vi (REF TR1316). If the reaction to this test is negative, the strain should be agglutinated with the O group pool test reagents Anti-Salmonella OMC, Anti-Salmonella OMD, Anti-Salmonella OME, Anti-Salmonella OMF and Anti-Salmonella OMG. Further serological differentiation must be carried out with the White-Kauffmann-Le Minor scheme. Due to antigen identities or relationships, cross-reactions with O-Group Pool test reagents, e.g. with *Citrobacter* spp., *Proteus* spp., *E. coli* or *Hafnia alvei*, are possible.

Procedure: slide agglutination | Storage: 2...8 °C | Preservative: sodium azide 0.9 mg/ml

Art. No.	Product	O-Groups	Liquid | Lyo.	Packing
TR1151	**Anti-Salmonella OMA**	(A, B, D, E, L)	liquid	1 ml
TR1151-01			liquid	3 ml
TR1161	**Anti-Salmonella OMB**	(C, F, G, H)	liquid	1 ml
TR1161-01			liquid	3 ml
TR1170	**Anti-Salmonella OMC**	(I, J, K, M, N, O, P)	liquid	1 ml
TR1171	**Anti-Salmonella OMD**	(Q, R, S, T, U, V, W)	liquid	1 ml
TR1172	**Anti-Salmonella OME**	(X, Y, Z, 51, 52, 53)	liquid	1 ml
TR1173	**Anti-Salmonella OMF**	(54, 55, 56, 57, 58, 59)	liquid	1 ml
TR1174	**Anti-Salmonella OMG**	(60, 61, 62, 63, 65, 66, 67)	liquid	1 ml
TR1316	**Anti-Salmonella Vi**		liquid	1 ml

Coverage of H-Phase Pools

H-Phase Pool test reagents

The test, using polyspecific H-Phase Pool test reagents Anti-Salmonella HMA, Anti-Salmonella HMB or Anti-Salmonella HMC, enables the identification of the most common H-antigens or H-antigen complexes of *Salmonella* strains. Furthermore the presence of the antigen complex H:1 should be tested by Anti-Salmonella H:1 (REF TR1437, TR1437-01).

Procedure: slide agglutination | Storage: 2...8 °C | Preservative: sodium azide 0.9 mg/ml

Art. No.	Product	H-Antigens	Liquid | Lyo.	Packing
TR1181	**Anti-Salmonella HMA**	(a, b, c, d, i, z_{10}, z_{29})	liquid	1 ml
TR1181-01			liquid	3 ml
TR1183	**Anti-Salmonella HMB**	(E, G)	liquid	1 ml
TR1183-01			liquid	3 ml
TR1185	**Anti-Salmonella HMC**	(k, y, z, L, Z_4, r)	liquid	1 ml
TR1185-01			liquid	3 ml

Determination of the O group using group-specific test reagents

Group specific test reagents Anti-Salmonella

Mixtures of monoclonal antibodies of the corresponding specificities in the form of cell culture supernatants. For identification of the serogroup of *Salmonella* spp. that agglutinate with the omnivalent test reagent and/or the polyspecific test reagent Anti-Salmonella I or alternatively with the O group pool test reagents. They exclusively agglutinate *Salmonella* of the declared serogroup.

According to the frequency of the reported serovars, the group-specific test reagents should be used in the following order:

1. Anti-Salmonella Group D
2. Anti-Salmonella Group B
3. Anti-Salmonella Group C
4. Anti-Salmonella Group E
5. Anti-Salmonella O:2 corresponds to Anti-Salmonella Group A

Procedure: slide agglutination | Storage: 2...8 °C | Preservative: sodium azide 0.9 mg/ml

Art. No.	Product	Description	Liquid | Lyo.	Packing
TR1201 TR1201-01	**Anti-Salmonella Group B**	Records all antigen combinations of group O:4 (B). Salmonella in group B are verified using Anti-Salmonella Group B (O:4,5,27). All possible antigen combinations for this O group are detected. A cross-reaction with strains in group D_3 (O:9,12,46,27) via O:27 is theoretically possible. Strains from this group are very rare, however. Anti-Salmonella O:4 can be used instead of Anti-Salmonella Group B. Cross-reactions with other Salmonella are excluded.	liquid liquid	1 ml 5 ml
TR1202	**Anti-Salmonella Group C**	Records all strains of group O:7 (C_1) and O:8 (C_2-C_3). Salmonella in group C are verified using Anti-Salmonella Group C (O:7,8). The mixture of the two monoclonal antibodies Anti-Salmonella O:7 and Anti-Salmonella O:8 enables detection of all strains in group C. Unlike polyclonal test reagents, cross-reactions with strains from groups O:6,14 (H) and O:18 (K) via the O:6 antigen are excluded.	liquid	1 ml
TR1203 TR1203-01	**Anti-Salmonella Group D**	Records all strains of group O:9 (D_1), O:9,46 (D_2) and O:9,46,27 (D_3). Salmonella in group D are verified using Anti-Salmonella Group D (O:9,Vi). The test reagent detects all possible antigen combinations for this group. Because the presence of the Vi antigen can inhibit the ability of *S.* Typhi to agglutinate due to anti-O:9, Anti-Salmonella Group D contains anti-Vi as well as anti-O:9. The presence of these antibodies means a reaction with *S.* Paratyphi C (O:6,7,Vi; group C) is possible. Serotypes in group D_2 can also contain the factors O:3 and O:10, the latter very weakly. Phage conversion due to ε_{15} and ε_{34} is possible as in group E. These serovars then react with the homologous antibodies of group E. Cross-reactions with Salmonella from other groups are excluded.	liquid liquid	1 ml 5 ml
TR1204	**Anti-Salmonella Group E (O:3 complex)**	Records all strains of group O:3,10; O:3,15; O:3,15,34 (E_1) and O:1,3,19 (E_4). Group O:3,10 also includes the previous groups O:3,15 (E_2) and O:3,15,34 (E_3). Salmonella in group E are verified with Anti-Salmonella Group E. The test reagent can also react with serovars from group D_2 (O:9,46) because these can have low levels of the antigen O:3 (and O:10) and for the same reason can also occur after lysogenisation of the antigen O:15 or the antigens O:15 and O:34 (see Group D).	liquid	1 ml

Determination of the O antigens using monospecific test reagents

The Anti-Salmonella monospecific test reagents are used either to identify the group-specific O antigens and thus to allocate an isolate to the appropriate group in the White-Kauffmann-Le Minor scheme or to detect additional O antigens if they are required for identifying or verifying the serovar.

The test reagents are monoclonal antibodies, test sera or a mixture of monoclonal antibodies and test serum. Monoclonal antibodies are produced from cell culture supernatants of hybridoma cell lines that secrete antibodies against the corresponding *Salmonella* antigens. The test sera are sera from immunised rabbits from which non-specific agglutinins are removed by absorption.

The test reagents for rare specificities are lyophilised and are ready to use after dissolving in 1 ml distilled water.

The possible antigen combinations in the O groups, the O antigens to be identified by serotyping and the required test reagents are indicated, as well as the frequency expected for the antigen combination in isolates from the corresponding group.

Group O:2 (A)

Possible antigen combinations: 1,2,12 and 2,12 (antigen O:1 is induced by phage conversion and is therefore underlined)
The group-specific antigen O:2 must be identified. It is not necessary to identify antigen O:12 and where applicable antigen O:1.
Anti-Salmonella O:2 detects all strains in group A.

Group O:4 (B)

Possible antigen combinations: O:4,12; O:1,4,12; O:4,5,12; O:1,4,5,12; O:4,12,27; O:1,4,12,27.
Antigens O:4, O:5 and O:27 must be identified; it is not necessary to identify antigen O:12 and where applicable antigen O:1.

Anti-Salmonella O:4 detects all strains in group B regardless of the antigen combination.

Anti-Salmonella O:5 detects all strains in group B, provided they have antigen O:5.

Anti-Salmonella O:27 detects all strains in group B, provided they have antigen O:27.

Antigen detection for O:4, O:5, O:27

Test Reagent	Agglutination of a *Salmonella* isolate		
Anti-Salmonella O:4	+	+	+
Anti-Salmonella O:5	+	–	–
Anti-Salmonella O:27	Examination not required because the antigens O:5 and O:27 do not occur together.	+	–
Result	**O:4,5,12**	**O:4,12,27**	**O:4,12** This result can also occur in strains that generally have antigen O:5, e.g. *S.* Typhimurium O:5- (early variant Copenhagen).
Frequency in the O group	common	rare	rare

Group O:7 (C_1) and Group O:8 (C_2-C_3)

Possible antigen combinations: O:6,7; O:6,7,Vi; O:6,7,14; O: 6,8; O:8; O:8,20.
Antigens O:7, O:8 as well as O:20 and O:6 in group C_2-C_3 must be identified.

Anti-Salmonella O:7 detects all strains in group C_1.
The O:6 antigen from group C_1 is the partial antigen O:6_2; it does not have to be identified.

Anti-Salmonella O:8 detects all strains in group C_2-C_3.

Anti-Salmonella O:6_1 is used to analyse serovars from groups C_2-C_3 for the absence or presence of the antigen O:6 (strains with antigen O:6,8).
The O:6 antigen from group C_2-C_3 is the partial antigen O:6_1.
Note: Does not include the antigen O:6_2 from the group O:7 (C_1). Does not agglutinate antigen O:6,14 (H).

Anti-Salmonella O:20 is used to differentiate the strains in the group C_2-C_3 by detecting the antigen O:20 (strains with antigen O:8,20).
If the result with Anti-Salmonella O:6_1 and Anti-Salmonella O:20 is negative, the strain only contains O:8.

Antigen detection for O:7, O:8, O:6_1, O:20

Test Reagent	Agglutination of a *Salmonella* isolate			
Anti-Salmonella O:7	+	–	–	–
Anti-Salmonella O:8	Examination not required.	+	+	+
Anti-Salmonella O:6_1	Examination not required.	+	–	–
Anti-Salmonella O:20	Examination not required.	Examination not required, because the antigens O:6 and O:20 do not occur together.	+	–
Result	**O:6,7**	**O:6,8**	**O:8,20**	**O:8**
Frequency in the O group	common	common	rare	very rare

Group O:9 (D_1), Group O:9,46 (D_2) and Group O:9,46,27 (D_3)

Possible antigen combinations: O:9,12; O:9,12,Vi; O:1,9,12; O:9,46, (extremely rare: O:1,9,12,46,27).
The antigens O:9, O:46, Vi, (O:27) must be identified. For isolates that showed a positive result for the Anti-Salmonella Group D, the agglutination may be caused by anti-O:9 and/or anti-Vi.

Anti-Salmonella O:9 detects all strains in group D regardless of the antigen combination. The agglutination can be inhibited by a very highly developed Vi antigen. With a negative result with Anti-Salmonella O:9 and a positive result with Anti-Salmonella Vi, the indicated procedure must be used.

Differentiation within group D is carried out using the following test reagents:

Anti-Salmonella O:46 detects all strains in group D_2 (O:9,46) and does not react with the strains in group D_1 (O:9,12). Strains in group D_3 are not agglutinated or only weakly agglutinated. Serovars in group D_3 are characterised by a positive result with Anti-Salmonella O:9 and **Anti-Salmonella O:27**.

Antigen detection for O:9, Vi, O:46, O:27

Test Reagent	Agglutination of a *Salmonella* isolate				
Anti-Salmonella O:9	+	+	–	+	+
Anti-Salmonella Vi	–	+	+	–	–
Anti-Salmonella O:46	–	Examination not required.	Examination not required.	+	+/–
Anti-Salmonella O:27	–	Examination not required.	Examination not required.	–	+
Result	**O:9,12**	**S. Typhi S. Dublin**	**S. Typhi, S. Paratyphi C or S. Dublin** *)	**O:9,46**	**O:9,12,46,27**
Frequency in the O group	very common	rare	rare	very rare	extremely rare

*) **S. Typhi, S. Paratyphi C or S. Dublin:** Inhibition of the O agglutination due to a highly developed Vi antigen. From the pure culture of the isolate, a suspension is prepared in isotonic sodium chloride solution that is heated for 60 min at 100 °C or 15 min at 120 °C.
This destroys the Vi antigen. If the reaction of the sediment with Anti-Salmonella O:9 after centrifugation is positive, the serovar is *S.* Typhi or *S.* Dublin. With a negative reaction with Anti-Salmonella O:9, the serovar must then be tested with Anti-Salmonella O:7.
With a positive result with O:7, the serovar can only be *S.* Paratyphi C.

Group O:3,10 (E_1) and Group O:1,3,19 (E_4)

Possible antigen combinations: O:3,10; O:3,15, O:3,15, 34, O:1,3,19 (extremely rare: O:1,3,10,19; O:1,3,15,19). The antigens O:10, O:15, O:19 and O:34 must be identified.

Anti-Salmonella O:10 detects all strains in group E_1 (O:3,10) that have not been converted by the phages ε_{15} or ε_{15} and ε_{34}. The test reagent does not react with the strains in group E_1 after phage conversion (previously groups E_2 and E_3) because the antigen O:10 can no longer be detected after lysogenisation. Strains from group E_4 are not agglutinated unless they have the antigen O:10 (e.g. *S.* Chittagong, O:1,3,10,19).

Anti-Salmonella O:15 detects all strains in group E_1 after conversion by the phages ε_{15} or ε_{15} and ε_{34} (previously groups E_2 and E_3). The test reagent does not react with the strains in group E_1 (O:3,10). Strains from group E_4 are not agglutinated unless they have the antigen O:15 (e.g. *S.* Dessau, O:1,3,15,19).

Anti-Salmonella O:19 detects all strains in group E_4. The test reagent does not react with the strains in group E_1 (O:3,10; O:3,15, O:3,15, 34).

Anti-Salmonella O:34 detects all strains in group E_1 after conversion by the phages ε_{15} and ε_{34} (previously group E_3). It does not react with the strains O:3,10 or O:3,15 and strains in group E_4 but does cross-react with the Salmonella antigens $O:12_2$, O:28 and O:55 and can therefore only be used to differentiate serovars within group E_1. Serovars in group D_2 (O:9,46) can have the antigens O:3 and O:10, as well as O:15 and O:34 due to phage conversion by ε_{15} and ε_{34}, and then react with the homologous antibodies from group E.

Antigen detection for O:10, O:15, O:34, O:19

Test Reagent	Agglutination of a *Salmonella* isolate					
Anti-Salmonella O:10	+	–	–	–	+	–
Anti-Salmonella O:15	Examination not required.	+	+	–	Examination not required.	+
Anti-Salmonella O:34	Examination not required.	–	+	Examination not required.	Examination not required.	–
Anti-Salmonella O:19	–	–	Examination not required.	+	+	+
Result	**O:3,10**	**O:3,15**	**O:3,15,34**	**O:1,3,19**	**O:1,3,10,19**	**O:1,3,15,19**
Frequency in the O group	common	rare	rare	very rare	extremely rare	extremely rare

Monospecific test reagents Anti-Salmonella O

Procedure: slide agglutination | Storage: 2...8 °C | Preservative: sodium azide 0.9 mg/ml

Art. No.	Product	Description	Liquid | Lyo.	Packing
TR1301	**Anti-Salmonella O:2**	Detects all strains in group A. Possible antigen combinations: 1,2,12 and 2,12 (antigen O:1 is induced by phage conversion and is therefore underlined). The group-specific antigen O:2 must be identified. It is not necessary to identify antigen O:12 and where applicable antigen O:1.	liquid	1 ml
TR1302 TR1302-01	**Anti-Salmonella O:4**	Detects all strains in group B regardless of the antigen combination. Possible antigen combinations: O:4,12; O:1,4,12; O:4,5,12; O:1,4,5,12; O:4,12,27; O:1,4,12,27. The antigens O:4, O:5 and O:27 or antigens O:1 and O:12 must be determined.	liquid liquid	1 ml 5 ml
TR1303 TR1303-01	**Anti-Salmonella O:5**	Detects all strains in group B, provided they have antigen O:5.	liquid liquid	1 ml 5 ml
TR1304	**Anti-Salmonella O:6_1**	Group C_2-C_3 Used to analyse serovars from group C_2-C_3 for the absence or presence of the antigen O:6 (strains with antigen O:6,8). The O:6 antigen from group C_2-C_3 is the partial antigen O:6_1.	lyophilised	1 ml
TR1305	**Anti-Salmonella O:7**	Detects all strains in group C_1. The O:6 antigen from group C_1 is the partial antigen O:6_2; it does not have to be identified.	liquid	1 ml
TR1306	**Anti-Salmonella O:8**	Detects all strains in group C_2-C_3.	liquid	1 ml
TR1307 TR1307-01	**Anti-Salmonella O:9**	Detects all strains in group D regardless of the antigen combination. The agglutination can be inhibited by a very highly developed Vi antigen.	liquid liquid	1 ml 5 ml
TR1308	**Anti-Salmonella O:10**	Group E_1 and Group E_4 Detects all strains in group E_1 (O:3,10) that have not been converted by the phages ε_{15} or ε_{15} and ε_{34}. Does not react with the strains in group E_1 after phage conversion (previously groups E_2 and E_3) because the antigen O:10 can no longer be detected after lysogenisation. Strains from group E_4 are not agglutinated unless they have the antigen O:10 (e.g. *S.* Chittagong, O:1,3,10,19).	liquid	1 ml
TR1323	**Anti-Salmonella O:11**	Group F	lyophilised	1 ml
TR1325	**Anti-Salmonella O:13**	Group G	lyophilised	1 ml
TR1309	**Anti-Salmonella O:14**	Group H Detects only the O:14 antigen in the H group but not that of the C_1 group.	lyophilised	1 ml
TR1310	**Anti-Salmonella O:15**	Group E_1 Detects all strains in group E_1 after conversion by the phages ε_{15} or ε_{15} and ε_{34} (previously groups E_2 and E_3). Does not react with the strains in group E_1 (O:3,10). Strains from group E_4 are not agglutinated unless they have the antigen O:15 (e.g. *S.* Dessau, O:1,3,15,19).	liquid	1 ml

Art. No.	Product	Description	Liquid | Lyo.	Packing
TR1328	**Anti-Salmonella O:16**	Group I	lyophilised	1 ml
TR1329	**Anti-Salmonella O:17**	Group J	lyophilised	1 ml
TS1330	**Anti-Salmonella O:18**	Group K	lyophilised	1 ml
TR1311	**Anti-Salmonella O:19**	Group E_4 Detects all strains in group E_4. Does not react with the strains in group E_1 (O:3,10; O:3,15, O:3,15,34).	liquid	1 ml
TR1312	**Anti-Salmonella O:20**	Used to differentiate the strains in groups C_2-C_3 by detecting the antigen O:20 (strains with antigen O:8,20). If the result with Anti-Salmonella O:6_1 and Anti-Salmonella O:20 is negative, the strain only contains O:8.	liquid	1 ml
TR1331	**Anti-Salmonella O:21**	Group L	lyophilised	1 ml
TS1332	**Anti-Salmonella O:22**	Group G	lyophilised	1 ml
TR1335	**Anti-Salmonella O:25**	Group H	lyophilised	1 ml
TR1313	**Anti-Salmonella O:27**	Group B and Group D_3 Detects all strains in group B and D_3, provided they have antigen O:27.	liquid	1 ml
TR1336	**Anti-Salmonella O:28**	Group M	lyophilised	1 ml
TR1339	**Anti-Salmonella O:30**	Group N	lyophilised	1 ml
TR1314	**Anti-Salmonella O:34**	Group E_3 Detects all strains in group E_1 after conversion by the phages ε_{15} and ε_{34} (previously group E_3). Does not react with the strains O:3,10 or O:3,15 and strains in group E_4 but does cross-react with the Salmonella antigens O:12_2, O:28 and O:55 and can therefore only be used to differentiate serovars within group E_1. Serovars in group D_2 (O:9,46) can have the antigens O:3 and O:10, as well as O:15 and O:34 due to phage conversion by ε_{15} and ε_{34}, and then react with the homologous antibodies from group E.	liquid	1 ml
TR1341	**Anti-Salmonella O:35**	Group O	lyophilised	1 ml
TR1344	**Anti-Salmonella O:38**	Group P	lyophilised	1 ml
TR1345	**Anti-Salmonella O:39**	Group Q	lyophilised	1 ml
TR1346	**Anti-Salmonella O:40**	Group R	lyophilised	1 ml
TR1347	**Anti-Salmonella O:41**	Group S	lyophilised	1 ml
TR1348	**Anti-Salmonella O:42**	Group T	lyophilised	1 ml
TR1349	**Anti-Salmonella O:43**	Group U	lyophilised	1 ml
TR1350	**Anti-Salmonella O:44**	Group V	lyophilised	1 ml
TR1351	**Anti-Salmonella O:45**	Group W	lyophilised	1 ml

Art. No.	Product	Description	Liquid | Lyo.	Packing
TR1315	**Anti-Salmonella O:46**	Group D_2 Anti-Salmonella O:46 detects all strains in group D_2 (O:9,46) and does not react with the strains in group D_1 (O:9,12). Strains in group D_3 are not agglutinated or only weakly agglutinated.	liquid	1 ml
TR1353	**Anti-Salmonella O:47**	Group X	lyophilised	1 ml
TR1354	**Anti-Salmonella O:48**	Group Y	lyophilised	1 ml
TR1355	**Anti-Salmonella O:50**	Group Z	lyophilised	1 ml
TR1356	**Anti-Salmonella O:51**		lyophilised	1 ml
TR1357	**Anti-Salmonella O:52**		lyophilised	1 ml
TR1358	**Anti-Salmonella O:53**		lyophilised	1 ml
TR1359	**Anti-Salmonella O:54**		lyophilised	1 ml
TR1360	**Anti-Salmonella O:55**	Reacts with some strains of the group O:59.	lyophilised	1 ml
TR1361	**Anti-Salmonella O:56**		lyophilised	1 ml
TR1362	**Anti-Salmonella O:57**		lyophilised	1 ml
TR1363	**Anti-Salmonella O:58**		lyophilised	1 ml
TR1364	**Anti-Salmonella O:59**		lyophilised	1 ml
TR1365	**Anti-Salmonella O:60**		lyophilised	1 ml
TR1364	**Anti-Salmonella O:59**		lyophilised	1 ml
TR1365	**Anti-Salmonella O:60**		lyophilised	1 ml
TR1366	**Anti-Salmonella O:61**		lyophilised	1 ml
TR1367	**Anti-Salmonella O:62**		lyophilised	1 ml
TR1368	**Anti-Salmonella O:63**		lyophilised	1 ml
TR1369	**Anti-Salmonella O:65**		lyophilised	1 ml
TR1370	**Anti-Salmonella O:66**		lyophilised	1 ml
TR1371	**Anti-Salmonella O:67**		lyophilised	1 ml

Monospecific test reagent Anti-Salmonella Vi

The test reagent is used to identify the Vi antigen according to the White-Kauffmann-Le Minor scheme. It does not contain any additional antibodies.
Procedure: slide agglutination | Storage: 2...8 °C | Preservative: sodium azide 0.9 mg/ml

Art. No.	Product	Liquid | Lyo.	Packing
TR1316	**Anti-Salmonella Vi**	liquid	1 ml

Determination of the H antigens using monospecific test reagents

The test reagents are monoclonal antibodies, test sera or a mixture of monoclonal antibodies and test serum. Monoclonal antibodies are produced from cell culture supernatants of hybridoma cell lines that secrete antibodies against the corresponding *Salmonella* H antigens. The test sera are sera from immunised rabbits from which non-specific agglutinins are removed by absorption.

For serotyping *Salmonella*, it is necessary to identify the H antigen(s) as well as the O antigens. For biphasic strains the H antigens of both phases must be identified. The Anti-Salmonella H test reagents are used to identify or verify the H antigens or H antigen complex of *Salmonella* strains according to the White-Kauffmann-Le Minor scheme with the help of the slide agglutination test. It enables the identification of the serovar.

Anti-Salmonella H:E, Anti-Salmonella H:L and Anti-Salmonella H:1 detect all possible combinations of the antigen H:e (e,h; e,n,x; e,n,z_{15}; e,n,x,z_{15}), the antigen H:*ℓ* (*ℓ*,v; *ℓ*,w; *ℓ*,z_{13}; *ℓ*,z_{28}; *ℓ*,z_{13},z_{28}) or the antigen H:1 (1,2; 1,5; 1,6; 1,7).
Anti-Salmonella H:g detects all possible combinations of the G complex provided they contain the antigen H:g (z.B. f,g; f,g,s; f,g,t; g,m; g,m,s; g,p; g,q; g,s,t; g,t; g,z_{51}). To verify all serovars that contain antigens in the G complex, that is, including the antigen H:m,t, Anti-Salmonella H:g,m must be used.

The correspondingly labelled products Anti-Salmonella H can also be used with biphasic strains for induction of the unverifiable H phase (Sven Gard swarming inhibition method).
Anti-Salmonella H:E, H:g, H:*ℓ* and H:1 inhibit all possible antigen combinations of the antigens H:e, H:g, H:*ℓ* and H:1. The lyophilised test reagents are ready to use after dissolving in 1 ml or 5 ml distilled water according to the declaration.

To verify the H antigens in the slide agglutination test, cultures on slant agar (e.g. Kligler culture medium) are suitable, ensuring the microbial material is collected from the lower, moist area of the slant agar. If verification of the H antigen is not successful, the strain must be inoculated on swarm agar for better characterisation of the flagellar antigens. We recommend TN1702 (sifin) for the swarm agar.

Sequence of testing using the Anti-Salmonella H test reagents

By identifying the O antigens the group of the isolate is determined. The sequence for the testing of the H antigens is determined by the epidemiologically more common serovars.

Example: For an isolate from group O:4 (B) and a positive reaction with Anti-Salmonella O:5, the presence of *S*. Typhimurium is most likely. Consequently, testing is first done with Anti-Salmonella H i and Anti-Salmonella H:1. If only one of the two antigens can be identified, phase induction must be carried out (see below).
With a negative result, Anti-Salmonella H:g (or Anti-Salmonella H:g,m) corresponding to the common serovars *S*. Derby (4,12:f,g:[1,2]) or *S*. Agona (4,12:f,g,s:[1,2]) must be used for testing.
With a negative result, other Anti-Salmonella H products must be used for analysis according to the frequency of the serovars.
It must be noted that *S*. Typhimurium also commonly occurs as monophasic variants (1,4,[5],12:i:-).

Phase induction

For biphasic strains that are only present in one H phase, the Sven Gard swarming inhibition method must be carried out to induce the 2nd phase. The Anti-Salmonella H test reagents suitable for phase induction are indicated in the table below.

Classical Sven Gard method
Mix 0.1 ml Anti-Salmonella H test reagent with 10 ml liquefied swarm agar (cooled to 40...45 °C) in a 6 cm diameter petri dish. After the agar has solidified, sprinkle the plate with approx. 100 µl distilled water and apply the strain at a single point in the centre of the dish. Incubate the dish with the agar layer face down overnight at 35 to 37 °C. For the slide agglutination test, collect material from the edge of the dish. If the phase induction is not successful, the inhibition procedure must be repeated.

Simplified modified procedure
We recommend the following simplified method: Prepare a dish (6 cm diameter) with 10 ml solidified swarm agar, add 0.1 ml Anti-Salmonella H drop by drop and spread across the surface with a sterile glass spatula. Then inoculate the centre of the dish and incubate as described above. After 16 to 20 hours, the strain that swarms can be used to identify the second, uninhibited H phase.

The simplified method usually enables the second phase to be identified at the first attempt. It also has the advantage of permitting swarm agar plates to be prepared and stored in advance and to be used as required for improving the expression of the H antigens or for the phase induction. The Anti-H products listed above as suitable for phase induction have been tested in this modified procedure and deliver results that are at least as good as in the classic method and in some cases, significantly better.

Special features

The test reagents against the complex antigens Anti-H E, Anti-H:g, Anti-H:L and Anti-H:1 are suitable for phase induction with strains possessing all possible antigen combinations in their respective complex. Thus Anti-Salmonella H:1 can be used to inhibit H:1,2, H:1,5, H:1,6 and H:1,7 with the same sucess as the polyclonal test reagent Anti-Salmonella H:1,2. The same applies for Anti-Salmonella H:E instead of Anti-H:e,h or Anti-Salmonella H:e,n,x, Anti-Salmonella H:L instead of Anti-Salmonella H:ℓ,v etc.

Monospecific test reagents Anti-Salmonella H

Procedure: slide agglutination | Storage: 2...8 °C | Preservative: sodium azide 0.9 mg/ml

Art. No.	Product	Description	Phase induction	Liquid | Lyo.	Packing
TR1401	**Anti-Salmonella H:a**	mAb, H:a	x	liquid	1 ml
TR1402	**Anti-Salmonella H:b**	mAb, H:b	x	liquid	1 ml
TR1403	**Anti-Salmonella H:c**	mAb, H:c	x	liquid	1 ml
TR1404	**Anti-Salmonella H:d**	mAb, H:d	x	liquid	1 ml
TR1405	**Anti-Salmonella H:E**	mAb, H:e,h; H:e,n,x; H:e,n,z_{15};	x	liquid	1 ml
TR1405-01		H:e,n,x,z_{15}	x	liquid	5 ml
TR1407	**Anti-Salmonella H:f**	mAb, H:f,g; H:f,g,s; H:f,g,t		lyophilised	1 ml
TR1406	**Anti-Salmonella H:g**	mAb, all antigen combinations of the H:G complex except H:m,t e.g. H:f,g; H:f,g,s; H:f,g,t; H:g,m; H:g,m,s; H:g,p; H:g,p,u; H:g,q; H:g,s,t; H:g,t; H:g,z_{51} Since our Product H:g however does not cover m,t strains, we have chosen to write the name of the product (for which we initially used capital letters) using small letter g.	x	liquid	1 ml
TR1406-01			x	liquid	5 ml

Art. No.	Product	Description	Phase induction	Liquid | Lyo.	Packing
TR1408	**Anti-Salmonella H:g,m**	mAb, all antigen combinations of H:G complexes, incl. H:m,t: e.g. H:f,g; H:f,g,s; H:f,g,t; H:g,p; H:g,p,u; H:g,q; H:g,s,t; H:g,t; H:g,z_{51} bzw. H:g,m; H:g,m,s,t; H:m,t	x	liquid	1 ml
TR1408-01			x	liquid	5 ml
TR1409	**Anti-Salmonella H:h**	mAb, H:e,h		liquid	1 ml
TR1410	**Anti-Salmonella H:i**	mAb, H:i	x	liquid	1 ml
TR1410-01			x	liquid	5 ml
TR1411	**Anti-Salmonella H:k**	mAb, H:k	x	lyophilised	1 ml
TR1412	**Anti-Salmonella H:L**	mAb, H:*ℓ*,v; H:*ℓ*,w; H:*ℓ*,z_{13}; H:*ℓ*,z_{28}; H:*ℓ*,z_{13},z_{28}	x	liquid	1 ml
TR1412-01			x	liquid	5 ml
TS1413	**Anti-Salmonella H:m**	pAb, H:g,m; H:g,m,s; H:g,m,s,t; H:g,m,q; H:g,m,p,s; H:g,m,t; H:m,p,t,u; H:m,t		lyophilised	1 ml
TR1438	**Anti-Salmonella H:n**	mAb, H:e,n,x; H:e,n,z_{15}; H:e,n,x,z_{15}	x	liquid	1 ml
TS1414	**Anti-Salmonella H:p**	pAb, H:g,m,p,s; H:g,p; H:g,p,s; H:g,p,u; H:m,p,t,u		lyophilised	1 ml
TS1415	**Anti-Salmonella H:q**	pAb, H:g,q; H:g,m,q		lyophilised	1 ml
TR1416	**Anti-Salmonella H:r**	mAb, H:r	x	liquid	1 ml
TS1417	**Anti-Salmonella H:s**	pAb, H:f,g,s; H:g,m,s; H:g,m,s,t; H:g,p,s; H:g,s,t		lyophilised	1 ml
TS1418	**Anti-Salmonella H:t**	pAb, H:m,t; H:f,g,t; H:g,m,t; H:g,m,s,t; H:g,t; H:g,s,t; H:m,p,t,u		lyophilised	1 ml
TS1419	**Anti-Salmonella H:u**	pAb, H:g,p,u; H:m,p,t,u		lyophilised	1 ml
TS1420	**Anti-Salmonella H:v**	pAb, H:*ℓ*,v		lyophilised	1 ml
TS1421	**Anti-Salmonella H:w**	pAb, H:*ℓ*,w		lyophilised	1 ml
TS1422	**Anti-Salmonella H:x**	pAb, H:e,n,x; H:e,n,x,z_{15}		lyophilised	1 ml
TR1423	**Anti-Salmonella H:y**	mAb, H:y	x	liquid	1 ml
TR1424	**Anti-Salmonella H:z**	mAb, H:z Identifies H:z in Subspecies I, II and III	x	liquid	1 ml
TS1425	**Anti-Salmonella H:z_4,z_{23}**	pAb, H:z_4,z_{23}; H:z_4,z_{24}; H:z_4,z_{32}; H:z_4,z_{23},z_{32}		lyophilised	1 ml
TS1426	**Anti-Salmonella H:z_6**	pAb, H:z_6		lyophilised	1 ml
TR1427	**Anti-Salmonella H:z_{10}**	mAb, H:z_{10}	x	liquid	1 ml
TS1428	**Anti-Salmonella H:z_{15}**	pAb, H:e,n,z_{15}; H:e,n,x,z_{15}		lyophilised	1 ml
TR1440	**Anti-Salmonella H:z_{23}**	mAb, H:z_4,z_{23}; H:z_4,z_{23},z_{32}		lyophilised	1 ml

Art. No.	Product	Description	Phase induction	Liquid | Lyo.	Packing
TS1429	**Anti-Salmonella H:z_{24}**	pAb, H:z_4,z_{24}		lyophilised	1 ml
TS1449	**Anti-Salmonella H:z_{28}**	pAb, H:ℓ,z_{28}; H:ℓ,z_{13},z_{28}		lyophilised	1 ml
TS1430	**Anti-Salmonella H:z_{29}**	pAb, H:z_{29}		lyophilised	1 ml
TS1431	**Anti-Salmonella H:z_{32}**	pAb, H:z_4,z_{32}		lyophilised	1 ml
TR1445	**Anti-Salmonella H:z_{35}**	mAb, H:z_{35}	x	lyophilised	1 ml
TR1447	**Anti-Salmonella H:z_{38}**	mAb, H:z_{38}	x	lyophilised	1 ml
TR1448	**Anti-Salmonella H:z_{41}**	mAb, H:z_{41}	x	lyophilised	1 ml
TR1437	**Anti-Salmonella H:1**	mAb, H:1,2; H:1,5; H:1,6; H:1,7;	x	liquid	1 ml
TR1437-01		H:1,2,7; H:1,5,7	x	liquid	5 ml
TR1433	**Anti-Salmonella H:2**	mAb, H:1,2		lyophilised	1 ml
TR1433-01				lyophilised	5 ml
TS1434	**Anti-Salmonella H:5**	pAb, H:1,5		lyophilised	1 ml
TR1435	**Anti-Salmonella H:6**	mAb, H:1,6		lyophilised	1 ml
TS1436	**Anti-Salmonella H:7**	pAb, H:1,7		lyophilised	1 ml

Control antigens for the Anti-Salmonella test reagents

The control antigens are used to check the agglutinability of the Anti-Salmonella test reagents and for quality control when carrying out the slide agglutination test.

Procedure: slide agglutination | Storage: 2...8 °C | Preservative: 0.5 % formalin

Art. No.	Product	Description	Liquid | Lyo.	Packing
TS1501	**Control antigen Salmonella Paratyphi A-OH**	2,12:a:[1,5] (Usually occurs as a monophasic variant.)	liquid	5 ml
TS1502	**Control antigen Salmonella Paratyphi B-OH**	1,4,[5],12:b:1,2	liquid	5 ml
TS1503	**Control antigen Salmonella Paratyphi C-OH**	6,7,[Vi]:c:1,5 (Use TS1507 for Vi)	liquid	5 ml
TS1504	**Control antigen Salmonella Typhi-OH**	9,12, [Vi]:d- (Use TS1507 for Vi)	liquid	5 ml
TS1505	**Control antigen Salmonella Typhimurium-OH**	1,4,[5],12:i:1,2 (Often occurs as a monophasic variant.)	liquid	5 ml
TS1506	**Control antigen Salmonella Enteritidis-OH**	1,9,12:g,m:-	liquid	5 ml
TS1507	**Control antigen Salmonella Vi**		liquid	5 ml

Examples of Serotyping

Suspected *S.* Enteritidis

Antigen detection

Test Reagent	Agglutination of a *Salmonella* isolate		
Anti-Salmonella A-67 + Vi, omnivalent	+		
Anti-Salmonella I (A-E + Vi)	+		
Anti-Salmonella Group D (O:9, Vi)	+		
Anti-Salmonella O:9	+		
Anti-Salmonella O:46	–		
Anti-Salmonella H:s	–		
Anti-Salmonella H:q	–		
Result of O antigen determination	**Suspected *S.* Enteritidis** O:9 (D_1)		
Anti-Salmonella H:g[1)]	+	+	–
Anti-Salmonella H:m (monospecific)	+	–	
Result antigen formula	***S.* Enteritidis** 1,9,12:g,m:-	↓	↓
Anti-Salmonella H:p (monospecific)		+	
Result of antigen formula		***S.* Dublin** 9,12,[Vi]:g,p:-	↓
Anti-Salmonella H:L[2)]			+
Anti-Salmonella H:v (monospecific)			+
Anti-Salmonella H:1[3)]			+
Anti-Salmonella H:5 (monospecific)			+
Result of antigen formula			***S.* Panama** 1,9,12:l,v:1,5

[1)] A positive result with Anti-Salmonella H:g proves that antigen H:g is present. H:m,t cannot be present. Using Anti-Salmonella H:g,m instead of Anti-Salmonella H:g in this example would be inappropriate, since Anti-Salmonella H:g,m records all combinations of antigen H:g including antigen H:m,t. A positive result using Anti-Salmonella H:g,m does not prove that H g,m is present.

[2)] A positive result with Anti-Salmonella H:L proves that antigen H:*ℓ* is present and is thus equivalent to the test with the polyclonal test reagent Anti-Salmonella H:*ℓ*,v, which does not react with H:*ℓ*,v only, but with all combinations of antigen H:*ℓ*.

[3)] Anti-Salmonella H:1 agglutinates all antigen combinations of the H:1 complex (H:1,2, H:1,5, H:1,6, H:1,7). An additional testing of the present antigen combination is possible with the monospecific test reagents Anti-Salmonella H:2, Anti-Salmonella H:5, Anti-Salmonella H:6 and Anti-Salmonella H:7.

Suspected *S.* Typhimurium

Antigen detection

Test Reagent	Agglutination of a *Salmonella* isolate					
Anti-Salmonella A-67+ Vi, omnivalent	+					
Anti-Salmonella I (A-E + Vi)	+					
Anti-Salmonella Group D (O:9, Vi)	+					
Anti-Salmonella Group B (O:4,5,27)	+					
Anti-Salmonella O:5	+		–			
Result of O antigen determination	**Suspected *S.* Thyphimurium** O:4,5		**Suspected *S.* Thyphimurium** O:4			
Anti-Salmonella H:i	+	–	+	–	–	
Anti-Salmonella H:1[1)]	+	–	+	–		
Anti-Salmonella H:2	+	–	+	–		
Result of antigen formula	***S.* Typhimurium O5+** 1,4,5,12:i:1,2	***S.*** 1,4,5,12:i:- monophasic variant	***S.* Typhimurium O5-** 1,4,12:i:1,2	***S.*** 1,4,12:i:- monophasic variant		
Anti-Salmonella H g oder Anti-Salmonella H g,m [2)]					+	+
Anti-Salmonella H:f					+	+
Anti-Salmonella H:s					–	+
Result of antigen formula					***S.* Derby** 1,4,12:f,g:-	***S.* Agona** 1,4,12:f,g,s:-

[1)] See note on Anti-Salmonella H:1, suspected *S.* Enteritidis

[2)] A positive result with Anti-Salmonella H:g proves that antigen H:g is present. Antigen H:m,t cannot be present. In this example, instead of Anti-Salmonella H:g, it would be possible to use Anti-Salmonella H:g,m, which records all combinations of antigen H:g including antigen H:m,t. The subsequent agglutination with Anti-H:f excludes H:m,t.

Strains with H:m,t can be easily identified with Anti-Salmonella H:m and Anti-Salmonella H:t.

In general, we recommend the use of Anti-Salmonella H:g if an H antigen in the G complex is suspected because a positive result verifies the present of antigen H:g.

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